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ELECTRICAL REVIEW AND WESTERN ELECTRICIAN

JULY 4 TO DECEMBER 26, 1908

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AUTHORS OF ARTICLES IN VOL. LIII OF THE ELECTRICAL REVIEW AND WESTERN ELECTRICIAN

ELECTRICAL REVIEW

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ELECTRIC HEATING ON A LARGE SCALE.

Electric heating, ideal from so many points of view, has seldom been employed on a large scale, if one except the electric furnace. There are several factors which have combined to prevent this, the two principal ones being the cost of the apparatus itself and the rates charged for electrical energy. It is generally overlooked that while the cost for a single thermal unit in the form of electrical energy may be high, the economy with which this is used brings the total cost much closer to that of an equivalent heating system using fuel. Strictly speaking, of course, it is rather the inefficiency of the fuel-using apparatus which brings the cost of operating them up nearer to that of the electric heater. But there are other factors which at times are even more important than an apparent considerable difference in the actual cost of the heating.

At the recent convention of the American Institute of Electrical Engineers a paper of some interest was read by C. E. Waddell, which describes one of the largest electric-heating systems in this country. This is installed at the Biltmore Estate, Biltmore, N. C., the reasons for its adoption being the cost of anthracite coal and the nuisance involved in its use. These objections led to the introduction of electric heaters for the hot-water system of the house and for performing all the laundry work of the household. The total rating of the installation as it stands is 167 kilowatts, 100 of which is represented by the hot-water heater and sixty-seven by the laundry equipment. The system consumes about 20,000 kilowatt-hours a month, a fairly respectable load.

In the paper Mr. Waddell gave some interesting data respecting the performance of the apparatus installed. The hot-water heater, which is really a small horizontal tubular boiler having electrical heaters inserted in the tubes, was found to give a thermal efficiency of about eighty-five per cent. This seems low, for with complete lagging there should hardly be fifteen per cent loss in radiation. It probably, however, represents fairly well the average all-day efficiency of the heater. The performance of the laundry apparatus is indicated by the records of a number of washes, but seems to vary considerably according to the size of the wash, and a larger number of trials must be noted before one will be able to figure closely on the performance to be expected of such devices. For instance, it was found that on one day sixty-eight pounds of water were expelled for every 100 kilowatt-hours supplied to the electric heater. On another day, for a somewhat smaller wash, 115 pounds of water were expelled for each 100 kilowatt-hours. But while closer figures are desirable from the engineering standpoint, so that the actual requirements of such apparatus may be known, it should be insisted upon that these are not the controlling factors for determining the selection of such devices. What might be called the "all-over economy" of the system is what should be borne in mind. Time and convenience are as valuable as fuel, and generally less available, and it is very easy to see that in an installation of this kind, although the heating engineers might figure out an enormous difference between the costs of producing a given amount of heat by the two methods, this feature may really be of minor importance and the installation of the electric system be a true economy. Indeed, given cheap electrical energy, it might often be found that there would no longer be any need of providing chimneys in summer residences.

PROGRESS IN WIRELESS TELEPHONY.

In an interesting paper by Mr. R. A. Fessenden on "Wireless Telephony," at the annual convention of the American Institute of Electrical Engineers, held at Atlantic City, N. J., this week, an excellent review of the history of this art was given. Certainly one of the most fascinating fields thrown open to the modern investigator has been the study of the principles underlying wireless transmission of signals and the development of apparatus for reducing different scientific possibilities to an art. This art was divided by Mr. Fessenden into two periods, the distinguishing features of the two constituting what is really a radical change in the method of transmission. The first period of wireless signaling may be considered as starting from the discovery of electromagnetic induction; that is to say, the transmission of electrical energy from one body to another without any intervening conductor. No real progress was made in the art, however, until after Hertz's work proved the existence of electric waves. A few years after this the discovery that an imperfect contact was sensitive to such waves made possible their utilization for transmitting signals, and fairly satisfactory methods were developed for this purpose. The distinguishing feature of this development was the use of spark discharges for producing the signals, these giving rise to discontinuous, sharply damped waves.

The second period is marked by the introduction of methods for continuous undamped signals which are much better for the purpose for a number of reasons, among which may be mentioned the greater ease of tuning, the increase in the effectiveness of the transmitting and signaling apparatus when using signals of this type, and the improved conditions under which the apparatus is used; that is to say, there is less strain, and, therefore, the apparatus is easier to construct and less liable to break down.

As a result of this development in wireless telegraphy wireless telephony became possible, for, given a continuous undamped signal, to transmit articulate speech it is only necessary to superimpose upon the signal variations corresponding to ordinary telephone currents. This has been done and Mr. Fessenden, among others, has produced a working wireless telephone system. Such a system of communication will for many purposes be far more satisfactory than a telegraph, since the latter requires the services of an expert operator, while the wireless telephone is as simple to use as the ordinary instrument. With such a gain, naturally some sacrifice must be expected, which in this case is that of range of operation. The harmonics rendering the human voice intelligible have amplitudes of varying length, but sometimes only about one per cent as great as that of the fundamental note. Hence, since the transmission of the voice by wireless waves is produced, not by the fundamental wave itself, but by the variations of this, it would seem that the distance of transmission of the voice would be only one-hundredth of that attainable by the wireless telegraph. Fortunately this severe restriction may be considerably modified by increasing, in the transmitter, the ratio of the harmonics to the fundamental and because the ear seems to be more sensitive to spoken words that to mere clicks. The range of transmission of the telephone, however, is considerably less than that of the telegraph, Mr. Fessenden putting it at about one-tenth or more of the latter, but this distance is modified very greatly by atmospheric conditions.

Regarding the possibilities of wireless telephony, it is evident, as pointed out, that there is not much possibility of replacing the present local manual telephone systems, as it is out of the question for every subscriber to install and maintain his own wireless plant. For long-distance transmission, on the other hand, Mr. Fessenden thinks there is a good opening, an advantage of the system being the absence of interruption due to storms blowing down the transmission lines. The flexibility of the system is thought to be greater, as the "wireless circuits" connecting, say, New York and Chicago, and Boston and Chicago, could be used to connect Boston and New York when the regular Boston and New York "wireless circuit" was in use. The most promising opening at present, however, is in connection with its use on shipboard for communication between ships or between ship and land. Here the position occupied by this system is unique. An expert operator is not necessary, as the engineer can take care of the generating apparatus and any one on the ship can use the telephone. There seems to be little doubt that for such purposes there will be rapid development, provided other influences do not interfere.

In connection with studies of the absorption of wireless signals due to atmospheric conditions, Mr. Fessenden has compared his observations with the weather maps of the government and is inclined to think there is some connection between the degree of absorption and the magnetic variation. This suggests that wireless signaling might offer to the Weather Bureau an entirely new means of making weather observations. If there is any connection between the absorption of wireless waves and the conditions of the upper layers of the atmosphere, which are no doubt controlling in important weather changes, careful comparison of the ease of transmission between suitably located stations should give valuable information regarding the atmospheric conditions; and to make this of practical value it would be only necessary to interpret it properly. If, as has been suggested, the absorption of the waves is due to large bodies or clouds of air in a peculiar condition, this condition, it may be expected, will exert its effect upon the weather. The Weather Bureau has for some time past been experimenting in making long-time predictions, and it has really met with thoroughly creditable success. For this purpose kites and pilot balloons are used. Why not study the relation between weather changes and this electric wave absorption with a view to determining what relations, if any, exist and making use of them when known?

The concluding portion of Mr. Fessenden's paper is devoted to a discussion of the relations between the Government and the private systems. He feels, perhaps naturally, that the restrictions which have been enforced, or are contemplated, have greatly retarded the commercial use of these two systems, and have made it impossible for any such system to be operated profitably to-day. This is an exceedingly important subject deserving the most careful study, not only of those directly interested in the two arts under discussion, but in those other branches of the electrical industry which may ultimately be affected by policies now followed. There are, of course, several sides to this question, and it is one which can not be decided offhand in an arbitrary manner. It would be well if every engineer would make himself familiar with what has already been done in this matter.

THE RESISTANCE EQUIVALENT OF ELECTROMAGNETIC RADIATION FROM A LINEAR OSCILLATOR.

In another column we publish an article by Mr. Oscar C. Roos on a subject entirely novel, perhaps, to most of our readers, "The Resistance Equivalent of Electromagnetic Radiation from a Linear Oscillator."

The author first cites the reasons for the divergencies found among the results obtained by various workers in attempting to give engineering data upon high-frequency phenomena present in the "verticals" used in the wireless art.

On the basis of a new law derived by him, which shows that any "vertical" of linear type vibrating at its lowest natural period or fundamental has a radiation resistance, R′, of forty ohms, he criticizes Professor J. A. Fleming's subsequent derivation of a similar law, when assuming a linear oscillator and a Hertz oscillator to be electrically equivalent.

The problem was attacked, as indicated, by Dr. John Stone Stone in a paper before the International Electrical Congress at St. Louis in 1904. The linear oscillator is decomposed into an infinite number of Hertz oscillators for all cases, and modifying assumptions pointed out for practical work. The practical formula for the present state of the art is given as a special case of a general formula. This special case, it is interesting to note, has been used in wireless engineering for three years.

The more general formula for R′ consists, when inspected, of an abbreviation for a series of discrete formulæ for definite regions of frequency, stated in units of the fundamental frequency of the vertical. It is evident that at all odd harmonics $R' = 40X$ ohms, where $X = 1, 3, 5, \ldots$ etc. As the author points out, it is at present impracticable to give an *a priori* treatment of the problem.

It is clearly shown that since ideal or practically simple harmonic vibrations have only of late been successfully produced in verticals and have been found to confirm old measurements of R′, we may infer that in at least one American system the damped waves hitherto used have behaved like undamped waves, both in regard to effective resistance and reactances introduced by radiation. This signifies great persistency in the intensity of the successive waves radiated from the vertical and shows that careful engineering methods have really a greater practical scope than the "cut-and-try" efforts which have made the development of radiotelegraphy spasmodically rapid, but to a great extent uncertain.

It is evident that in view of the importance of exact high-frequency measurements of voltage and current at the base of a vertical, to get empirical confirmation of calculations it is imperative to have a criterion of the accuracy of these readings.

Few electrical engineers are required to allow for variations in capacity or inductance with change of frequency. The wireless engineer must, however, be provided with accurately calibrated voltmeters, ammeters, standards of inductance and capacity, eliminating these effects. Frequencies of 60,000 cycles and upward are used and necessitate special methods of checking to avoid ever-present sources of error at these high-frequencies.

It seems desirable that the Duddell arc, when giving nearly pure sinusoidal oscillations, be used for checking the calculations on the vertical reactance and resistance. The high-frequency dynamo is not yet reliable for this work, and all final checks must be calorimetric. The voltage to ground and the current at the base of the antenna being known in two cases, there is obtained R′ and Z, the radiation resistance and the reactance of the vertical at the base, respectively.

Independent resonance measurements give as a check the value of the reactance when the frequency is known. This is a means, as we understand the author, of checking the uniformity of the constants of the antenna per unit length. We infer that the empirical correction of these assumptions and of those made under the MacDonald theory are included in the method as commercially applied, but withheld for the present.

The paper as a whole is timely and shows the present tendency to fusion of theory and practice in the more recent developments of electrical science. The electrical art is indeed becoming more amenable to methods of physical research which a decade ago were looked upon as scientific recreations. With this paper as a starting point the radiotelegraphic engineer is now in a position to make definite engineering tests on a very obscure and difficult problem.

The Society of Wireless Telegraph Engineers, founded in Boston, Mass., February 26, 1907, to which we have referred in our issue of June 13, has had this problem brought to its attention in a number of interesting papers during the past year. It is to be hoped that future papers of this character will receive more publicity through this society.

Annual Convention of the American Institute of Electrical Engineers.

The Twenty-Fifth Convention Opened at Atlantic City, N. J., June 29, with Good Attendance and Beautiful Weather—The First Day's Sessions.

(*Special to the* ELECTRICAL REVIEW, ATLANTIC CITY, N. J., JUNE 30.)

THE twenty-fifth annual convention of the American Institute of Electrical Engineers was called to order by President H. G. Stott at eleven o'clock, Monday morning, June 29, in the Sun parlor of the Hotel Traymore, at Atlantic City, N. J., under particularly promising conditions. The attendance was unusually good for an opening session, the weather could not have been finer, and the fact that all the papers to be presented had been printed and distributed to the membership beforehand is likely to bring out good discussions. As the number of papers to be read is large, it is probable that most of the sessions will be rather long. Indeed, the first session overran the allotted time by three-quarters of an hour; but, on the other hand, the afternoon session was half an hour late in getting under way, and was through half an hour before the time set.

Among those present were A. H. Babcock, San Francisco; H. H. Barnes, Jr., New York; B. A. Behrend, Milwaukee; A. W. Berresford, Milwaukee; James G. Biddle, Philadelphia; Charles Blizard, Philadelphia; Louis E. Bogen, Milwaukee; Morgan Brooks, Urbana, Ill.; George A. Damon, Chicago; F. E. Donohoe, New York; Thomas Duncan, Lafayette, Ind.; W. C. L. Eglin, Philadelphia; J. W. Fraser, Charlotte, N. C.; Albert F. Ganz, Hoboken, N. J.; C. M. Goddard, Boston; A. W. Henshaw, Schenectady, N. Y.; Carl Hering, Philadelphia; Cary T. Hutchinson, New York; Dugald C. Jackson, Boston; Edwin B. Katte, New York; A. E. Kennelly, Cambridge, Mass.; H. B. Kirkland, New York; A. A. Knudson, New York; John Langan, New York; R. D. Mershon, New York; Farley Osgood, Newark, N. J.; Ralph W. Pope, New York; Charles W. Price, New York; Calvin W. Rice, New York; Charles E. Speirs, New York; Calvert Townley, New Haven, Ct.; J. B. Whitehead, Baltimore.

The first session was opened by the introduction of Mayor Franklin P. Stoy, of Atlantic City, who in a humorous address welcomed the Institute to the city, extended the freedom of the town and guaranteed a continuance of the present good weather during the convention.

President Stott, after thanking the mayor for his courteous welcome, delivered the annual presidential address, the title being "The Evolution of Engineering," an abstract of which follows:

Eighty years ago Thomas Tredgold defined engineering as "The art of directing the great sources of power in nature for the use and convenience of man." The question naturally arises: Does this definition hold good to-day? Is it broad enough? If not, how can we better define the engineer's sphere of activity? If we accept Tredgold's definition as our standard, will we reach the position in society which belongs to us by right of education, achievement and highly developed power of logical deduction from facts observed and investigated?

Engineers may be divided into two classes: first, those who believe that the engineer should be restricted to a specific vocation, such as electrical, steam, hydraulic, pneumatic, or sanitary engineering, etc.; second, those who wish to see him take his place not only as an engineer but also as a public-spirited citizen and leader.

The score or more of divisions of electrical engineering which exist to-day are the necessary outcome of the consolidations of manufacturing and other interests into a few large concerns: they are the natural economic results of competition. As these consolidations have undoubtedly resulted in greater efficiency and, therefore, in reduced cost of production, there is every reason to expect a continuance of this evolution from the simple factory manufacturing only one article, to the complex one which manufactures many things. This process of segregation is evidently one of infinite application in all pursuits, tending strongly to an ever-narrower development of the individual, but at the same time increasing his efficiency to a maximum in his own particular specialty. This increase in efficiency, however, will cease if the engineer becomes so highly specialized as to ignore the necessity of keeping in touch with the entire sphere covered by his company, as the evolution of each branch must be synchronized with that of all.

The other class, to which the term "second" has been arbitrarily assigned merely to indicate its numerical inferiority, embraces all those who have broadened their field through self-education, experience, opportunity and natural adaptability for administrative work. The term self-education is used advisedly, as both classes are assumed to start with the same technical training, and as a matter of actual fact the second class almost invariably evolves from the specialists.

The second class is necessarily a restricted one, as, while the legitimate field of work of the engineer is extremely broad and almost unlimited, yet as a rule he has apparently decided to keep in the background and only come to the front when called. The result of this policy is that when the opportunity comes, the engineer is taken at his own valuation and passed over for others who, while not suffering from modesty, are lacking in engineering education and experience, and therefore are forced to call in engineers (to act in a subordinate position) to supply the incumbent's deficiency in the qualifications necessary for the office.

What is the cause of this anomalous situation? Has not the whole body of engineers some share in the blame? We have seen that there is to-day an inherent tendency to specialization in engineering, and that by far the greater number of our members are becoming experts in one or two subjects only, and that comparatively few attempt to keep in touch with the more general aspects of engineering. This condition is caused not so much by a lack of willingness as by lack of time and opportunity.

This centrifugal force acting on our profession has fortunately a nearly equal centripetal one which is found in such societies as the American Institute of Electrical Engineers, in which all can once more be brought back to a common centre on the common ground so clearly described in its constitution, which says that the object of the American Institute of Electrical Engineers "shall be the advancement of the theory and practice of electrical engineering and of the allied arts and sciences."

The conference held in Washington, D. C., last month, which was called by President Roosevelt to consider what steps should be taken to conserve our natural resources, was preceded by a series of conferences held by the presidents of the four national engineering societies, at which a series of broad resolutions were drafted and afterward presented at the conference as representing the opinions of 20,000 American engineers. The committee on resolutions presented a very able report to the conference, embodying practically everything the engineers had recommended, with one exception, as that particular item had already been covered in a bill introduced into Congress. The resolutions were unanimously adopted.

Several important deductions may be made from this incident. First, united recommendations after careful investigations of facts by engineers, on any public question involving engineering problems, will be not only courteously received but welcomed and highly appreciated by our state and federal governments. Secondly, the facts presented at this conference were of such a far-reaching and important nature that every member of this Institute should feel it is his duty carefully to study the able papers presented, and to further in every way possible the policy of preserving our natural resources. Thirdly, co-operation on the part of the four national engineering societies is absolutely essential to success in any movement of this kind; and, as a corollary, success is certain if we co-operate. Fourthly, if engineers are to take the place in society which belongs to them by right of education and training, they must take an active part in matters of general policy or civic interest, no matter how remote these matters may seem from Tredgold's definition of engineering.

Is it not the engineers' civic duty to take a more active part in public affairs, giving of their special knowledge freely, as may be required of them, at the same time insisting upon the same high ideals of faithful, honest and loyal performance of duties in public life as they have been accustomed to in their every-day work as engineers?

These suggestions are clearly outside the scope of this Institute as set forth in its constitution, so that to carry them out it may become necessary to organize a new society in which membership would be limited to members of the four national engineering societies, and whose object would frankly be to use all legitimate political methods to influence legislation on matters affecting engineering. Such a society could with propriety take up the consideration of many problems of which the public now hears only one side, simply because the engineer has maintained an attitude of reserve. Our large corporations and manufacturers are realizing as never before the benefit of publicity departments, not only for advertising purposes, but for the purpose of disarming adverse criticism by a calm statement of facts.

In conclusion, let us remember that if we wish to progress and assume our proper place in the world, we must be aggressive and not passive in allegiance to our engineering societies; that the day is long past for hiding our light under a bushel, and that instead of Tredgold's definition of engineering, the following more correctly expresses the position of the engineer to-day:

Engineering—The art of organizing and directing men, and of controlling the forces and materials of nature for the benefit of the human race.

Following the presidential address the two papers assigned for the first session were presented, that presented by F. G. Baum being read, in his absence, by Percy H. Thomas. Abstracts of these papers follow:

A paper entitled "Electricity as Viewed by the Insurance Engineer. Should the American Institute of Electrical Engineers Interest Itself in Fire Protection?" was read by C. M. Goddard, secretary of the Underwriters' National Electric Association. In this a brief review is given of the annual fire loss in this country, which for the year 1907 was $180,000,000, while the average for the past thirty-two years has been $134,000,000. Since 1860 the insurance companies have paid out $2,500,000,000 in losses, while the total property loss by fire has been $4,250,000,000 since 1875. There are approximately 300 insurance companies doing business in the country with outstanding risks of $30,000,000,000. The annual per capita loss by fire in Austria, Denmark, France, Germany, Italy and Switzerland varies from twelve cents in Italy to forty-nine cents in Germany, with an average of thirty-three cents. This may be compared with the average per capita loss in the United States of $2.47. Fifty per cent of the fires are due to faults of management, which include all sorts of easily avoidable conditions likely to cause fire hazard. These figures indicate the importance of reducing the fire hazard in this country and justify the continuous efforts which the Underwriters' association is making in this direction. Mr. Goddard explained the requisites of a good fire-protection engineer and insisted upon his honesty of purpose, and pleaded for co-operation of the electrical engineer with the former. He said that electricity may become a serious fire hazard, but due to the regulations which have been enforced the insurance companies believe that any undue hazard from electricity has been and is being guarded against and that electric power gives us to-day the safest illuminant and the safest source of power we have.

F. G. Baum presented a paper entitled "Water Power Development in the National Forests—A Suggested Government Policy." Recently the government has given permits to companies proposing to make power developments on condition that the permits be revokable at the pleasure of the Secretary of the Interior and that there be a conserving water royalty charge by the government on the power output of the plant. Temporary permits are objected to by power companies, and objection has also been raised to the conservation charge when it is based on the output of the plant. The author, after discussing the importance to the country of proper development of the water powers, suggests that a proper conservation charge can be made only on the basis of the cost to the government of that which is furnished by the government. He thinks that the proceeds from any particular privilege shall not be devoted to any other watershed or section nor to any purpose except the particular privilege asked for. The conservation charge would have a maximum limit at any given time, which could be determined by calculating the yearly cost of the conservation to the government. This charge can be fixed for a period of, say, ten years, when a new adjustment may be made and a new charge made yearly to meet the changing cost of maintenance. The question of the proper conservation charge is entirely a separate matter from the charge to be made for lands and rights of way for development, and the two matters should be kept distinct. Rights of way and lands necessary for the development should be charged for on a fair basis of value as would be determined if the lands belonged to private parties and a value had to be set on them for power purposes by a court or a commission. Such lands should be deeded outright by the government to the power company, and the only changing condition then, as time goes on, would be the yearly conservation charge.

President Stott then introduced President-elect L. A. Ferguson, who asked for a continuation of the support which had been given his predecessors and outlined certain phases of work which he thought the Institute might take up with profit. It should endeavor to instruct the younger members in engineering matters. It should bring into closer touch with its active work those engineers who have taken up executive duties and who are now generally only associates and not members. It should endeavor to interest the leading members of other engineering societies. At the present time there is much duplication of work in many localities because of the different electrical societies there. These should be brought together under the Institute leadership. In conclusion Mr. Ferguson emphasized the degree to which the success of the Institute, as a whole, depends upon its members individually.

The discussion on the papers which had been read was then opened by J. H. Finney, who took up Mr. Baum's paper somewhat in detail and disagreed with all the latter's important conclusions. Mr. Finney believes that the resources of the country belong to the country as a whole and the benefits derived from each of them must not be confined to its section. He quoted, with approval, from President Roosevelt's opening address before the recent conservation conference, in which the same stand was taken, and in which it was asserted that we should consider ourselves as the trustees of resources upon which future generations will depend, and we should so manage as to harmonize the work of private capital, of the state and of federal governments. Taking up in detail Mr. Baum's proposals for government conservation charges, Mr. Finney contended that they were not in accordance with practice in other lines of business and that practical conditions make a fixed rate desirable. The policy of the government may be summed up in the phrase "Equal justice to all."

E. R. Taylor also dissented from Mr. Baum's views, holding that the whole country should profit from the resources of any favored section.

Professor J. P. Jackson, referring to President Stott's address, said that while the engineer alone might be backward in asserting himself, as a body, engineers carry weight. Turning then to Mr. Goddard's paper, he said this was most timely. He suggested it might be advisable to have a committee of engineers to consider means of reducing the tremendous economic waste which now takes place from fires.

P. V. Wells, of the Forest Service, outlined the general policy of that service with respect to the protection of water powers. He took issue with Mr. Baum, saying the latter confused the policy of the service with the desires of Congress. The Forest Service does not like the present system of revocable permits and would like to make them irrevocable, if not violated, for a period of, say, fifty years. This Congress will not allow. The service now specifies the charges which will be made, so far as it can, and it requires that the permits be used, setting times for the beginning and completion of the work. Uniform charges are best, for many reasons. Mr. Baum's analogies do not hold, for land is free to settlers and irrigation is furnished them at cost, while companies seeking a profit from irrigation are required to pay for it. The service recognizes the value of storage and does not charge for the water stored, but it does charge for the head developed by such storage. The charges of the service are too low to obstruct any development, but give the developers of the most favorable sites the best chances of making a profit.

A. H. Babcock said the various speakers seemed to misapprehend Mr. Baum, who merely took the stand that when the people of a district develop its resources they should enjoy the benefits thereby secured. Taking up Mr. Goddard's paper, he said that he had watched the fires started by the San Francisco earthquake, and it was a remarkable fact that these had all started in the section of the city fed by the large storage battery of the United Gas and Electric Company through its underground wires. In the outlying districts the power was cut off by the breaking of the pole lines and there were no fires.

Dr. C. P. Steinmetz said he agreed with Mr. Baum that the present method of making conservation charges is not just, but he did not, therefore, admit the justice of the latter's proposed method. The argument which he makes is the very one now being used with much effect against the setting aside of forest reservations. The people in distant sections are told that they will not be benefited. But the reverse is the truth. A water development in Maine saves fuel there and helps to keep the price of coal down; and the price of iron in San Francisco is dependent upon the cost of coal. If local interests only are conserved there can be no excuse for governmental aid. There are two features to be considered: the development of our resources as completely as possible and the encouragement of private capital in the work.

Regarding Mr. Goddard's paper, Dr. Steinmetz said the question is really broader than a mere fire risk. There is the risk to life and the risk to capital. It would be proper for the Institute to take the matter up in its broadest aspects. There might be a committee for considering the safeguarding of all interests, or it might be better to secure and publish papers on such topics, as it is exceedingly difficult to lay down rules applicable to all situations. What is not good practice in cities may be good practice in small towns.

L. A. Ferguson said Mr. Babcock's statement regarding the San Francisco fires was remarkable, to say the least. The Commonwealth Edison Company, of Chicago, had tried overhead high-tension wires in the outlying districts and had abandoned them as bad practice. He thoroughly agreed with Dr. Steinmetz.

Mr. Babcock replied that he had not attributed the fires to the underground wires, but had merely called attention to a remarkable coincidence.

William McClellan said that the destruction of our forests has ruined many good water powers, and those which have escaped should help to rehabilitate the ones damaged.

C. F. Scott commented upon President Stott's address, saying the Institute should endeavor to co-operate with other engineering societies and thus secure a greater influence.

The first session was then adjourned.

MONDAY AFTERNOON'S SESSION.

The second session was called to order at 2.30 Monday afternoon, and the four papers on the programme were read and discussed.

In a paper entitled "A Study of Multi-Office Automatic Switchboard Telephone Systems," W. Lee Campbell discussed the enormous economic waste which the wire, cable and conduit equipment of the telephone system involves, the reasons which make this waste expedient in manually operated systems, and how it can be reduced in systems employing automatic switchboards. Of the three items of cost —that of apparatus, that of office and buildings, and that of wire, cable and conduit—the last is the largest. Under usual circumstances this part of the system costs more than the other two parts combined, and not infrequently it represents two-thirds of the entire first cost. The author states that in the average telephone system, containing but one central office, nine-tenths of the cable and wire plant is idle during the peak of the load and ninety-eight per cent is not in use under average conditions. Party-line service is but a partial remedy for this condition, and the only method known of materially reducing the great economic waste thus represented is to divide the central office up into a number of smaller offices. The saving which may be effected in this way depends upon local conditions. It is evident that with a number of central offices well distributed the subscribers' lines will be considerably shorter, so that it will only be necessary to have a sufficient number of trunks between offices to handle the maximum business. On the other hand, a single large central office usually costs less to operate. The author then constructs an arbitrary curve showing the probable number of calls per day per line on systems of different sizes, and on this basis he constructs other curves representing various items in first cost and operating expense for systems varying from 1,000 to 14,000 lines. In this way he compares the manual system with the automatic. It was found that the cost per line of manual equipment increases rapidly with the size of the office. With the automatic system this increase is relatively slow. If the equipment is for 5,000 lines or more, the space occupied by the automatic system is only about half that of the manual, and with a station of 14,000 lines, the total cost of the office equipment of the automatic system is about equal to that of the manual. Curves are given showing the various items in the cost of operation of the two systems for central offices of different sizes. From these curves it is found that when the ultimate number of subscribers which may be expected in one-office district in fifteen years does not exceed the capacity of a single multiple board—that is, 10,000 lines—and there is no concentrated group of subscribers at a considerable distance from the best location of the single office, a one-office system will be the most economical when manual equipment is used. However, there are conditions under which it is profitable to divide such systems, as the saving and annual charges on the wire and conduit will more than offset the increase in the central office expenses. Roughly speaking, an economical arrangement of the average manual system will include offices not much less than two miles apart. There is an objection, however, to the multi-office manual system on account of the slower service given and greater liability of mistakes, but there are no such objections to the divisions of the automatic systems; and, on the other hand, this division can be carried much further than in the manual system with a much greater saving in wire and conduit. Several assumed cases are then considered and the most satisfactory arrangement for each is found. For example, a particular 50,000-line system is divided into five main offices, one of which is subdivided into eight branch offices, and the other four into five branches each. This gives a system with an ultimate capacity of 100,000 lines, which can be handled with instruments having five numbers. The author then dwells upon the advantages of the multi-office system, such as the facility with which this is expanded or can follow the shifting of the population. Such a system is easily adapted to meet any unexpected demand.

The discussion was opened by the reading by P. H. Thomas of two communications dealing with the subject of the paper. The first, from A. B. Smith, said the writer had long hoped that the automatic telephone would solve the city telephone problem. It now seemed to have reached that stage, as the multi-office system described offered many advantages. However, it seemed to involve a disadvantage in requiring a system of heavy trunks. Would not an automatic trunking switch solve the whole problem?

The second letter was from John Wicks, and it agreed, in general, with Mr. Campbell's views. Now that the automatic system offered party line service—that is to say, inexpensive service—it had removed one of the serious obstacles to its wide use. What is wanted is an inexpensive trunking system, and this, too, is now available in the two-way trunks, which are good for service both in calling and answering.

Professor Morgan Brooks said that it is wrong to plan for a system which will keep the wires in use the greater part of the time. What is wanted is a system which will always have the wires free when a call is to be made. To this end the automatic assists, as it saves time in disconnecting.

L. E. Hurtz emphasized the great saving due to the switching units which make small exchanges possible.

R. A. Fessenden, in a paper entitled "Wireless Telephony," gave a brief historical review of the development of wireless signaling. The first period began with the work of Henry in 1838 and ended with 1902. The second period, beginning with 1902 and continuing up to the present time, has been marked by the gradual abandonment of the damped-wave coherer system and the substitution of the elements of the sustained-wave nonmichrophonic contact type. A good deal of the new apparatus devised in this work is described. Regarding the possibilities of this system, Mr. Fessenden thinks there is no immediate prospect of its taking the place of local exchanges, but there is a good field for it for long-distance lines. For transmarine work and communicating between ships it is exceptionally well suited. Regarding the range of transmission, there is little difficulty governing distances of 100 miles. Beyond this atmospheric absorption begins to make itself felt. The author also explains his views of the retarding effect which the various governments of the world have exerted on the development of this important new art. There was no discussion on this paper.

A paper by Dr. A. E. Kennelly and S. E. Whiting on "The Measurement of Rotary Speeds of Dynamo Machines of the Stroboscopic Fork" was read. This calls attention to the use of the stroboscopic fork by Dr. C. V. Drysdale and describes the authors' work in developing this instrument to meet their own particular needs. An electrically operated fork is used, upon the sides of which are two movable weights shifted by means of cords and wheels and with a pointer indicating the change in the pitch of the fork with the position of the weights. The slit screens are carried on the ends of the fork and through the slits a peculiar target is viewed. This contains, first, a square, then a pentagon, a hexagon, a ring of fourteen marks, and a similar outer ring of eighteen marks. By viewing this screen through the slits the speed can be easily read within one part in 1,800. Attention is called to the fact that there is no patent on the stroboscopic method of measuring speeds, and it is free to any one who wishes to use it.

The discussion on this paper was opened by J. B. Taylor, who said that the engineer is often not so much concerned with actual speeds as with differences in speed, and he described the stroboscopic method used at Schenectady for this purpose.

Professor H. A. Perkins said that he used three forks of different pitch, and by counting the number of coincidences which occurred when any one was in use the range could be extended 150 revolutions each way. This, taken with the subdivisions of the frequency into one-half, one-quarter, etc., gave practically the entire range from nothing to the highest frequency.

Dr. C. H. Sharp said the instrument

exhibited by Dr. Kennelly was not only very accurate, but portable, and hence would be most useful in practice.

C. E. Waddell, in a paper entitled "Notes on the Electric Heating Plant of the Biltmore Estate," described the electric heating systems which have taken the place of various other devices in the Biltmore house. The reasons for the change were, first, the objection to burning soft coal and the high price of anthracite coal, and the desire to do away with the hauling of fuel and ashes, with the incident noise and dirt. Electrical energy was available at eight and one-half mills per kilowatt-hour, so that this made possible a comparison of the economic features of the coal and electric systems. Due to the somewhat irregular character of the loads, the electric system is not under such a great disadvantage as would at first be assumed. The hot water for the house is heated in a boiler three feet in diameter, five feet long, containing twenty flues, each of which encloses a five-kilowatt heating element. The laundry has been completely fitted up with ironing, dry and washing apparatus, with a total rating of sixty-seven kilowatts. The author concludes that electric heating has suffered from the fact that its economic possibilities have usually been considered from its thermal-unit value, and that the lesson to be drawn from the Biltmore installation is that a careful analysis of all the conditions may disclose the fact that while theoretically a disparity exists, nevertheless, economy may accrue due to the better operating conditions. He also takes occasion to state that certain of the auxiliary appliances accepted as standards in lighting work will have to be abandoned or remodeled for heating purposes. Fireproof or asbestos-covered wire is to be preferred to rubber, even in conduit installations.

The discussion was opened by P. H. Thomas, who said that a large heating equipment, such as described, became a real engineering problem and should be treated as such.

A number of questions were asked, such as the cost of electric heating as compared with fuel, details of the electric steam boiler and other uses of electricity. Mr. Waddell replied to these, but nothing new was brought out.

The second session was then adjourned.

In the evening a reception was held at the Casino, a large attendance being present.

W. H. B., Jr.

The First Year's Work of the New York State Public Service Commission.

On July 1 the Public Service Commission for the First District of New York state, created under the Public Service Commissions Law, was one year old. It has done noteworthy work in two fields during the year—those of lighting and transportation, substantiating Governor Hughes' belief in recommending its creation to succeed the old Rapid Transit Commission and the State Commission of Gas and Electricity.

William R. Willcox, chairman of the commission for the First District, has stated that, in spite of great difficulties, he is satisfied with the results of the work done by the commission. A few of the most notable results accomplished through the work of the commission are better express and local service in the New York subway, and more frequent service on all the elevated roads and greatly increased service on all the more important surface lines. The car movement over the Brooklyn Bridge has been materially accelerated.

Evils of financial mismanagement and consequent deterioration in operating service have been disclosed, and the experience gained by the investigations has resulted in action looking toward the prevention in the future of the abuses of the past.

The commission proposes to reform the system of accounting, and will make such changes as will compel companies to make monthly allowances for depreciation and to set aside funds for the replacement of worn-out rolling stock.

After much study the commission has decided that where a field is monopolistic —that is, where a monopoly, properly regulated, can best serve the needs of the community—it is inadvisable to encourage the entrance of competitors. It is believed that the soundness of this principle will be indicated in the future by the improvement in service of the public service corporations.

The commission has perfected plans for the Fourth avenue subway in Brooklyn, and has taken definite steps toward the building of new subways and elevated lines.

In the field of gas and electricity the commission has done effective work in the testing of gas and electric meters. The electric light companies, at the solicitation of the commission, have resumed the giving of breakdown service to periodical consumers.

The New Holland-American Liner Rotterdam.

On Wednesday evening, June 24, a large company of representative business men and prominent citizens were the guests of the Holland-American Steamship Company at a dinner on the new steamship Rotterdam, which has just been placed in service. This is the third largest transatlantic liner, and its appointments are exceptionally complete. It is electrically lighted throughout, provided with a remarkable system of ventilation and heating, and electric elevators, telephones, heating and cooking devices render a trip very luxurious.

This vessel is the fourth of the same name to have been built and employed in transatlantic service by the Holland-America line. The first Rotterdam appeared in 1872 and was a steamer of 2,000 tons. The second was a four-masted steamer of 4,500 tons, and appeared in 1885. The third was brought out in 1897, was of 8,300 tons, and was the first twin-screw steamer of the line. The new Rotterdam of 1908, with a tonnage of 24,170 and a displacement of 37,190 tons, eclipses all her earlier namesakes not only separately but also collectively, the single tonnage exceeding the total of the three predecessors.

In point of luxurious appointment and accommodations the Holland-American company considers this craft "the last word" in ocean liners.

Disagreement in Insurance Companies' Suit Against Denver Lighting Company.

During 1907, in Denver, Col., a low-potential wire was crossed by a high-tension conductor and a series of fires, alleged to be on the circuit of the low-potential wire, were started. A number of dwellings and a church were burned, and it was held that in each case the flames had started around the electric light fixtures. The insurance companies settled the claims, took the subrogation, and brought suit against the lighting company for the recovery of $30,000, the amount of insurance paid upon the church loss.

The principal point involved was whether the electric light company had protected its wires by properly grounding them to carry off any accidental high-tension currents. The insurance companies had experts from Chicago and Cleveland to testify that if the low-tension wires had been properly grounded no fire could have resulted, but the company had experts to testify that the ground was of little value except for protection to life, and the jury disagreed, the voting being four to eight against the insurance companies. Barger & Hicks, of Chicago, and Sylvester Williams, of Denver, represented the insurance companies. Another trial will be held.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

FORTY-FIRST CONVENTION, HELD AT ATLANTIC CITY, N. J., JUNE 22 TO 25.

The first session of the forty-first annual convention of the American Railway Master Mechanics' Association was called to order at 9.30 A. M., Monday, June 22, by the president, William McIntosh, superintendent of motive power of the Central Railroad of New Jersey, at Atlantic City, N. J. Prayer was offered by the Rev. J. H. Setchell. The association was welcomed to Atlantic City by Mayor Stoy, and response was made on behalf of the association by J. F. Deems.

In his presidential address Mr. McIntosh emphasized the importance of careful selection in the membership of the association, and indicated the necessity ultimately of the Master Mechanics' and Master Car Builders' Associations being consolidated into one powerful, united, representative organization. The progress of the times, the conditions of the work and the character of the problems demand this step.

The report of the secretary, Joseph W. Taylor, showed that there were 862 active members, nineteen associate members and thirty-seven honorary members, a total of 918. The receipts of the secretary's office for the year had been $5,200.33, and the expenses $5,200.33, with unpaid dues amounting to $1,440. The report of the treasurer showed a balance on hand of $1,912.72. The secretary announced that the executive committee recommended that the annual dues for the present year should be fixed at $5, the same as last year, which recommendation was approved.

The report of the committee on "Mechanical Stokers" was presented by J. F. Walsh. This was the subject of considerable discussion, and on motion the present committee was continued and made a standing committee.

The report of the committee on "Blanks for Reporting Work on Engines Undergoing Repairs" was presented by Theodore H. Curtis, chairman.

The report of the committee on "The Proper Width of Track on Curves to Secure the Best Results with Engines of Different Lengths of Rigid Wheel Base" was presented by F. M. Whyte. This report was received and the subject continued as recommended by the committee.

The paper entitled "Fuel Economy" was submitted by W. E. Squire, and a topical discussion held on the subject "The Smoke Nuisance."

This was followed by a topical discussion on "Alloy Steel."

The report on "Washing Out Locomotive Boilers" was then presented by H. T. Bentley.

The second session was called to order at 9.30 A. M. on June 23.

J. F. DeVoy presented the report of the committee on "Castle Nuts."

The report on "Apprenticeship System" was presented by C. W. Cross. On motion it was resolved that the report of the committee be adopted and that principles recommended by the committee be endorsed by the association as recommended practice, and substituted for the "Code of Apprenticeship Rules" adopted in 1898.

The report of the committee on "Superheating" was presented by H. H. Vaughan. This report was accepted and the committee continued.

The report of the committee on "Mallet Articulated Compound Steam Locomotives" was presented by J. E. Muhlfeld.

The paper by A. W. Gibbs, entitled "Tests of Briquetted Coal," was presented.

The third session was called to order at 9.40 A. M., June 24. The first report presented was that of the committee on "Size and Capacity of Safety Valves," by F. M. Gilbert, chairman.

The report on "Revision of Standards" was read by W. H. V. Rosing.

The topic, "Standardization of Locomotive Parts" was discussed, the discussion being opened by G. R. Henderson.

This was followed by the report on "Various Designs of Four-Cylinder Compound Locomotives in Service."

After the report of the committee on nominations was adopted the election of officers for the ensuing year was held. The following officers were elected: President, H. H. Vaughan, assistant to vice-president Canadian Pacific Railroad; first-vice president, G. W. Wildin, mechanical superintendent New York, New Haven & Hartford Railroad; second vice-president, C. E. Fuller, assistant superintendent motive power and machinery Union Pacific Railway; third vice-president, J. E. Muhlfeld, superintendent motive power and machinery Baltimore & Ohio Railroad; treasurer, Angus Sinclair, New York city; executive members, H. T. Bentley, Chicago & Northwestern; T. Rumney, Erie; T. H. Curtis, Louisville & Nashville.

Westinghouse Reorganization Plan.

The United States Court at Pittsburg, Pa., on petition by receivers of the Westinghouse Electric and Manufacturing Company, has entered an order directing the payment of interest due July 1 upon the funded debt and floating debt of the company, and also interest due August 1 on collateral notes of the company. This amounts to $500,000 interest due on bonds and notes, due on July 1, and $180,000 interest on a $6,000,000 loan, due on August 1. The receivers stated that they had sufficient funds to meet these obligations.

At the meeting of the readjustment committee on June 26 it was stated that the details of the circular to be issued to stockholders and bondholders were practically worked out and that the circular would be issued during this week. It was also stated that the merchandise creditors' plan, after a necessary delay to complete details and secure the small remaining amount of subscribers to new stock, would be put into effect about September 1. The two months' extension will enable the committees to perfect the reorganization plan proposed, and it is believed that before September 1 announcement will be made regarding the changes in the personnel of the company.

Great satisfaction is expressed over the completion of the important contract recently announced with the Bergmann Electric Company, of Germany, whereby that company will construct a large plant for the manufacture of Westinghouse single-phase apparatus. The company will install the Westinghouse electric traction system in Germany, and the combination has been formed for the purpose of furnishing the requirements of the Prussian state railway administration, which has decided to electrify the steam railways, $12,500,000 having been appropriated to begin the work.

American Electrochemical Society.

The fall meeting of the American Electrochemical Society will be held in New York city, probably in October. The dates contemplated are October 30, with a session at the College of the City of New York, and October 31, with a session at the Chemists' Club, 108 West Fifty-fifth street.

International Congress on Electrical Units and Standards.

The following memorandum as to the proposals to be laid before the Congress on Electrical Units and Standards to be held in London in October next has been prepared. The congress will assemble on October 12.

The general object of the International Congress on Electrical Units and Standards, which is to meet on the invitation of His Majesty's government in London in October, 1908, is to consider and advise as to the steps which should be taken to bring about agreement in the definition of electrical units which form the basis of legislation in different countries, and in the methods of constructing and employing the electrical standards necessary to give effect to these definitions.

It is hoped that the delegates to the congress may find themselves able to embody their conclusions in draft articles which might be commended to the several governments represented as a basis for uniform legislation and administration in relation to electrical units and standards.

The fundamental units of electrical measurement are the ohm, the ampere and the volt. Of these two are primary units, being independent, and the other secondary or derived. It is generally agreed that the ohm should be accepted as one of the primary units. There is some difference of opinion as to whether the ampere or volt should be the second. This point will be one for the conference to consider.

Again, the ohm is realized by means of the resistance of a column of mercury of definite dimensions, the ampere by means of the electrolytic deposition of silver, and the volt by aid of a standard cell.

If this method of realizing the units be accepted by the congress, specifications for the ohm and ampere will call for consideration, while the standard cell must be selected and the method of setting it up prescribed.

In view of the scientific questions raised in connection with each of these matters, including also the choice of the two primary units, it will be suggested at an early meeting of the congress, should such a course appear to be desirable, that the congress should appoint a small technical commission of experts to discuss the question, and report thereon to the congress.

The congress will also be asked to consider the best methods of securing uniformity of administration in the future, and for arriving at a decision on any questions left undecided at the close of the congress.

It is desirable to have some definite questions before the congress, and with this object the following propositions embodying conclusions arrived at by the representatives of the various National Standardizing Laboratories which met at the Reichsanstalt in 1906, and which are also generally in accordance with the decisions of the Chicago congress held in 1893, will be brought forward as a basis for discussion:

1. That the ohm shall be the first primary unit.
2. That the ampere shall be the second primary unit.
3. That in consequence the volt shall be treated as a secondary or derived unit.
4. That the international ohm be defined as the resistance at the temperature of melting ice of a column of mercury of uniform cross-section terminated by planes at right angles to its length 106.3 centimetres in length and 14.4521 grammes in mass.
5. That the international ampere be defined as the unvarying electrical current which, when passed through a solution of nitrate of silver in water, deposits silver at the rate of 0.001118 gramme per second.
6. That the international volt be defined as that electromotive force which, when applied steadily between the ends of a conductor of resistance one international ohm, produces a current of one international ampere.
7. That the Weston cadmium cell be adopted as a convenient standard of electromotive force, having, at a temparture of seventeen degrees centigrade, an electromotive force of .... international volts, but that it is undesirable that the number representing the electromotive force of this cell should be the subject of legislation in any country.
8. That specifications dealing with the methods of setting up mercury standards of resistance, of realizing the ampere by the deposition of silver and of preparing standard cells, be issued with the authority of the congress, and that for this purpose a technical commission be appointed to prepare these specifications.
9. That the congress consider and advise as to the best method of securing uniformity with regard to the fundamental electrical standards for the future.

Exports of copper for the first five months of 1907 were 66,044 tons; for the first five months of 1908, 133,872 tons. Imports of copper for the first five months of 1907 were 56,250 tons; for the first five months of 1908, 36,600 tons.—*Copper Gossip.*

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

TOLEDO RAILWAYS AND LIGHT COMPANY.

The report of the Toledo (Ohio) Railways and Light Company for the month of May and five months ended May 31 shows May gross of $198,973; expenses, $109,444; May net, $89,529; other income, $81; total income, $89,610; charges and taxes, $71,719; May surplus, $17,891. Five months' gross, $1,028,607; expenses, $574,930; five months' net, $453,677; other income, $2,774; total income, $456,-451; charges and taxes, $348,373; five months' surplus, $108,078.

DETROIT UNITED RAILWAY COMPANY.

The report of the Detroit United Railway Company, Detroit, Mich., for the month of May and five months ended May 31 shows May gross of $599,643; expenses, $365,875; May net, $233,768; other income, $4,464; total income, $238,-232; charges, $135,661; May surplus, $120,571. Five months' gross, $2,649,-635; expenses, $1,726,116; five months' net, $923,519; other income, $23,944; total income, $949,463; charges, $675,-794; five months' surplus, $271,669.

ELECTRIC STORAGE BATTERY COMPANY.

The preferred and common dividends on the stock of the Electric Storage Battery Company have been cut from one per cent quarterly to three-quarters of one per cent. This is the second cut in six months. Three months ago the rate was reduced from one and one-quarter per cent to one per cent.

While business has fallen off very greatly since last October, an improvement has been manifested within the last few weeks. A number of inquiries have been received from large customers, and several orders have been taken. While the company's shipments are not as great as those of a year ago, the amount of orders on its books for future delivery is as large as last year's.

MONTREAL STREET RAILWAY COMPANY.

The report of the Montreal Street Railway Company, of Montreal, Quebec, for the month of May and eight months (October 1 to May 31) shows May gross of $313,678; expenses, $169,723; May net, $143,955; charges, etc., $61,801; May surplus, $82,154, compared with a May surplus of $75,823 in 1907. Eight months' gross, $2,341,551; expenses, $1,-485,623; eight months' net, $855,928; charges, $385,788; eight months' surplus, $470,140.

NEW WEST EXCHANGE AT CINCINNATI, OHIO.

BY J. E. PEAVEY.

The telephone system of Cincinnati, Ohio, scores another improvement in the new West Exchange, located at 930 York street. Early in 1907 the Cincinnati & Suburban Bell Telephone Company decided to further improve its telephone system in that city and provide for the rapidly increasing business by building an entirely new exchange to take the place of the old West office, located at Eighth and Freeman avenues. Consequently a new exchange centre for the district was obtained, and without delay an exchange building erected with sufficient capacity to accommodate the largest type of multiple relay switchboard with auxiliary apparatus and ample district offices.

The new building has three stories and a deep, well-lighted and ventilated basement.

FIG. 1.—NEW WEST EXCHANGE OF THE CINCINNATI & SUBURBAN BELL TELEPHONE COMPANY, CINCINNATI, OHIO.

As shown in Fig. 1, the building is very substantially constructed of blue granite and Shawnee speckled brick, and is fireproof throughout. The interior framing is of steel and all partitions are of tile and the floors concrete, with staircases constructed of steel and white Italian marble. Corridors and vestibules are also of white Italian marble, with floors of a neat mosaic design. The only wood entering into the construction is used for floors on the concrete to soften the tread, doors and a few minor details. The windows in external walls exposed to adjoining property have metal casings and wired glass, thereby insuring against fire from external sources. The entire third floor of the building is used for the switchboards and as an operating room. The second floor contains the apparatus room and operators' quarters. The ground floor is used entirely for district offices and the basement contains the heating system and exchange power plant, cable runway and various accessories belonging to a first-class building of this character. All wires enter the building through a tunnel from the exchange manhole in the street. After the cables enter the basement they are supported on a unique runway or rack to a point directly beneath the main frame, where they rise into the main frame terminals. Fig. 2 shows this cable rack or runway in the basement.

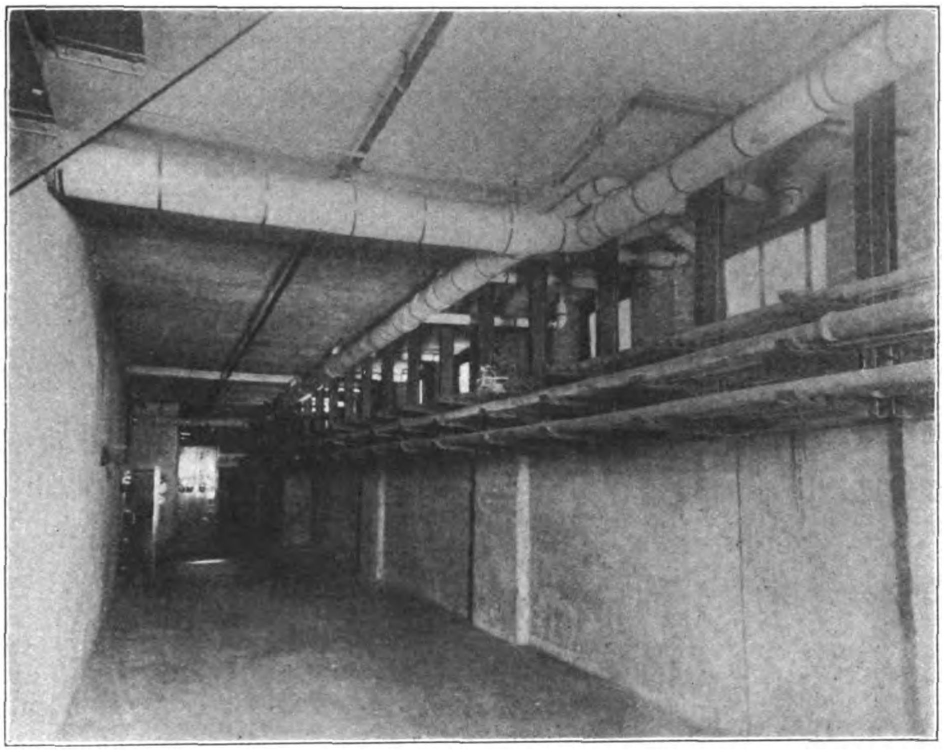


FIG. 2.—CABLE RUNS IN SUBWAY—WEST EXCHANGE OF THE CINCINNATI & SUBURBAN BELL TELEPHONE COMPANY.

Standard Western Electric equipment is used throughout. The switchboard has an ultimate capacity of 9,600 subscribers' lines and a present equipment of 5,000. Fig. 3 is a view of one corner of the operating room, showing a portion of the front of switchboard. Fig. 4 is a rear view of the power switchboard, and gives some idea of the generally substantial character of the construction and assembly throughout this exchange installation.

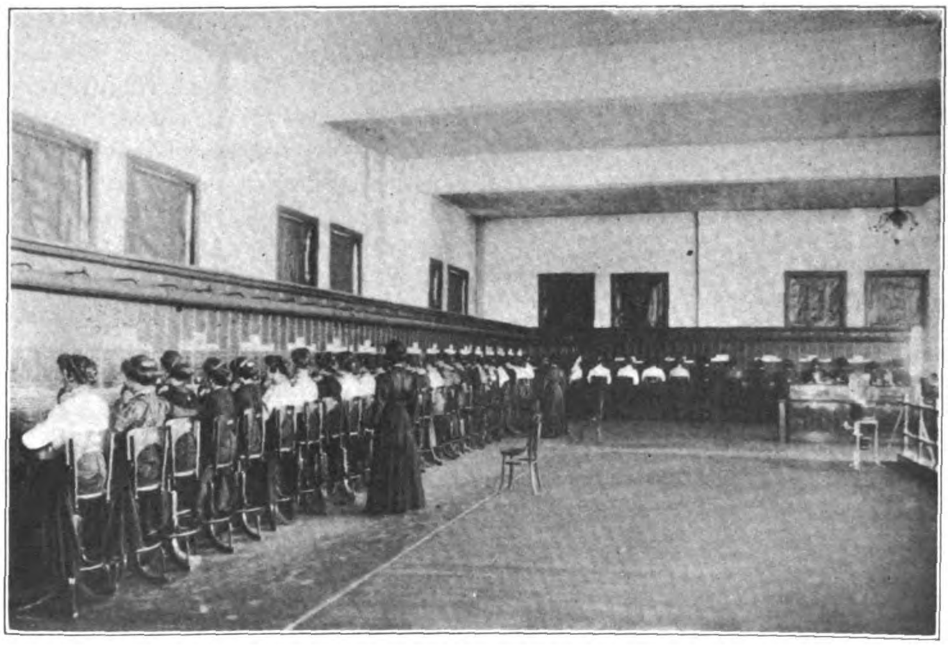


FIG. 3.—WEST EXCHANGE OF THE CINCINNATI & SUBURBAN BELL TELEPHONE COMPANY—FRONT OF SWITCHBOARD.

The exchange possesses several distinct features of importance, the principal of which is the use of forty-eight volts on all cords for transmission purposes—both local and toll. This is the second office so equipped by this company, forty-eight volts having been adopted as a standard for all offices having a comparatively long substation loop. Machine or automatic ringing from the trunk or "B" operator position is also used, which materially reduces the "don't answer" reports and otherwise aids in economical operation. The interior arrangement of the exchange, both from an artistic and operating standpoint, is very complete, every facility for operating and maintaining the plant having been carefully worked out and provided for.

This being the eighth large exchange built by the Cincinnati & Suburban Bell

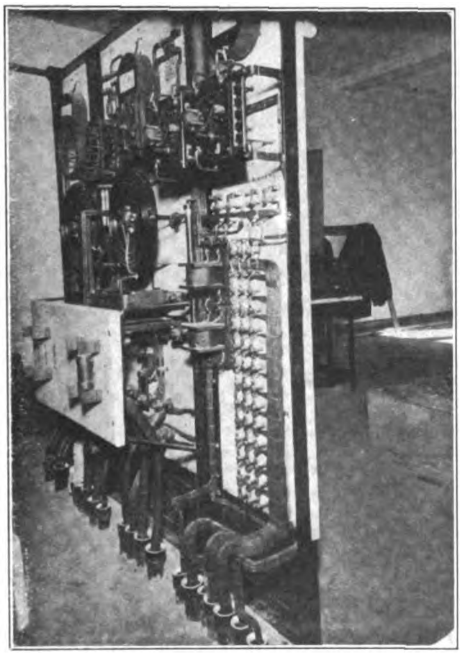


FIG. 4.—REAR OF POWER BOARD AT WEST EXCHANGE.

Company in the past five years, as a consequence a large fund of practical information on modern exchange design and construction was at the company's disposal. The transfer or cutting-over from the old to the new exchange was accomplished at 2 P. M. on Saturday, February 15, 1908, and required just 100 seconds. So successful was the cut-over that not one of the eleven other exchanges in the city was aware when the transfer was made. Considering the hour of the day, with its operating load, this is considered quite a feat.

All credit for this handsome exchange and its successful completion must be given to B. L. Kilgour, general manager of the company, who gave considerable personal attention to the engineering work; also to T. C. Reed, superintendent of the cable department, for the thorough workmanship that permitted the exchange to be transferred from the old to the new building without a single case of trouble or complaint.

THE TUNGSTEN LAMP.[1]

BY E. F. TWEEDY.

In considering the commercial effects of the introduction of the tungsten lamp the present, together with the possible users of electric light, may be divided into three classes according to their probable relations to this new illuminant. The first class consists of existing customers who are now using electric light at what might be termed the "point of saturation," based on the present standard of illumination, thereby reducing their watt capacity and consequently decreasing the revenue of the central station. To illustrate this a concrete example of this class will be cited. The United Cigar Stores Company has consistently recognized the advertising value of brilliantly lighted stores. To carry out this idea effectively they have been large consumers of electricity, their total outlay for electric lighting on Manhattan Island alone during the year 1907 being about $80,000. By means of the tungsten lamp they now expect to reduce this expense by nearly one-half, without sacrificing in the slightest degree their present high standard of illumination.

The second class is likewise composed of present consumers, but in their case the illumination is below the "point of saturation" above referred to, for the present standard of illumination. This class has limited its quantity of illumination, the reason for this being largely one of dollars and cents. The question now arises as to whether this class will utilize the tungsten lamp for the purpose of securing the same illumination for less money, or to secure a greater amount of illumination for the same money. The latter alternative seems more probable, but central stations can not wait passively for such a result. It is time for active work among such a class of customers, in order to point out to them the advantages which they will derive from a greater amount of illumination, now that a cheaper source of light is at hand. Unless this is done central-station income from this class will probably be diminished, at least temporarily. For the present, while the tungsten lamp is made only in sizes of comparatively high candle-power, it does not seem likely that it will replace the carbon lamp in domestic lighting. It is very probable that multiple lamps of smaller candle-power will soon be upon the market; in fact, a 110-volt tungsten lamp of twenty candle-power, consuming twenty-five watts, was exhibited at the recent Chicago convention, and appeared to be a complete success. A lamp of this and smaller size will find an extensive field in the lighting of the home. In using this lamp for domestic lighting, however, considerable care must be used in the manner in which it is installed. The carbon lamp with clear glass bulb and without a diffusing shade is frequently placed directly in the line of vision. With the tungsten lamp, the intrinsic brilliancy of which is over twice that of the carbon lamp, the practice above described must be discontinued, or else the money saved in light bills will soon reach the pocket of the oculist. The tungsten lamp must be installed well above the line of vision, or else be so shaded that its intrinsic brilliancy will be largely reduced, and this fact should be thoroughly impressed upon all customers who are about to install this lamp. It is evident that such a course is desirable from the central station standpoint. By installing tungsten lamps in the manner described, the lessened efficiency of the installation, aside from the lamps, will offset in some measure the high efficiency of the light sources themselves.

The third class consists of those who are at the present time employing some other means for securing illumination than by electricity, in the interest of economy solely. (It is assumed that this is the only reason a person could have for using any other illuminant in preference to the electric light.) It is from this class that the lost revenue from classes one and two must be regained, and there is every reason to believe that not only will any possible loss be thus recovered, but that the electric lighting industry will experience a tremendous growth as a result of its being able to secure a class of customers which has heretofore been unobtainable.

In order to secure these possible customers described under class three above, this company has decided upon a campaign directed, at the start, against the gas arc. A proposition will be made to the users of this type of illuminant whereby the company will arrange for the wiring and for the installing of a tungsten fixture to replace the gas lamp. The customer will be allowed to select his own fixture from a number of designs covering a considerable range in price, and the installation will be made under the customer's direction. The total cost of the wiring, the fixture and the tungsten lamps will be assumed by the company, but this

[1] Abstract of a paper read before a meeting of the Contract and Inspection Department of the New York Edison Company, New York city, June 11.

amount will be repaid by the customer, without interest, in twelve consecutive monthly payments, which will be added to the monthly bills for current. After the final payment has been made the entire equipment, excepting the lamps, which are to be returned at the end of their life, will become the property of the customer. If the customer should vacate the premises before the last instalment is paid, or if the contract should be terminated before the final payment, it is understood that the installation may be transferred to the successor under a similar arrangement, to continue until all payments have been made. If such a transfer should be impossible, the original customer must pay the full amount necessary for a complete liquidation.

There are a vast number of gas arcs in use in this city at the present time, but the policy outlined above should result in their nearly complete elimination. A few figures comparing the cost of operation of a gas arc to that of a tungsten fixture, giving approximately equal illumination, may be of interest. The majority of gas arcs, particularly those installed in small stores, are in service on a rental basis. The Municipal Lighting Company has a large number of arcs so installed. Their charges are seventy cents a month for the four-mantle lamp and a dollar a month for the one having six mantles. These prices include maintenance, so, adding the cost of the gas consumed by the lamp, the total operating cost is secured. Some figures recently obtained under actual working conditions were as follows: Cost of gas consumed by a four-mantle lamp burning four hours a day (excluding Sundays) for one month, was $1.62; adding to this the rental charge of seventy cents makes a total monthly cost of $2.32. For equal illumination a tungsten fixture would be required having four forty-watt or possibly three sixty-watt lamps. Assuming the latter combination, with a life of 1,000 hours for the tungsten lamps and current at ten cents per kilowatt-hour, a total monthly cost of $2.35 would result. To this might be added an interest charge upon the cost of the equipment, which would reach its full value only at the end of the first year, when all payments had been made, and is really too insignificant to be included, as the total cost of the equipment, excluding lamps, will rarely exceed $15. Compare the above figures and then take into consideration the many advantages possessed by the tungsten lamp not shared by the gas arc, namely, the color of the light, which is nearly a pure white, as compared with the greenish-yellow color of the gas lamp; a comparative absence of heat, the presence of which makes the gas arc decidedly objectionable during the greater part of the year; and lastly, the fact that the atmosphere is not vitiated. It is stated that a four-mantle gas arc consumes as much oxygen as a dozen people, and the truth of this statement is evident to one who has entered a certain class of small stores on a winter's day. Even if the cost of a given amount of illumination is slightly greater with the tungsten lamp than with a gas arc—which is probably true in the case of certain inverted mantle arcs—the advantages enumerated above should outweigh any such slight difference in cost.

The use of the tungsten lamp for show-window lighting will be touched upon. The fundamental requirements for effective window lighting are: (1) That the sources of light be concealed from the eyes of the passerby, or, if this is impracticable, that they be surrounded by diffusing globes or shades, so that their intrinsic brilliancy will be largely reduced; (2) that a sufficient quantity of light be thrown upon the goods to be displayed so that the portion of this light which is reflected to the eyes of the observer will produce the desired effect, namely, a vivid visual perception of the goods which are on display.

A Single-Phase Locomotive for the Prussian State Railways.

A brief description is given in *Electrical Engineering* (London), for June 11, of the new single-phase locomotive which has been built for experiment on the single-phase line of the Prussian State Railways, at Oranienburg. The locomotive consists of two two-axle units coupled together. Three of the four motors are driven by single-phase motors of the Winter-Eichberg compensated repulsion type, and a fourth motor may be mounted on the remaining axle if found necessary. Each motor is rated at 350 horse-power on the one-hour-and-seventy-five-degrees-centigrade basis. With this load the speed of the motor is 450 revolutions a minute. Using forced draft, the continuous capacity of the motors is 250 horse-power, the speed then being 500 revolutions a minute. These motors are said to differ but little from the 350-horse-power motor experimented with two years ago. The latter weighed five and one-half tons, had six poles, and was designed for twenty-five cycles. The motors are geared to the locomotive axles with a ratio of 1 to 4.21, and the driving wheels have a diameter of 4.6 feet, so that the speed at the one-hour rating is seventeen and one-half miles an hour with a total draw-bar pull of 22,000 pounds. At the continuous output rating the speed is nineteen and one-half miles an hour with a draw-bar pull of 14,300 pounds. The maximum speed of the locomotive is thirty-five miles an hour. The total weight of the two units is fifty-nine and one-half tons. The locomotive is supplied with current at 6,000 volts, twenty-five cycles, by means of two bow collectors, one on each unit. The pressure on the wire is nine pounds, which is controlled by compressed air. The main transformer reduces the pressure from 6,000 to 1,000 volts. It is air-cooled by forced draft supplied from a fan driven by a thirty-horse-power Winter-Eichberg motor, which is started by means of a series choking-coil which is automatically short-circuited when a speed of 700 revolutions a minute is attained. The air for the transformers and motors is drawn through choke filters to free it from dust. Compressed air for the brakes, bow collectors and other devices is supplied from a compressor driven by a seven-horse-power motor which is automatically started when the pressure falls below six atmospheres. The main controller has four starting positions and four running positions, and a simplified controller for operating at the lowest voltage only is supplied for use in switching operations. By means of a choking-coil, the centre of which is connected to the motor lead and the ends to transformer tappings, the connections are changed from point to point without short-circuiting the transformer. The contactors controlling the connections are operated by current from the main transformer at a pressure of 300 volts.

American Street and Interurban Railway Association.

The annual convention of the American Street and Interurban Railway Association and the affiliated associations of the Accountants, Engineers, Claim Agents, Transportation and Traffic Managers, and Manufacturers, will be held at Atlantic City, N. J., on Monday, Tuesday, Wednesday, Thursday and Friday, October 12 to 16. The days upon which the different associations will hold their meetings have not been definitely decided upon, but these will be announced in the near future.

The exhibit of the Manufacturers' Association will be located on Young's "Million-Dollar" Pier, and it is expected that a display even more attractive than that of last year will be given.

THE RESISTANCE EQUIVALENT OF ELECTROMAGNETIC RADIATION FROM A LINEAR OSCILLATOR.

BY OSCAR C. ROOS.

In presenting this article the writer first wishes to call attention to one or two preliminary considerations which have given rise to some obscurity in the treatment of such problems as the wireless telegraph engineer is called upon to solve. It is then purposed to indicate the method of an engineering attack upon the problem of the number of watts expended in the ether as electromagnetic radiation with a given harmonic current at the base of the vertical used in wireless telegraphy. There follows the resulting solution of the equally important question of the current intensity at the base of the vertical with a given harmonic electromotive force.

On examination of several papers which have appeared to account for the radiation from a vertical, it becomes increasingly evident that a tendency exists to ignore the inherent differences in the physical behavior of Hertz oscillators and the large oscillators of the vertical, inverted "L," "T"-shaped and other types used as verticals in wireless telegraphy. Three serious consequences have immediately ensued to mar the accuracy of all analyses based on the assumed similarity: (1) Deductions made as to the resistance equivalent of radiation from hot-wire measurements have not led to consistent results when the frequency was changed, (2) reactances measured at the "driving point" of a vertical wire have not furnished consistent values of current, and (3) the expected resistance equivalents and the observed have not, in analyses hitherto presented, agreed within engineering limits of accuracy.

The subject of the linear oscillator as a whole is an extremely intricate one if a rigorous method of analysis (such as is given in MacDonald's "Electric Waves") is used. Abraham and Hack have given a treatment of the linear oscillator which, while elegant from a mathematical standpoint, is not as accurate in practice as MacDonald's, and whose artificial assumptions allow no simple conception of the dissipative agencies in action. These, however, are easily grasped from a study of the engineering theory of radiation developed by an American physicist and engineer, J. S. Stone, and presented before the International Electrical Congress at St. Louis in 1903 and subsequently republished in these columns (October 15, 1904). Although this theory has been before the technical and scientific world for more than three years, no practical application seems to have been made of it, as far as the writer is aware, in any phase of the wireless telegraph industry, except as undertaken by one or two personally interested mathematicians and members of his technical staff. Hence, as was to be expected, the errors mentioned above as the result of applying cumbersome analyses directly to the problem have crept into the work even of writers of some considerable authority on electrical matters.

Professor J. A. Fleming, author of "The Principles of Electric Wave Telegraphy," in a paper on the Poulsen arc and continuous electric oscillations, published in these columns on November 9, 1907, identifies himself with those who have fallen into the error of basing their work on the assumption that Hertz's treatment of the electric doublet shows it equivalent to a linear oscillator, and has, in addition, "grafted" on these assumptions a physical condition taken from MacDonald's analysis above referred to, which analysis is based on an entirely different treatment from that of Hertz. I shall not go into details as regards this forcible "hybridization" of formulæ; as in a future paper I expect to present MacDonald's results made practical for wireless telegraph engineers with the aid of Stone's engineering method.

In indicating a more accurate treatment of the problem of the resistance equivalent of radiation (a term first used by Stone) I must state that after all is said and done the acceptance of this theory is really based on facts rather than analysis, since no published analysis that is likely to be put to use for several years yet, is complete enough to take all the factors of the problem into consideration, especially that of the variability of the resistance equivalent of radiation with leakage, etc.

In Professor Fleming's article above mentioned there occurs a formula giving the power in watts of a Hertz oscillator vibrating at its fundamental

$$W = 40\,\pi^2 \frac{l^2}{\lambda^2} A^2$$

As an expression of the power of a Hertz oscillator or electric doublet the above is correct, since we may take the current to be practically uniform along the axis. When applied by Professor Fleming to a linear oscillator or wireless telegraph vertical, however, whose height is not negligible in comparison with the wave-length of the emitted radiation, it is seriously in error, since the current is not uniform along the axis, but is distributed according to a "cosine law" with a maximum at the base and nodes at the free ends of the vertical wire and its earth "image," if we assume uniform constants per unit length of the vertical.

In the summer of 1905 I was led, in the pursuit of a mathematical research on the inductance per unit length of a vertical, to a formula for the energy of radiation, whose accuracy has since been shown by the increased accuracy of predictions as to resistance of radiation; some have been verified, experimentally, by observers in a different field of electric wave engineering.

This practical engineering formula is a special case of a more general result, which includes all frequencies of vibration from zero to infinity, and to which I shall refer later on, but which in the present state of the art would not be called upon for accurate quantitative results.

Returning to Professor Fleming's article, we find the formula given by him would be correct for a wireless telegraph antenna if his l, or length of complete oscillator, were replaced by a smaller length l_H equal in value to the length of the equivalent Hertz oscillator acting at a distance. This quantity l_H is found by using Stone's method of decomposing the linear oscillator vibrating at its fundamental frequency into an infinite number of Hertz oscillators of length varying according to an inverse cosine law, between zero and the length of the vertical. This law follows from the general differential equations of the problem as solved for current, which in all cases varies as a circular function along the complete linear oscillator, and in the case of the fundamental frequency of vibration gives the cosine curve with antinode of current at the equatorial plane.

The linear oscillator may, accordingly, be looked upon, as regards its resultant field at a distance, the criterion of radiation by Poynting's theorem, as being composed of an infinite number of elementary Hertz oscillators, each of whose lengths is expressible by the formula $l_H = \frac{v}{n} \cos^{-1} \frac{nx}{v}$ and the average or effective length $l_{eH} =$

$$\frac{v}{n} \int_{-a}^{+a} \cos^{-1} \frac{nx}{v} \frac{dnx}{v}$$

where $$x < +a > -a$$

and $$\frac{na}{v} = \frac{\pi}{2}$$

In the above a is the length of vertical or air wire; $v = 3 \times 10^{10}$ centimetres per second, the velocity of light; n ($= 2\pi f$ where $f =$ frequency) is the "vectangular velocity" and is variously called "periodicity," "oscillation number," etc., which are misnomers; as it has the dimensions of an angular velocity and in fact is the angular velocity of the vector whose projection on a plane would show the harmonic time relations of the current in question.

The above quantity l_{eH} is the effective or average length of a Hertz oscillator giving the same field and energy flow at a distant point, as our linear oscillator. A physically more direct procedure is to decompose the linear oscillator into an infinite number of elementary current filaments of different charges, but equal lengths, in accordance with Hertz's own expressions. The results of the two methods are in this instance, however, identical.

In the multiple antennæ used by the Stone Telegraph and Telephone Company it has been found that the assumption that $l = \frac{\lambda}{2}$ at fundamental frequency, where $l = 2a$, or twice the height of the vertical and $\lambda =$ wave length emitted, is very approximately true. The uniformity of the vertical wire constants along its length is quite sufficiently accurate for engineering practice. Now, the effective length l_{eH} may be taken as $l_{eH} = \frac{2}{\pi} l$ when we have the fundamental vibration, and Professor Fleming's formula then becomes

$$W = 40\,\pi^2 \left(\frac{2}{\pi}\,l\right)^2 \frac{A^2}{\lambda^2} = 160\,\frac{l^2}{\lambda^2}\,A^2$$

for the complete linear oscillator where A is the maximum current, or $W = 40\,A^2$ watts.

The hot-wire ammeter, however, reads effective values, hence $W = 80\,A_e^2$ where $A_e =$ effective amperes for the complete oscillator and R^1, the "resistance equivalent of radiation," equals forty ohms for the air wire alone. This result has been the basis of regular engineering treatment of transmitting and receiving problems of all kinds since it was discovered and has been incorporated in patents now pending for radiotelegraphy, suitable constants being applied where the conditions are not those assumed in this case.

If we "hybridize" MacDonald's result with the above conditions by assuming for a vertical $l = \frac{\lambda}{2.5}$ and an approximately cosine law of current distribution along the vertical, we find that R^1 comes out as about twenty-five ohms instead of sixty-four, as given by Fleming.

Passing now to the more general method of viewing the problem, we will first take the region of frequencies below the fundamental, since most verticals in use are loaded with inductances. Such verticals can vibrate effectively, solely at frequencies below the fundamental on account of the increase of R^1 as the square of the frequency, although there are theoretically an infinite number of frequencies at definite periods apart in the frequency scale where such natural vibrations are possible. As we approach zero frequency the current distribution curve flattens until in the limit with zero frequency it approaches a straight line. This range of frequencies, while not as interesting from an analytical standpoint as that above the fundamental, is, however, the practical one for wireless telegraph

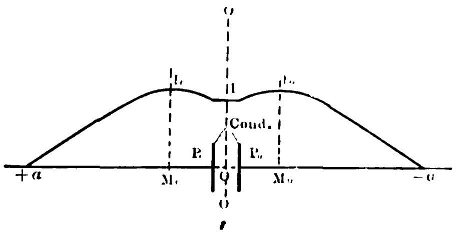


FIG. 1.—CURRENT DISTRIBUTION IN A LINEAR OSCILLATOR.

engineers in the present published state of the art. The formula covering it is

$$R^1 = 40\,csc^2\,k\,\frac{\pi}{2}\left(1 - \cos k\,\frac{\pi}{2}\right)^2 \text{ ohms}$$

where k is the fraction of the fundamental frequency at which the vertical is to vibrate, assuming unit current at base of vertical, and maximum current therefore as $csc\,\frac{na}{v} = csc\,k\,\frac{\pi}{2}$. This, of course, is a special case of the more general formula for R^1 covering all frequencies previously referred to.

For frequencies just above the fundamental we find by reference to Fig. 1 that the current distribution in a linear oscillator is equivalent to two complete systems of Hertz oscillators, which overlap by almost a quarter wave-length, and whose radiative tendencies may be considered absent where each passes through the equatorial plane; in other words, the current loop or antinode is shifted toward the free end of the wire and equals the current at the base multiplied by $csc\,\frac{na}{v}$ where a is the length of air wire in cm. $n =$ vectangular velocity

$v = 3 \times 10^{10}$ cm. per sec. = velocity of light.

To illustrate: In Fig. 1 we have a complete linear oscillator represented with the current distribution along its length due to a "forced" oscillation above the fundamental of the vertical, and having an inductive reactance requiring, therefore, a condenser c at the equatorial plane to neutralize said inductance reactance at the "driving points" P_1 and P_{11}.

Since the current throughout the condenser C is constant and equals I_o, the maximum current I_1, or I_{11}, is $I_0\,csc\,\frac{na}{v}$. This distribution of current holds within engineering limits in a helix of wire having uniformly distributed electrical constants, as in the case of the linear oscillator assumed. It is interesting to note a substantial empirical confirmation of the above theoretical distribution by C. J. Watson in the London *Electrician* of January 3, 1908. He found that with capacity added to a helix as an exciting connection for stationary waves that the node of pressure, and therefore current antinode, was shifted toward the open end of the vertical.

We may assume the effect of radiation at the driving point of the antenna or linear oscillator to be that of a purely non-inductive resistance. Assuming the distribution of current and potential to the left of the equatorial plane OO to be due to the image of the right-hand distribution. The distance of the antinodes of current from the equatorial plane $= \frac{ak}{1+k}$ where k is the fractional part of the fundamental frequency $\left(\text{say } \frac{1}{3}\right)$ by which the impressed frequency exceeds it, therefore $OM_1 = OM_{11} = \frac{a}{4}$ and $I_1 = I_{11} = I_0\,csc\,60°$. Fig. 1 incidentally shows the danger of drawing conclusions from hot-wire readings at the "base" of a linear oscillator vibrating above its natural or free period. If we re-draw Fig. 1 to show solely the variable part of the current distribution curve, as in Fig. 2, we have the basis of an engineering method of attack on the problem of all higher frequencies.

If we conceive a series of Hertz oscillators which have infinitesimal uniform currents and which vary in length from $+a$ to $-a$ (or $2a$) to $l_1\ o_1\ l_1$ at o_1 and zero at I_o, according to the inverse current distribution law, we shall obtain a mathematical "current sheet" if these elementary oscillators are laid side by side, as it were. It is readily seen that the dotted parts of the distribution curves on opposite sides of the equatorial plane contribute nothing to the radiation; in fact, the only questionable point of this analysis to be checked by practice is raised by the tacit assumption made that all the elementary Hertzian oscillators from $2a$ to zero have the same radiative power, when it is quite evident by an application of MacDonald's analysis that more radiation takes place from the outer halves of the oscillator than the inner: as a corrective tendency, however, the relatively stronger equatorial fields seem to restore the uniformity of action between the above parts. We may now represent Fig. 2 by a series of Hertz oscillators as in Fig. 3. Four elementary oscillators are shown, $a_1\ a_2$ and $a_3\ a_4$ are treated as one oscillator of length $a_1\ a_2 + a_3\ a_4 = 2a_1\ a_2$, $b_1\ b_2 + b_2\ b_3 = 2\ b_1\ b_2$ and $c_1\ c_2 + c_2\ c_3 = 2\ c_1\ c_2$, etc.; hence the averaging is simply a problem of quadrature applied to the current sheet "area," $+ a\ I_1\ I_0\ I_{11} - a + a$.

The fractional overlapping of the central "current distribution sheets" becomes less and less as we pass to frequencies above the fundamental and is zero at the octave—an impossible case, however, since the reactance at the driving point is infinite for the octave and for all even harmonics including zero frequency, according to Stone's formula (which has been amply verified by engineering results).

$$Z = -L_1\, v\, ctn\, \frac{na}{v}$$

where Z = reactance L_1 = inductance per cm. (c. g. s.) $2\,a$ = length of complete linear oscillator.

Proceeding to frequencies above the octave, we have a supplementary overlapping of the middle "current sheet" units, and on each side of this region two complete "current sheets" in opposite phases from the joined middle sheets, and each of length $= \frac{\lambda}{2}$.

To illustrate: In Fig. 4 we have a current distribution curve giving us a sheet of elementary Hertz oscillators for a frequency (say) two and one-third times that at the fundamental —our frequency unit in this analysis— *i. e.*, above the octave. Since for the octave $\frac{na}{v} = 2\left(\frac{\pi}{2}\right)$, for this frequency $\frac{na}{v} = \frac{7}{3}\cdot\left(\frac{\pi}{2}\right)$ radians. However, as the maximum current at the octave with unity current at equatorial plane is $csc\ \pi = \infty$, we have a discontinuity to take account of in our formula. It will be noticed that since our equivalent length Hertzian oscillator is derived by calculating the average "height" of the Hertzian oscillators in the oscillator current-sheet, by taking the "area" of same, we can ignore

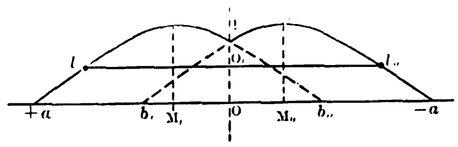


FIG. 2.—VARIABLE PART OF THE CURRENT DISTRIBUTION CURVE OF A LINEAR OSCILLATOR.

the symmetrical image of either side in obtaining this result and hence only one set of oscillators is indicated in Fig. 4.

In Fig. 5 we have the current distribution curve giving the Hertzian oscillator "sheet" or "area" for a frequency about 3.5 times fundamental frequency. In

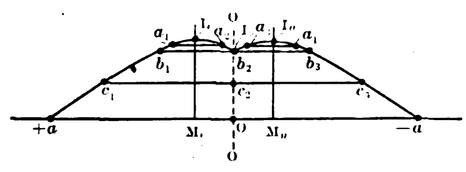


FIG. 3.—LINEAR OSCILLATOR REPRESENTED AS A SERIES OF HERTZ OSCILLATORS.

both Figs. 4 and 5 we notice a partial or "basal sheet" and a complete "sheet," the latter corresponding to a complete linear oscillator of length equal to length of "sheet base" $C_2\ C_3$. This linear oscillator is, of course, equivalent to a radiation resistance of eighty ohms, since its current distribution is sinusoidal and it may therefore be considered to be a separate added linear oscillator vibrating at its fundamental. By taking the "area" of the basal segment oc_1I_0 and getting its

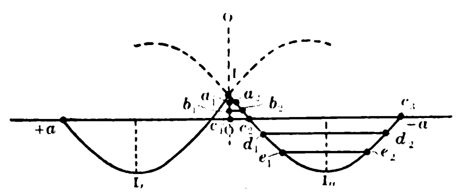


FIG. 4.—CURRENT DISTRIBUTION CURVE FOR A SHEET OF HERTZ OSCILLATORS.

ratio to the half area of the above complete added "oscillator-sheet," we obtain a ratio which gives us the "effective length" l_{eH} of the Hertzian oscillator corresponding to the above basal segment: this ratio, squared and multiplied by forty ohms, gives us the resistance equivalent of the basal sheet to be added to the complete or eighty-ohm "sheet." Thus the problem for all higher frequencies resolves itself into the determination of the above "basal area" effect in any case and the addition to it of a number of equal linear oscillators vibrating at their common fundamental.

We have accordingly:

Below the fundamental

$$\frac{na}{v} = k\,\frac{\pi}{2} \text{ and } R^1 = 40\ csc^2\,\frac{na}{v}\left(1 - \cos k\,\frac{\pi}{2}\right)^2 \qquad (1)$$

Between fundamental and octave

$$\frac{na}{v} = (1 + k)\,\frac{\pi}{2} \text{ and } R^1 = 40\ csc^2\,\frac{na}{v}\left(1 + \sin k\,\frac{\pi}{2}\right)^2 \qquad (2)$$

Between octave and first harmonic

$$\frac{na}{v} = (1 + k)\,\frac{\pi}{2} \text{ and } R^1 = 40\ csc^2\,\frac{na}{v}\left[\left(1 - \cos k\,\frac{\pi}{2}\right)^2 + 80\right] \qquad (3)$$

Between first harmonic and double octave

$$\frac{na}{v} = (3 + k)\,\frac{\pi}{2} \text{ and } R^1 = 40\ csc^2\,\frac{na}{v}\left[\left(1 + \sin k\,\frac{\pi}{2}\right)^2 + 80\right] \qquad (4)$$

The general formula becomes by induction,

$$R^1 = \frac{40}{\sin^2\frac{na}{v}}\cdot\left[\left(1 - \left\{\sin m\,\frac{\pi}{2} + \cos m\,\frac{\pi}{2}\right\}\cos\frac{na}{v}\right)^2 + m - \sin^2 m\,\frac{\pi}{2}\right] \qquad (5)$$

where $\frac{na}{v} = \left(m + k\right)\frac{\pi}{2}$, m being an integer and k a fraction.

The locus of R^1 as a function of the fundamental vibration as a frequency unit is roughly shown in Fig. 6.

For all even harmonics we are confronted with the very significant limitation of a theoretically infinite value for R^1 considered as a resistance operating at the driving point or base of the vertical. The physical reason for this becomes clear if we recollect, (1) that every linear uniform current element contained in the "oscillator sheet," being as regards radiation a separate elementary Hertz doublet of given length, offers an elementary dissipative (or radiative) resistance, according to the strength of its field at a distance, and (2) that the filaments which may be considered to end on the "base" or earthed part of the fictitious "current sheet," are, when the limiting cases of the even fundamental frequencies are approached, but a small and even vanishing percentage of the total sum or "area" of the current filaments composing said "sheet"; hence the rise of R^1 with the increase in the ratio of maximum current to basal current of antenna. It is well to remember that since the reactance and

R^1 of the linear oscillator are assumed, of course, in series, that the high reactances, approaching infinity at the even multiple harmonics, are, in addition to the reactance of the vertical *per se*, a separate means of limiting the current at the base.

In the above treatment it has been tacitly assumed that the series of synchronously vibrating segments on a vertical, under the conditions for stationary waves permits practically uniform maximum amplitudes of current in each segment, and that the radiation from any segment, according to Hack's amplification of Abraham's work on the linear oscillator, does not seriously modify the radiation from any other, and thirdly, that the field at a distance, due to a uniform current filament, is proportional to length of said linear elementary current. When mutual influences between current "segments" are appreciable they can be replaced by equivalent reactances and resistances, after attack by a modification of Heaviside's operational methods of analysis for this class of problems, and Stone's engineering treatment may then be applied to get the new form of R^1. However, the complexity of the results is not always compensated for by the gain in accuracy.

$= IR^1$. Therefore the vector sum or total drop gives us

$$I^2R^2 + I^2X = E^2$$

which gives us a cubic for I in the known quantities R^1, X and E.

In conclusion it may be stated that, as a matter of fact, the preceding general formula for R^1 has been amply verified both at and below the fundamental frequency by using substitution experimental methods of tuning to the vertical and

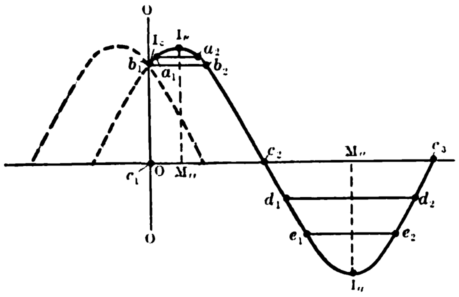


FIG. 5.—CURRENT DISTRIBUTION CURVE FOR A SHEET OF HERTZ OSCILLATORS FOR A DIFFERENT FREQUENCY.

thus reproducing the "contained R^1," *e. g.*, it is common practice to find at a frequency approximately one-half that of the fundamental a substitution value for R^1 of nine to ten ohms as required by this analysis, and not sixteen ohms, according to Fleming's formula. We have in the field of wireless telephone experiments further external evidence to corroborate the above analysis, these experiments indicating a value for R^1 of nine ohms at approximately the half fundamental frequency. These are cases taken at random from many to illustrate the importance of engineering instead of rule-of-thumb in wireless telegraphy—a field which already bids fair, by the use of precision methods aided by analysis, to outrank in accuracy of performance prediction some of the older branches of electrical engineering.

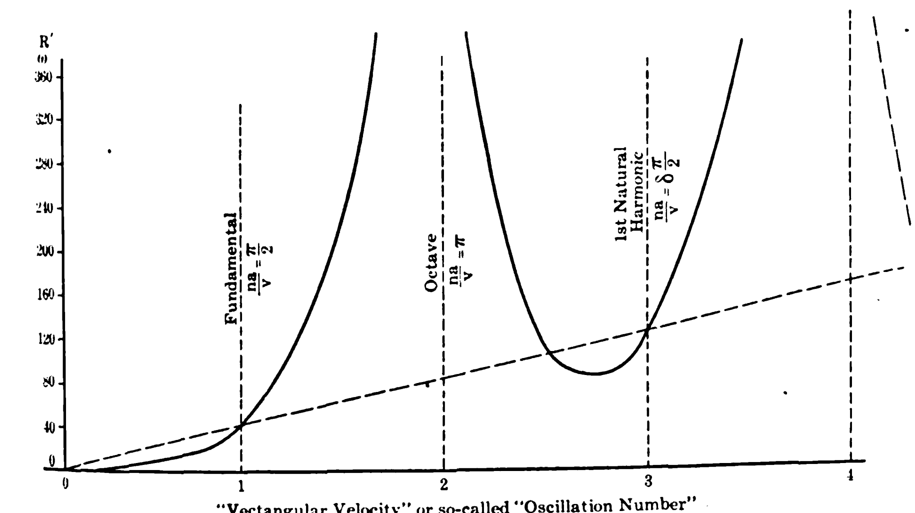


FIG. 6.—ROUGHLY DRAWN GRAPH OF FUNCTION R, "THE RESISTANCE EQUIVALENT OF RADIATION" AT DIFFERENT FREQUENCIES.

The final problem of the actual basal effective current I in a linear oscillator with an electromotive force E may be attacked in the usual manner of alternating-current problems as follows:

We know that the reactance "drop" to be accounted for in the vertical at the driving point is IX where $X = -L_1 \, v \, \frac{d}{dn} \frac{na}{v}$ and the resistance "drop"

BOOK REVIEWS.

"Die Elecktrizitätswerkbetriebe in Lichte der Statistik." Fritz Hoppe. Leipzig. Johann Ambrosius Barth. Cloth. 325 pages. 116 curve sheets and 197 tables. 7½ inches by 11 inches. Price, paper bound, 12 marks; cloth, 13 marks 20 pfgs.

This is the second edition of a similar treatise on statistics of power-plant operation, to which much material has been added, thus bringing it up to date. The book is divided into nine chapters and one appendix. The first chapter covers the development of electric power plants in Germany, discussing the number of plants, capacity of same, the system of power distribution employed, etc. Chapter ii, besides other material, gives the power consumption per section of the country, per inhabitant and the cost of same. Chapters iii, iv and v describe the kind of plant, *viz.*, steam, hydraulic or gas, and the type of machinery installed in each case. In these chapters the actual cost of operation is treated in detail. Chapter vi discusses the financial end of power-plant design and construction. Chapter vii discusses the rates to consumers, *viz.*, flat, maximum and minimum demand, sliding scale, etc. Chapter viii gives prices paid by railroads and factories, and the generating cost and the selling price. The last chapter treats of other Continental power plants as well as Great Britain and South Africa. The appendix gives different systems of bookkeeping used in power-plant operation.

It is evident that the compiling of the data mentioned, which are a fractional part of the whole, is tedious work. To facilitate matters, an exhaustive index is appended. The book is of great value to consulting and operating engineers and capitalists, particularly those of European countries.

"How to Become a Motorman." Second Edition. V. B. Livermore and J. R. Williams. New York. D. Van Nostrand Company. Cloth. 248 pages. Illustrated. 5 by 6½ inches. Furnished by the ELECTRICAL REVIEW for $1.

This is intended to be a thoroughly practical book for the motorman. The fundamental principles of the electric motor are briefly explained and then the different sizes and appliances are taken up separately, each being described with much detail, the methods of operation explained at length, and wire diagrams being given. All the systems of car and train control in use in this country are explained. The last portion of the book is devoted to study of air-brake systems for electric cars, the controlling apparatus being explained fully. The final chapter contains general rules for the guidance of motormen and conductors.

THE SMALL STATION AND ITS ECONOMICAL OPERATION.[1]

BY J. I. WHITTLESEY AND PAUL SPENCER.

The manager of the small plant generally has to be his own designing as well as his own operating engineer. He seldom, if ever, can afford to call in a consulting engineer to guide him in his work. There is undoubtedly a tendency in electrical engineering as in all other matters to follow the prevailing fad, and many small plants throughout the country have, in order to keep in the fashion, adopted complicated and costly improvements entirely unsuited to their conditions.

It should be a cardinal principle in all station design that no piece of apparatus or any appliance should be installed that can not justify itself, not only on the basis of the economy promised by the manufacturer of the appliance, but also on the most conservative basis; full consideration being given to its first cost, its depreciation, the additional labor that its use may entail, and the question of extensive repairs, which can be made in a small plant only with difficulty.

Every additional piece of apparatus in the station is an additional source of possible trouble and cost. It will be found that many of the so-called labor-saving devices and other promised adjuncts to economy are applicable only to stations of comparatively large size and have no place in such stations as this paper is considering.

The simple design is always the safer one to adopt for the manager of a small station. If he will be content with following out the lines suggested in this paper for the design of his plant, he will save himself a great deal of time and useless worry in attempting to decide the question of economy to be obtained from the refinements recommended, and he will certainly not run the risk of making the serious and costly mistakes into which some managers have been drawn.

While it is important that the design of the station should be simple, simplicity of design does not mean lack of design, and it is probably of even more importance in the cost of the small plant than of the large plant that it should be arranged at the start so that it can be developed along definite lines.

Every station manager should forecast for himself the development of his load so that he may have some idea of the conditions it will be necessary for him to meet from year to year in the future. It is an excellent plan to assume some reasonable percentage of growth in order to ascertain what point at the end of a period, say ten years, the expected load on the station may reach, and to draw up some tentative plan, at least, to meet such an estimated load, working backward on the problem to see when the additional apparatus will have to be installed, in order that the capacity may keep pace with the growing load.

With such a more or less definite plan in mind the extensions can be made from year to year in the most economical manner, so far as first cost is required, and with a uniformity in the design and size of apparatus that will help toward efficient operation. Such a definite plan will also enable the station manager to avoid the costly rearrangement of buildings and of apparatus, which have so frequently been necessary in the past and have swelled so much the station's scrap pile.

Assuming that a new station is to be built, certain broad features of the design can be laid down as essential.

First of all, the plant will undoubtedly supply alternating-current service, generating and distributing at 2,300 volts, multiphase, sixty cycles. One class of apparatus only should be installed, and the entire business, whether commercial lighting, street lighting or power, should be supplied at sixty cycles, alternating current.

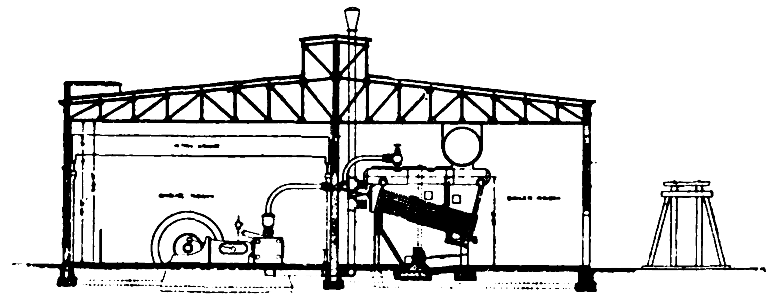


FIG. 1.—SECTIONAL VIEW OF PROPOSED PLANT.

In choosing a site one should be selected that will have railroad facilities and, if possible, a supply for condensing water, as a condensing plant will be desirable when the load has grown to a certain point. The site should be of suitable shape and sufficiently large to provide ample facilities for future extensions.

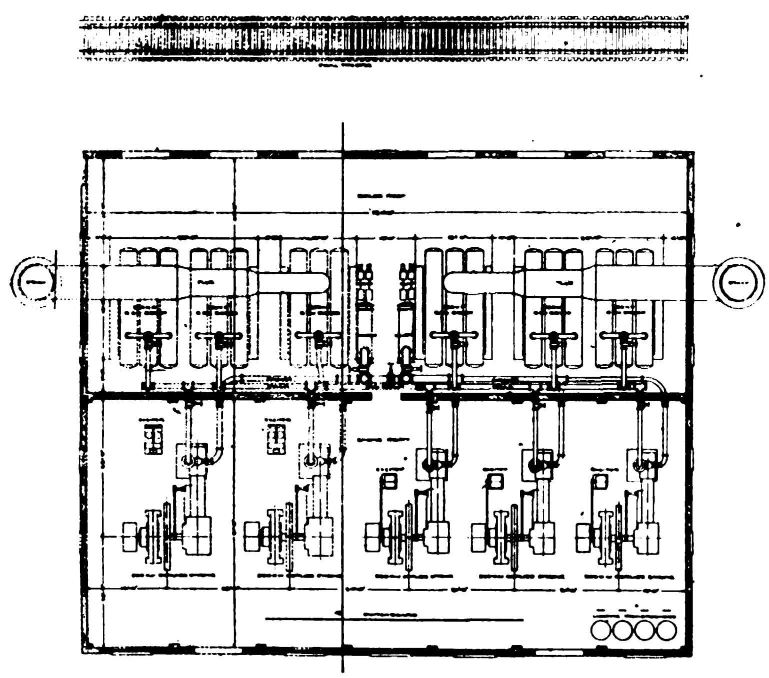


FIG. 2.—PLAN VIEW OF PROPOSED PLANT.

It is also desirable that there should be room on this property for stable or store room, as economy in the entire operation of the company will be gained by having all such buildings located at one point. The site chosen should, if it can be obtained without sacrificing other advantages, be close to the centre of the town. In this way distribution will become simpler and the plant itself and other

[1] Abstract of a paper read before the National Electric Light Association, Chicago, Ill., May 23.

buildings will be more convenient for the employés and more directly under the supervision of the manager.

The design of the engine and boiler room should, of course, provide for indefinite extension. This means a parallel engine and boiler room.

The station itself should be fireproof, with brick walls, concrete floors and steel roof. A crane in the engine room is desirable but not necessary. The gutters and flashings should be of copper, and window frames, doors, hardware and other details should be substantial, so as to keep down the cost of building repairs.

The stack should be of brick, as steel stacks will in every case be found to be the most expensive in the end, both because they require a constant maintenance charge for painting and because sooner or later they must be replaced.

For a small load, say under 1,000 horsepower, we believe that a simple non-condensing station will show the greatest total economy, including not only economy in operation but interest and depreciation on the apparatus installed.

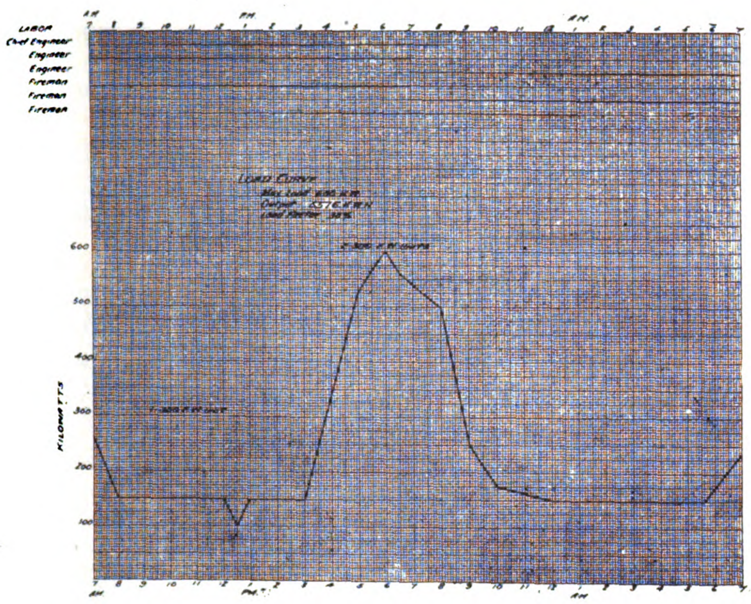


Fig. 3.—Assumed Load Curve for an Average Maximum Day.

Consideration should also be given to the fact that in such a station, with only a small number of men employed, it is impossible to obtain, for the wages paid, very expert men and that, therefore, the best results will be obtained by keeping all the apparatus as simple as possible.

The generating unit should be direct-connected with engines, preferably of the Corliss type, of moderate speed. The boilers may either be fire-tube or water-tube, but should be hand-fired, with no elaborate machinery for handling fuel or ashes. The station auxiliaries should be reduced to a minimum.

The exciters will be belt-driven from the engines, and the only steam auxiliaries will be a feed-water heater and the boiler-feed pumps.

The switchboard design should provide for exciter panels, located in the middle of the board, with sufficient space left for all future extensions. A Tirrill regulator will be found most desirable. Its first cost is low, and in a station where labor is to be reduced to a minimum it will be necessary to have such a voltage regulation if good service is to be given. With the exciter panels located in the middle of the switchboard, the generator panels will extend as may be needed on one end and the feeder panels on the other. All connections from the generators to the switchboard should be carried in cable under the floor, and the outgoing feeders should also be carried under the floor to a wire tower at the corner of the building.

TABLE I.

TABLE OF LOADS AND APPARATUS.

Year.	Maximum Load.	Kw-Hour Output.	Units.	Total Capacity Kilowatts.	Available Capacity[1] Kilowatts.
1908	600	1,320,000	3 300-kw	900	750
1909	660	1,452,000	....	900	750
1910	726	1,597,200	....	900	750
1911	799	1,757,800	1 500-kw	1,400	1,125
1912	879	1,933,800	....	1,400	1,125
1913	967	2,127,400	....	1,400	1,125
1914	1,064	2,340,800	....	1,400	1,125
1915	1,170	2,574,000	....	1,400	1,125
1916	1,287	2,831,400	1 500-kw	1,900	1,750
1917	1,416	3,115,200	....	1,900	1,750
1918	1,558	3,426,700	....	1,900	1,750

Note—Yearly growth, 10 per cent. Output, 2,200 kilowatt-hours per maximum demand.

[1] Available capacity is largest unit down with 25 per cent overload on remaining apparatus.

Fuel should be delivered to the plant on a railroad siding extending the length of the boiler room and parallel to it. If possible a trestle should be installed, so as to provide headroom for dumping the coal from the cars, which can be stored under the trestle and wheeled to the boiler room as needed.

A general plan of the station embodying the above general ideas is shown in Fig. 1 and Fig. 2.

It will be noted upon examination of these drawings that the building suggested is extremely simple in design, and contains no basement, either under engine or boiler room. The steam piping is overhead with the exception of the free exhaust lines from the engines, and the arrangement is such as to give the shortest possible length of connections from boiler to engines.

While an ash hopper and basement under the boilers keeps the boiler room clean and enables more rapid and easier cleaning of fires, it increases the cost of getting out ashes and gives additional space to be kept clean. The additional cost is practically prohibitive.

The solid portion of the drawing indicates the building as it would be constructed for immediate needs: namely, a maximum load of 600 kilowatts, containing three 300-kilowatt units. The future extension to take care of the growth in load for ten years is indicated by dotted lines.

It is assumed that this station is to be built to meet a present maximum load of 600 kilowatts and that this load will be increased at the rate of ten per cent per annum compounded, and that the load-factor will be equivalent to 2,200 hours per year for each kilowatt of the maximum demand. This station can be built at a cost of from $125 to $150 per kilowatt.

Table I shows the growth in maximum load and output, and the station capacity installed to meet this load, for a period of ten years.

It will be noted that the original installation of three 300-kilowatt units would carry the load safely through three years with one unit out of service, at which time a 500-kilowatt would be installed, which would carry it five years; a second 500 would then have to be purchased, which would give an available capacity more than sufficient to carry the load through the remaining three years.

The complete plans of the station, including the dotted portion, show all of these units installed, with necessary boiler capacity. Such a station would have a total capacity, with the largest engine out of service, of 1,750 kilowatts, allowing a twenty-five-per cent overload on the units available for service.

There is also given in Fig. 3 an assumed load-curve for an average maximum day. On this sheet is also shown the capacity of generators running to meet the load, from which it will be seen that the 300-kilowatt unit will be running at only approximately half load during the light portions of the day and night. This would, of course, increase the fuel consumption during these hours over what it might be with a small unit of exactly the necessary size to meet the present load. It is expected, however, that in a very short time the day load would be increased so that the 300-kilowatt unit would be operating under more economical conditions. Should the territory in which the station is operating be of such character that it is impossible to obtain any great amount of day load, it would be desirable, perhaps, to install a somewhat smaller unit than that shown on the plan.

The operation of such a plant would require a minimum of labor and repairs. From experiences with similar plants, a total of six men is amply sufficient, including one chief engineer, two running engineers, two firemen and one fireroom helper. The hours which these men should work are shown in diagram on the load-curve sheet. By lapping the chief engineer and the helper, we should have four men in the plant over the peak of the load.

The overlap covers the afternoon hours, giving the chief engineer the best opportunity to overhaul apparatus and providing him with the necessary help to carry on his minor station repairs.

With the plant as described there will be practically no continuous repair work, with the exception of that required to keep the boilers in first-class condition. There will be but two single-cylinder slow-speed engines and one boiler-feed pump running at a time during the peak, and only one engine and one feed-pump for twenty hours of the day.

As this is a non-condensing plant, the steam pressure will be low, not over 120 pounds, which will make it possible, with a small amount of labor and attention, to keep the piping, valves, packings and so forth, in perfect condition, so that there should be no excuse for their not being maintained always at initial efficiency, even with the limited station force employed. When the engineer of a station is relieved of the care and annoyance ordinarily caused by condensing apparatus, mechanical stokers, forced draft and other complications, his whole attention may be given to maintaining the efficiency of his boilers and engines and seeing that they are operated to the best advantage under the load conditions.

The following particular points are brought up as essential to the economical operation of the station:

In the engine room it will be important for the chief engineer to see that the capacity in apparatus running follows closely the load curve. All units should be run at their highest possible point of efficiency. It is always desirable to run them overloaded rather than underloaded, and the engineer should not be afraid of carrying his units up to their full overload point.

The chief engineer should certainly have an indicator and take frequent cards so that he may know at all times the condition of his valves and cylinders and remedy any defects that may show up.

But it is in the boiler room that the greatest possibility lies of wasting or saving fuel and improving the station economy. No positive rules for firing can be laid down in general, on account of the differences found between fuels, and also on account of the various methods of firing adopted by different men, which if properly carried out may result equally well.

The cutting in and out of boilers and banking of fires must be watched as closely as the running of the engine room to make the boiler capacity meet the loads most economically. With most boilers of good design it is found more economical to overload them twenty-five per cent above builder's rating and in order to carry a short peak to go to fifty per cent or more rather than cut in an additional boiler. The slight falling off in efficiency of a boiler at these high ratings does not consume as much fuel as that required to keep one boiler banked, which can only be used for a few hours a day.

With a non-condensing plant there is no difficulty in getting hot feed-water always above 200 degrees, so that this point will not trouble the engineer.

The combined boiler efficiency, including the grate and heating surface, can be kept up to the highest point only by constant attention to the condition of the boiler setting and the tubes. Draft gauges and thermometers, which cost but little and are very simple to use, will give the engineer exact information with regard to the condition of the boiler and help the firemen to get the best out of the boiler and the coal. A thermometer should be installed on the feed line into the boiler and draft gauges on uptakes and immediately over the fire. A high-reading thermometer for getting flue gases should be used by the engineer occasionally to tell him the temperature of his flue gases, which will be a guide on the efficiency of the boiler. Periodical readings of the draft at different points through the boiler should be made to determine the loss of draft and see if the air leaks are excessive.

One great source of loss of boiler efficiency is the bad condition of boiler setting, cracks around drums and other points in the setting which admit cold air, decreasing the draft and lowering the temperature. Most plants have an excess draft available from the stack, so that even with a very bad condition in this respect ample draft is still obtainable for burning the coal as fast as is required. This results in a continuous loss unknown to the engineer, unless investigation with draft gauge or by torches is made, as suggested.

Every one is perfectly familiar with the necessity of keeping the boiler clean, both inside and out, to maintain its efficiency. The frequency of such cleaning will depend entirely upon the quality of fuel and water used. An increase of ten per cent in boiler efficiency can easily be made, even where conditions are not very bad, by repairing, setting and cleaning boilers.

An automatic damper regulator is essential, especially in a small plant where natural draft is used.

It is hardly practicable in a small plant for the engineer to make elaborate tests, flue-gas analyses, engine-efficiency or evaporation tests, but the total running results of the plant can be kept very accurately by a proper method of records, and it is very essential for the chief himself to keep such records or station log. He is not responsible for two factors greatly affecting his cost: namely, the nature of the load on the plant and the fuel furnished him. He can, however, by keeping accurate records, furnish the management with the information necessary for them to determine whether or not the fuel purchased is the best for the price and how the cost of production can be decreased by improving the load-factor. No scientific test is as good as a comparative run of several months under similar conditions.

In many plants of this size the output and the shape of the load curve are very similar from day to day and from month to month, so that, by obtaining the amount of coal burned and the output, a very accurate comparison can be made with different fuels, methods of firing and handling of the units.

It is essential, then, for the economical operation of a small plant that integrating wattmeters be installed on each generator and the daily output kept on the log sheet. The indicating instruments should also be read at sufficiently frequent intervals to enable a daily load curve to be plotted. Every pound of coal and ash should be weighed and the record turned in for each shift or period of load.

The engineer will have his pay-rolls and bills for material, so that with a very small amount of bookkeeping he can get the actual cost of labor, fuel, oil and waste, repairs to buildings, repairs to engines, repairs to boilers and repairs to electrical apparatus.

It is hardly possible in such a plant to subdivide the labor, as the ordinary repair work and maintenance of apparatus is done by the regular station help, part of whose time is also put into operating. Any extraordinary repairs requiring outside help or machine work will be entered up separately.

The engineer of the plant should not hesitate to try experiments in operating, provided, of course, the service is not endangered; such as different hours of cutting in and out boilers, overloading and underloading boilers, cutting engines in and out on the load at different hours. But these experiments will be of no value unless they follow out a definite programme to its final results and unless records are kept accurately and analyzed intelligently to compare the results obtained. Conclusions are often jumped at in station operating which at sight seem apparently correct but upon analysis prove to be entirely wrong. Good records and a careful analysis are the only proofs that can be accepted.

In taking hold of an old plant which is not operating at good efficiency it is difficult sometimes to locate the trouble and correct it. It is, of course, necessary to first secure accurate records as already described. This, however, will only show the total pounds of coal per kilowatt-hour and will not tell where the losses are.

The easiest point to be attacked first is the engine economy, which can be very readily brought up to its highest possible point with the engines in use. The records will then show if any gain in efficiency has been made.

After having brought the engines up to their best efficiency for the type, the boilers should then be carefully inspected and cleaned up. Boilers that have been neglected will require heavy expenditures to bring them up to a good standard of efficiency. This, however, must be done if the manager is determined to get good results from his plant in the end. No patching or partial cleaning of a boiler should be made unless it is absolutely necessary at the time to keep them in operative condition. Thorough repairs only will pay, but they will pay well in fuel saved, as the records will show if they are properly kept.

The operating costs of such a plant are given in Table II. The figures are conservative for a new plant, well built along the design suggested, and have been bettered in actual experience. Two columns of cost are given: First for a station having a load of 600 kilowatts and an output of 1,320,000 kilowatt-hours per year, and the other for the same station with twice the output and additional capacity necessary.

The figures for labor and fuel will vary considerably in different localities and under different conditions of the labor and fuel markets.

TABLE II.

OPERATING COST.

	Present Output.		Double Output.	
Item.	Amount.	Per Kw-Hour.	Amount.	Per Kw-Hour.
Superintendent	$1,000	0.0757 cent	$1,000	0.0379 cent
Labor	5,040	0.3819 "	6,480	0.2454 "
Fuel	9,723	0.7366 "	19,446	0.7366 "
Water	634	0.0480 "	1,268	0.0480 "
Oil and waste	600	0.0454 "	800	0.0303 "
Miscellaneous supplies and expense	500	0.0378 "	600	0.0227 "
Repairs, buildings	100	0.0076 "	100	0.0038 "
Repairs, steam	700	0.0530 "	1,000	0.0379 "
Repairs, electrical	75	0.0057 "	100	0.0038 "
Total	$18,372	1.3917 cents	$30,794	1.1664 cents

NOTES—Coal based upon Pennsylvania bituminous at $3.00 per ton, 5.5 pounds per kilowatt-hour.

Water based upon cost at 10 cents per thousand gallons, 40 pounds per kilowatt-hour.

Superintendent's salary at $3,000, one-third charged to production.

Labor: Chief engineer at $1,200 per year.
Two engineers at $900 per year.
Two firemen at $720 per year.
One helper at $600 per year.

Electrical Action of Sodium.

Some additional information is given by C. E. S. Phillips in *Nature* (London), for June 11, regarding the power of sodium to dissipate electrical charges. This was referred to in the ELECTRICAL REVIEW for June 20. He now thinks that the greater or less effect due to different portions of the same rod was caused merely by inequalities in the temperature of the sections examined. By lowering the temperature so as to reduce the oxidation of the surface, a more complete diselectrification was produced. This result seemed at first sight to point to a cause other than chemical action. A slight current of air and even a soap film were sufficient to stop the discharging effect, also supporting the view that an electrified gas was emanating from the metal. A bright surface of potassium gave no appreciable discharging effect when cooled with a mixture of ice and salt. In all cases the surfaces could be seen in the dark to be glowing strongly. Further experiment has shown that no active gas can be driven from sodium by heat, and that the true explanation of the action lies in the positive electrification of the air surrounding the freshly cut surface. With warm sodium it is seen that the gold-leaf falls rapidly for a very short distance, while after cooling the action is more prolonged. It is clear, therefore, that the action in the first case, although violent, is so transient, owing to the whole surface being rapidly oxidized, as to appear of small amount. A far larger discharging action was obtained with reduced oxidation owing to the effect being more prolonged.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

An Electrical Pendulum Without Mechanical Connections.

The precise measure of time is a problem presenting a number of difficulties, since the oscillation of a pendulum is affected by temperature variations, barometric changes, variations in the friction of the escapement, and changes in the viscosity of the oil used for lubricating the movement. It has been estimated that fifty per cent of the driving power is lost in friction of the movement, and the latter is affected greatly by atmospheric conditions. When electrical or magnetic means are employed for driving the pendulum, instead of gearing, irregularities in the contact device may affect the swinging of the pendulum. To avoid all of these disturbing actions a pendulum has been designed by C. Fery in which an impulse is imparted to the pendulum without it being necessary for the latter to come into contact with any other body. For this purpose a horseshoe magnet is attached to the lower part of the pendulum, one end of which, as the pendulum swings, enters a small solenoid which gives it the required impulse to keep a swing of constant amplitude. The use of a horseshoe magnet is advantageous, as it renders the pendulum astatic and makes the magnet more permanent and more effective. The current flowing through the small coil is made and reversed by means of two contacts attached to a supplemental pendulum having the same period as the master pendulum and kept in oscillation by means of a copper ring at its lower extremity into which one end of the horseshoe magnet enters at one end of the swing. The eddy currents thus set up in this ring first move it along with the magnet in one direction, closing the circuit through the actuating coil, so as to give the master pendulum a pull. When the latter reaches the end of its swing and starts back, it drags the supplementary pendulum with it, due to the eddy currents set up, reversing the current through the driving solenoid and thus imparting a push to the master pendulum. In this way there is no mechanical contact and all the influence exerted upon the pendulum can be brought under perfect control. The entire apparatus may be enclosed within a sealed case protected from atmospheric changes and maintained at a constant temperature. This is made easier by the fact that the pendulum may be started from a distance by passing a current through the driving coil.—*Translated and abstracted from L'Industrie Électrique (Paris), June 10.*

Electric Iron and Steel Furnaces.

In this concluding section of a study of electric iron and steel furnaces some of the latest induction furnaces constructed are described. The Kjellin furnace of the latest type has a magnetic core with three legs—two outside the circular annular crucible and one within. Furnaces of this type, with capacities of eight tons, are now being built. With the bulk of the charge the ohmic resistance decreases, while the self-induction increases, thus reducing the power-factor. To compensate for this the frequency of the current may be lowered. A 750-kilowatt furnace being constructed for the Volklingen works is to be fed with currents at 5,000 volts, five cycles, per second. The core length is eight and one-quarter feet in this case. Such low frequencies are not desirable, as they necessitate special generators. The Electro Metal Company, of Ludvika, Sweden, improves the power-factor by raising the bath resistance, which is accomplished by means of a bifilar trough, which follows the outlines of a figure U in a closed curve. A furnace for 5,000 volts, at fifteen cycles a second, is being installed in the Volklingen works, where the five-cycle furnace is in use. In the new furnace the trough is elliptic, having the general shape of the figure eight with the central bridge much broader than the outer limbs. Both cores of the transformer are thus surrounded by the trough, while the bridge portion affords a spacious hearth. The transformer primary is cooled by filtered air, and a secondary of a few turns, also air-cooled, is placed about each primary. The currents from the two secondaries are led to electrodes placed so that the circuit is completed through the bridge portion of the hearth, thus bringing the current density at that point up to what it is in the narrower sections. The greater part of the heating is, however, by means of induced currents. The whole furnace has a semi-cylindrical bottom to enable it to be rocked for pouring purposes. In lining the furnace hoops of iron are set in, which are utilized for heating and drying out the lining. In use this furnace is never completely emptied, about 1,600 pounds of steel being left in the hearth to keep it hot. A complete heat lasts from two to three hours. The power-factor of the furnace is said to be 0.87. The thermal efficiency is from fifty to eighty per cent. The furnace operates steadily, and the temperature is easily controlled by varying the applied voltage. Another type of induction furnace has been constructed by Schneider & Company, of Creusot, France, in which the desired high resistance of the bath is secured by contracting the hearth in two parts. This furnace consists of two chambers connected by L-shaped channels having relatively small cross-sections, each of which is spanned by a transformer core. The furnace is charged in the larger of the two chambers, about 1,000 pounds of molten iron being poured in first to act as conductor. It is mounted on three pedestals, two of which may be raised and lowered to cause the metal to flow through the channels. Usually, however, the difference in temperature is sufficient to maintain the circulation. In this furnace about three tons of steel can be refined in twenty-four hours, about 1,600 pounds being drawn off after each treatment. From 800 to 900 kilowatt-hours are said to be necessary to refine one ton of steel, and the efficiency is estimated at fifty-five per cent. If liquid charges were used entirely, the output of the furnace would be increased to fifteen tons. Although in the pure induction furnaces there is not supposed to be any electrolytic action, purification being due entirely to chemical action brought about by heat, the manner in which phosphorus and sulphur are removed suggests that the alternating current must have some additional action.—*Abstracted from Engineering (London), June 12.*

The Cadmium Cell at a Low Temperature.

Although a great deal of research work has been carried out on the cadmium cell, it is surprising, says Henry Tinsley, that more attention has not been given to its behavior with varying temperature, especially at low temperatures. A cold snap in last April enabled him to carry out some experiments on a batch of cadmium cells which he had made up according to the London National Physical Laboratory's specification. On completion these were found to be correct within three or four parts in 100,000 when compared with a standard cell which had been checked. During the cold spell the temperature of the room in which these cells had been placed fell as low as three degrees centigrade, when it was found that the cells of the batch showed a difference of 190 parts in 100,000 as compared with the standard, and were thus near two millivolts off. All of the cells showed good agreement among themselves. It was not thought that this variation was due to careless manipulation, otherwise greater variation among the thirty-six cells of the batch would have been expected, while this was found to be only ten parts in 100,000. A typical cell was taken from this batch and observations made upon it as the temperature of the room changed, readings being taken every half hour, and the test cell with a checked standard being placed in an oil bath. The lowest temperature observed was 3.2 degrees centigrade. As the temperature rose from this, the master cell showed a uniform decrease in potential from about 1.0199 volts at 3.2 degrees to 1.0192 at twenty-two degrees. The new cell taken from the batch, however, showed a potential of only 1.0181 at 3.2 degrees and the electromotive force rose rapidly with the temperature, being about 1.0195 at ten degrees, and crossed the check-cell curve at twelve degrees, the electromotive force then being 1.0196. The curve then turned over, reaching its maximum value at fifteen degrees, when the potential was 1.0197. At seventeen degrees the curve had become parallel to the check-cell curve and from there on apparently was a straight line, about 0.0002 volt above the line for the latter cell. From this curve it is seen that below fifteen degrees the test cell had a positive temperature coefficient and above this the coefficient had the normal sign. It seems evident from this that this change in the temperature coefficient can hardly be due to chemical effect, as there is no such alteration in the solubility of the cadmium-sulphate solution. Some other explanation must be sought. The new cells had been constructed with cadmium amalgam containing twelve and one-half per cent of cadmium. The amalgam in the check cell contained but ten per cent of cadmium, and it was noticed that the latter remained bright and liquid throughout the experiments, while the twelve and a half per cent amalgam apparently became solid and the surface took on a frosty or crystalline appearance. Above fifteen degrees the latter again appeared to be fluid and the surface was bright. Early experiments with the new cells showed that above fourteen degrees centigrade they are in excellent agreement with the master cell, not varying more than two or three parts in 100,000 from their mean. Mr. Tinsley suggests that this investigation seems to indicate, although it has not yet been proved, that the twelve and one-half per cent cadmium amalgam becomes solid at temperatures below about ten degrees centigrade, and thus departs from its two-phase system of cadmium and mercury. It is probable that a similar curve would be obtained for the ten per cent amalgam cell if the temperature were carried low enough. The twelve and one-half per cent amalgam cell is in favor in Germany, although F. E. Smith, of the National Physical Laboratory, has pointed out the necessity of paying attention to the percentage of the amount of cadmium used in preparing the amalgam.—*Abstracted from the Electrician (London), June 12.*

Electricity or Gas?—The Problem of the Small Consumer.

Many years ago electricity was known popularly in England as "the poor man's light," but progress in gas lighting brought this expression into disuse. Now the development of high-efficiency incandescent lamps has turned the tables so that electricity should be able to live up to its former title. This is the view taken by J. D. McKenzie, who analyzes the problem presented in the supplying of electricity to the small consumer. When electric lighting was but little used the supply company could pick and choose its clients, and it generally completely ignored the small consumer. This policy can not be followed to-day. The electricity supply company must find some means of supplying light to the small home if it is to extend its field. In all large cities, and in many small ones, there are tens of thousands of homes requiring a maximum installation of from three to ten lamps, with a maximum demand of from one to five lamps at a time. Although the individual consumption may be very small, the aggregate would make a wide difference in the output of the central station. These small consumers are to a great extent grouped together closely, so that the supplying of them is a comparatively easy matter. The objections to the use of electricity by the small consumer are: First, the high cost of installation, and, second, the cost of using the supply. In other words, it is said that electrical apparatus is too expensive to install and the price for electrical energy is prohibitive. The author does not accept this view, for although the present price of metallic filaments is high, they are fragile, the price must come down, and improvements will surely be made mechanically. These objections, however, do not obtain for low-voltage supply, and hence need not be considered in the plan which he suggests. Regarding the cost of installation, it is cheaper to run a gas pipe than to lay underground cables meeting all the requirements of the Board of Trade; but many of these rules are unnecessary and there is no reason why a simpler method should not be adopted in which some relaxation of rules and regulations could be secured. Although it may be cheaper to lay gas pipe than underground cables, this should not deter the electric company from putting in its wires if it can see a profit in so doing; and if an overhead distributing system be provided for groups of houses, the electrical connection will probably be cheaper than the gas pipes. Moreover, in the majority of cases, the supply cables are actually passing the poor men's houses, many times merely to supply a light, short load. In such cases a short run of cable would be all that is necessary. Another item in the cost of installation is that of the meter. The average meter in use to-day is too expensive for this purpose. What is needed is one costing about $5 for a five-ampere load. The cost of electrical energy is then considered. This is found to be 5.2 cents per kilowatt-hour delivered to the consumer, not including any profit. This could probably be sold at six cents a kilowatt-hour and pay well. The cost of electric service is compared with that of gas, and the author says that from recent figures which he has obtained the cost for similar periods and identical conditions was 71 to 100 in favor of electric lighting where the price of energy was six cents a kilowatt-hour and that of gas sixty-six cents a thousand cubic feet. At this ratio electricity might be sold for ten cents a kilowatt-hour, which would be equivalent to gas at seventy-eight cents a thousand feet. The scheme of distribution proposed is to use a working potential of 200 volts alternating and to install a balancing autotransformer for each group of eight houses. From each branch of the transformer a supply is taken off to each house, giving twenty-five volts there. For a low-potential system of this kind elaborate precautions for the safety of the users are not necessary, and a much cheaper and simpler method of utilization may be adopted.—*Abstracted from the Electrical Review (London), June 12.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Westinghouse New Model Roney Mechanical Stoker.

One of the problems most prominently befôre engineers at the present time is that of obtaining large evaporative capacity with sustained efficiency and smokeless operation. This subject came up before the Smoke Convention held in Cleveland last week.

Owing to the extreme difficulty of getting firemen to stoke in the manner required to secure the desired results, it has been quite generally agreed upon by engineers that the mechanical stoker furnishes the simplest and the cheapest means of maintaining the conditions necessary for smokeless combustion, especially of long-flaming bituminous fuels. These conditions are especially difficult to realize, except by mechanical means, under the heavy demands encountered in the modern boiler plant—which often require steaming rates of fifty to 100 per cent above rating for long periods. The essential requirements for perfect smokeless combustion are:

(1) That the fuel be fed continuously to the furnace in small quantities in order that the volatile gases may be driven off at a uniform rate.

(2) That these volatile gases shall be mixed with sufficient air and maintained at a high temperature.

(3) A sufficient distance must be provided between the fuel bed and the heating surface of the boiler in order that the volatile gases will have time to be completely consumed before being chilled by contact with the comparatively cool surfaces of the boiler.

(4) A suitable grate with liberal air passages for consuming the fixed carbon remaining after the coking process.

(5) Some means of continuously agitating the fuel so as to bring all the particles of carbon into intimate contact with the air supply.

(6) From a mechanical standpoint the grate bar should have a large ratio of cooling to heating surface to permit higher rates of combustion, at the same time insuring a long life.

In addition to the above, to permit high rates of combustion with moderate draft pressures, the following are also necessary:

(7) An automatic means of agitating and advancing the fuel bed at the proper rate of combustion to suit the load carried.

(8) Adjustable area for admission of air through the grate, increasing with the rate of combustion, so as to avoid excessive pressure drop through the grates and the fuel bed.

These conditions have been carefully considered in the design of the improved stoker herein described, and the improvements embodied therein represent the gradual development from experience gained in the equipment of over a million and a quarter horse-power in boiler capacity. The following is a summary of the most important features of the New Model stoker later discussed in detail.

FEATURES OF WESTINGHOUSE NEW MODEL MECHANICAL STOKER.

(1) Number of complete grate bars reduced one-half.

(2) Interchangeable parts (tops, webs, guards and dumping grates).

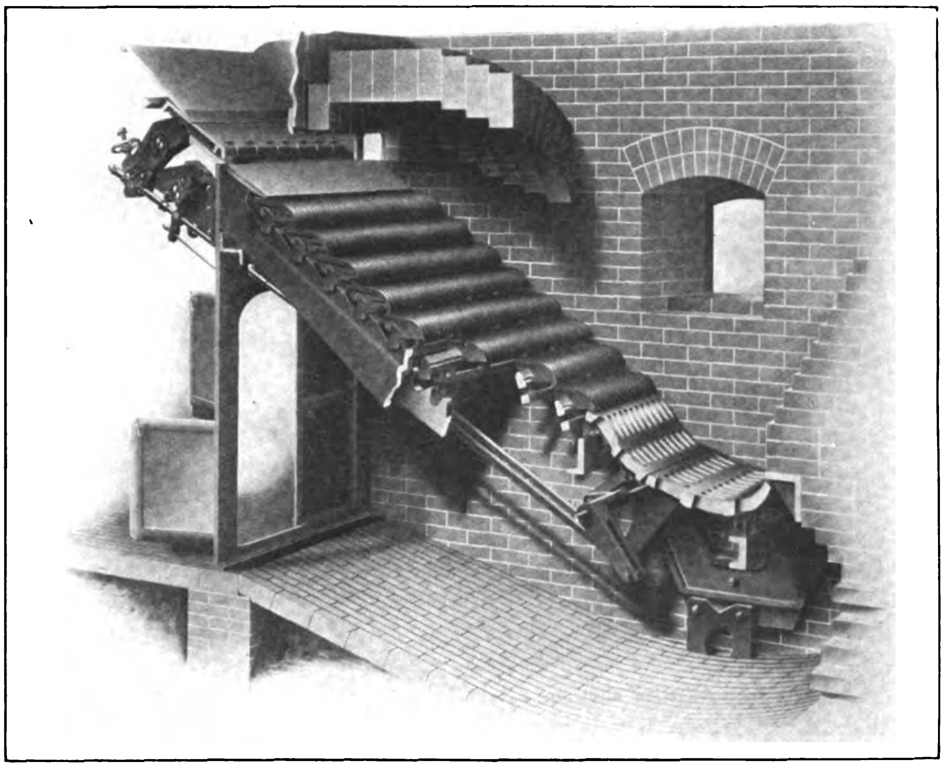
(3) Grate bars automatically centre themselves in side bearers by their own weight.

(4) No lost motion in grate movement due to wear, as grates return to inclined position by their own weight.

(5) Cooling surface of grate-bar tops 7.4 times the heating surface.

(6) Low cost of repairs, owing to small number of moving parts and long life of tops.

(7) Redistribution of grate-bar tops possible so as to equalize wear over all parts of the furnace.



SECTIONAL VIEW OF NEW MODEL WESTINGHOUSE RONEY MECHANICAL STOKER.

(8) No threaded bolts inside of furnace.

(9) Non-sifting tops provided for first four rows of upper grates.

(10) Guards and dumping grates interchangeable without disturbing side or centre bearers.

(11) Improved leverage for operating guard and dumping grate, minimizing labor of handling.

(12) Thrust of connecting rod on rocker arm, direct—not sidewise—thus avoiding twisting forces.

(13) One hand adjustment for both grate movements.

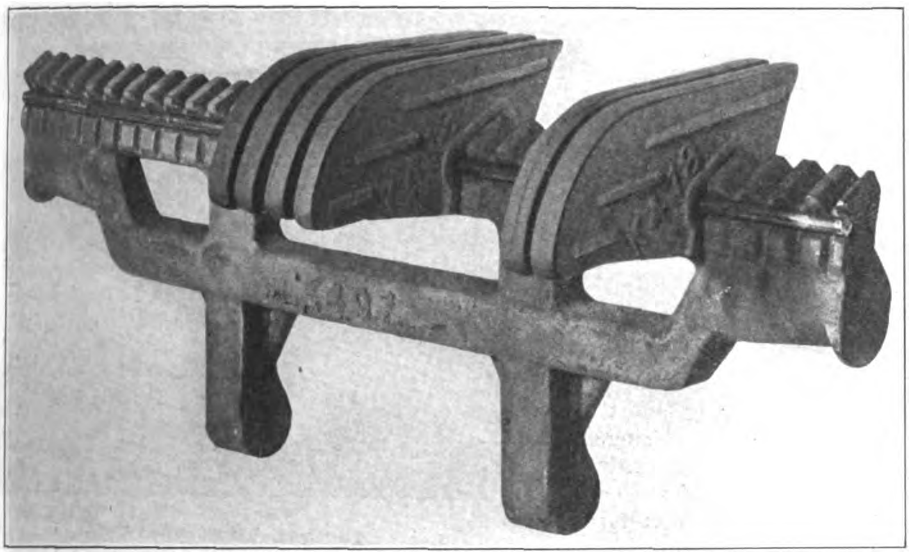
(14) Stop provided on each connecting rod to hold grates open for dislodging clinker.

(15) Improved air distribution over

arch, which cools the arch and heats the incoming air, thus preventing smoke.

(16) Baffles over arch direct air supply so as to obtain uniform air distribution over fire.

(17) Constant draft area through grate-bar tops practically two-thirds of total draft area.

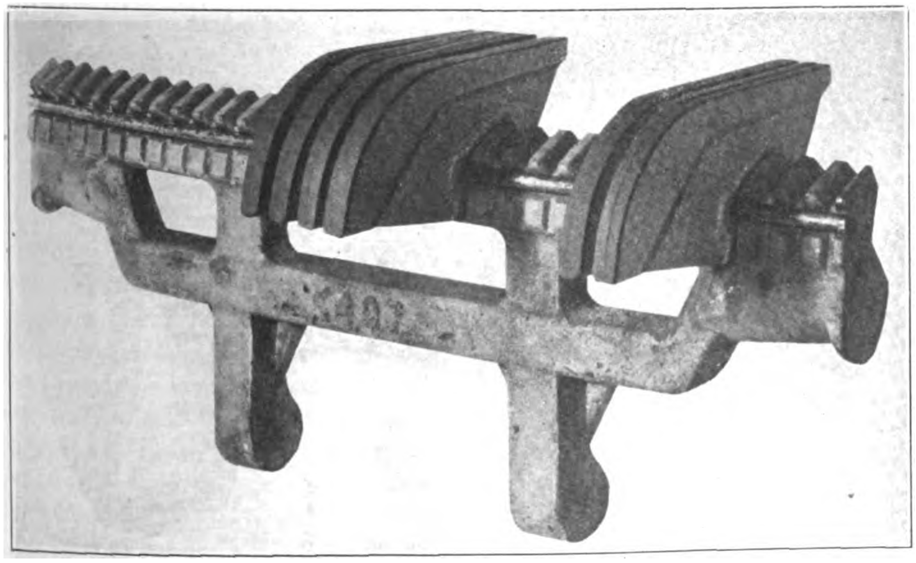


Upper Grate Bars, New Model Westinghouse Roney Mechanical Stoker.

(18) Moderate fluctuation in draft between limiting movements of grate bars.

GENERAL DESCRIPTION.

Reviewing briefly the general type, it will be seen that the coal is fed into a hopper extending across the boiler front, usually by gravity from an overhead bin. From this hopper the fuel is automatically



Lower Grate Bars, New Model Westinghouse Roney Mechanical Stoker.

supplied to the furnace by a reciprocating pusher operated from the rock shaft by an eccentric. The fuel descends through the throat of the arch on to the upper grate bars, where it is subjected to an intense heat radiated from the incandescent fire-brick arch spanning the upper portion of the furnace. This entirely cokes the fuel and drives off all the volatile gases, leaving the coke, or fixed carbon, which is then gradually worked down the inclined surface by the rocking motion of the grate bars, imparted to them from the eccentric on the rock shaft.

The oscillation of the grate bars not only works the fuel slowly down the furnace, but also keeps it constantly agitated, thus preventing to a large extent the formation of clinker, and bringing the fuel into intimate contact with the incoming air. After the solid combustibles have been totally consumed the remaining ash is discharged on to the dumping grate at the bottom of the furnace. The operations necessary to clean the fire are very simple. First the guard is raised to a position which prevents the fuel bed from sliding. Next, the dumping grate is dropped, permitting the ashes to fall into the ash pit.

From the foregoing brief description it will be evident that all the essential conditions necessary for high rates of combustion and smokeless operation have been fully realized, *viz.:*

(1) Fuel is fed to the furnace at a uniform rate, depending upon the load.

(2) Fuel is coked in the presence of a preheated air supply.

(3) Combustible is brought into intimate contact with the required quantity of air for complete combustion.

SECTIONAL GRATE BARS.

One of the most important features of the New Model Roney stoker is the sectional grate bar, or fire top, illustrated herewith. For the upper four grates a non-sifting type top is used, provided with abutting horizontal ledges to prevent the fine fuel from sifting through the bars and at the same time permit a free entrance of the air. As only the thin edge of the fire top is exposed to the direct heat of the fire, while both sides and the bottom edge are cooled by the incoming air, it is evident that these tops are well protected from overheating, thus insuring long life. As previously mentioned, for each square foot exposed to the fire, 7.4 square feet of surface is cooled by the air, giving 7.4 times the cooling effect of the flat-top grate bar.

As will be seen from the illustration, the grate proper consists of a number of thin plates set on edge in V-grooves. These hook over a trussed web and are held in place by a key-rod slipped in from the end. They are, therefore, easily removed. The webs have conical bearing surfaces at the end, which makes them self-centering in the side bearers and prevents any uneven wear. By lifting the webs out of the bearers and removing the key-rods, the tops may be redistributed if desired, so as to equalize the wear in various parts of the furnace.

Eight samples selected from different parts of the furnace below the arch line after seven months' wear showed a maximum and annual depreciation of about sixty-six per cent, indicating a minimum life of one and a half years.

An average annual depreciation of about seventeen per cent was shown by these eight samples, indicating a probable life of about six years if the bars are redistributed from time to time. In the upper part of the furnace, however, the wear was practically *nil.* It should be noted that the boiler from which the samples were taken was subjected to unusually severe conditions, having been operated above rating practically continuously and at times forced to 100 per cent above its rated capacity.

One of the principal advantages of the sectional grate-bar tops is that it reduces the amount of scrap when they have been sufficiently worn to be discarded. In this stoker, all internal parts are made interchangeable. No bolts are used and any part can be removed without disturbing the other.

GUARDS AND DUMPING GRATES.

The new type of guard prevents the fire from sliding into the ash pit when the dumping grate is operated. As the lower end of the guard is now raised, instead of cutting through the fire, as formerly, it not only makes it possible to dislodge from the fire all clinker formed at the bottom, but also provides an unobstructed descent for the ash and clinker separately. When dropped to its normal position it permits the lower edge of the fire to settle quietly without tendency to slide.

The new dumping grate is hinged about one-third forward, dumping both front and rear. Being nearly balanced, it is very easily operated. The upward motion of the dumping grate breaks up any clinker bridge tending to form between the grates and bridge wall. Both the dumping guard and grates rest in U-shaped trunions in the side bearers, the guard being simply hooked over the bearing rods. The latter can, therefore, be easily removed without dismantling any portion of the stoker.

ROCKER MOTION.

The rocking motion is transmitted to the grate bars by means of a connecting rod from the eccentric "agitator." As the grate-bar tops are unbalanced, they return to the inclined position by their own weight, and, therefore, only one feed adjustment is necessary, made by the sheath nut on the end of the connecting rod. As motion has to be transmitted to the connecting rod in one direction only by the agitator, a simple-looking device, or dog, is used for holding the grates open to permit rapid trimming of the fires.

AIR DISTRIBUTION.

As previously outlined, the most essential requirements for smokeless combustion are a gradual coking of the green fuel and an adequate supply of preheated air admitted above the coking bed. These conditions have received special attention in the design of the New Model Roney stoker. The air supply to effect the combustion of volatile hydrocarbons is admitted through two windgates located on either side of the stoker. It first passes to the rear of the fire-brick arch, extending across the front of the furnace, and is then directed by baffles to the crown of the arch, at which point it enters the front air spaces. From the latter it enters the furnace through the spaces between the stoker front and the first ring of arch brick. Passing the air over the furnace in this manner not only preheats the air, but assists materially in cooling the arch.

The fire-brick arch is of such extent and so designed that it completely cokes the green fuel and directs the gases downward over the hottest part of the fire, therefore permitting the volatile gases to be completely consumed before coming in contact with any of the boiler heating surfaces.

COMBUSTION.

With the grates open maximum width the effective admission area of the entire grate is 36.8 per cent of the project area of the furnace. At maximum opening—*i. e.*, in their lower position—the effective opening is 24.3; taking actual time of opening and closing, the average effective draft area of this type of stoker is 27.4 per cent of the total projected area, as compared with an average of 17.9 per cent with flat horizontal fire tops. This increased admission area makes it possible to maintain a higher rate of combustion. This has been very effectively brought out by a series of capacity tests conducted upon a 475-horse-power Babcock & Wilcox stoker-fired boiler at East Pittsburg. During these tests an output of over double rating, 224.7 per cent, was maintained for six hours, with but 0.42 inch furnace draft. This corresponds to a rate of combustion of forty-eight pounds per square foot per hour, with a very reasonable over-all efficiency of 63.5 per cent at this load. A test of twenty-five per cent above rating was maintained for six hours with 0.18 inch draft, with seventy-four per cent efficiency and twenty-three pounds of coal per square foot of grate per hour. The fact that the boiler and grate passed through this severe test without damage, while the brick setting was melted down, illustrates the effectiveness of the improved air distribution throughout the grates, and also the fact that a somewhat higher rate of combustion may be normally maintained with the same efficiency. In other words, a higher output per boiler unit.

APPLICATION.

The Westinghouse New Model Roney stoker has been adopted in about fifty plants for lighting, railway, railroad and industrial service, with such good results that many equipped with the older type are voluntarily changing over to the new. The extent of application of this new type requires but brief reference. Suffice it to say that its labor-saving ability has been appreciated to such an extent that in New York, for example, some of the large power stations are now being equipped with them.

A Novel and Improved Indicator Reducing Motion.

A new and novel improved indicator reducing motion, on which patent has been lately applied for by F. H. and F. O. Ball, of the American Engine Company, Bound Brook, N. J., is seen for the first time as one of many novel details of the new American-Ball "Angle Compound" engine. It may be stated in the beginning,

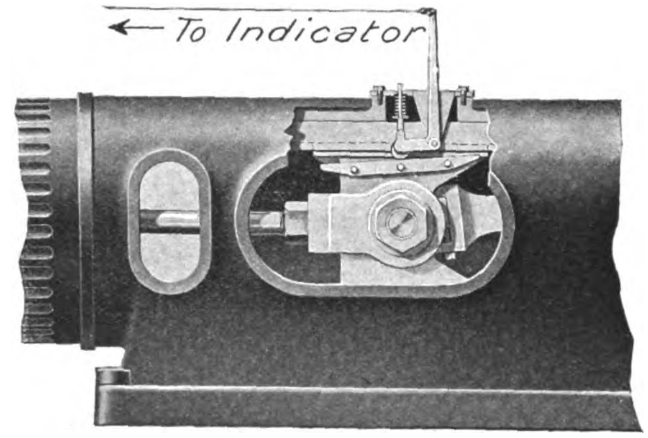


FIG. 1.—INDICATOR ATTACHED TO ENGINE.

however, that there exists no physical reason why this indicator rig should not be applied to other engines, inasmuch as its design and construction involve no features which should forbid its use on Corliss type engines, or any other type of reciprocating engine.

The illustration, Fig. 1, A and B, shows the elevation and end view of the complete rig in connection with the cross-

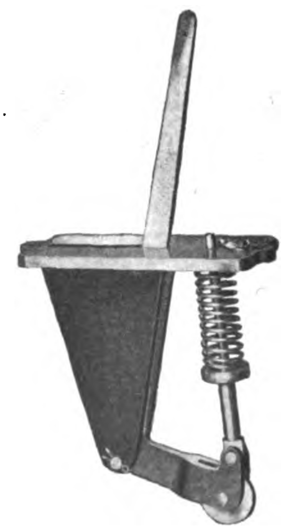


FIG. 2.—TRANSLATING LEVER.

head. It will be seen that the device consists essentially in a slotted plate through which moves an L-shaped lever. At the elbow this lever is pivoted through a bolt, at the apex of a triangular slotted plate cast as one with the outer plate of the device, and at right angles to it. The short arm of the L-shaped lever is forked. In the fork is set, by means of a pin, a small wheel or roller. Also connected with this arm is a pin which works through and at right angles to the outer plate. A helical spring, pressing against the outer plate and a disc resting on the shoulder of the pin, constantly tends to maintain the L arm at the extreme end of the slot. The device is fastened by bolts to the frame of the engine.

On the cross-head is secured, by means of bolts, a cast-iron cam plate or slide set at an angle in the vertical plane with the lower end directed away from the cylinder and at such an angle that the lower or front end is in the neighborhood of two inches below the rear end. The angle of this cam plate is determined by the length of the stroke of the engine, so that the same difference in height between the front and rear ends of the plate will be preserved in all cases. It will be seen that when the cross-head is in position nearest the cylinder the lower end of the cam plate or slide attached to the cross-head is in contact with the wheel or roller at the lower end of the L arm, and as the cross-head travels forward this wheel or roller with its arm is raised in exact proportion to the piston travel against the pressure of the spring; the reverse taking place as the cross-head returns. The strength of the coiled spring is sufficient to prevent any lost motion with this device, even in a high-speed engine. It will furthermore appear that the adjustment of the cam plate can always be so arranged that the travel of the upper end of the L arm is exactly that desired to turn the indicator cylinder the required distance without further reduction.

Referring to Fig. 2, it will be seen that on top of the exterior plate is a small flat trigger or lock which engages with a slot milled into the spindle or pin working in and out through the plate. Thus when the pin is pushed to its extreme top position, the trigger can be slipped into the slot and the rig instantly thrown out of engagement. It is but the work of an instant to release the trigger and to throw the indicator rig into service.

As far as the exterior appearance of this rig is concerned, the only visible portion is a highly polished oblong metal plate on the engine frame with a slot through which projects a six or seven-inch lever with a hole in the top. The indicator cord may be kept constantly attached to the lever and cards taken continually, if so desired, on the rig thrown in and out of service as many times as desired by the simple turn of a wrist.

A New Ward Leonard Battery-Charging Rheostat.

Based upon a clear understanding of the work of a battery-charging rheostat and the requirements of an apparatus for this service, the Ward Leonard Electric Company, Bronxville, N. Y., has made a new departure in storage-battery rheostat design. A given minimum number of cells has a fixed minimum voltage, which in charging are opposed to the line-charging

FIG. 1.—TYPE MC BATTERY-CHARGING RHEOSTAT.

volts; the difference between the battery volts and the line-charging volts is the maximum volts applied to the rheostat. In the Ward Leonard MC type rheostat, illustrated herewith, there are several switches in parallel, each switch controlling its respective resistance. Each resistance is designed to carry the maximum amperes that can be made to pass by the maximum volts that can be applied as stated above. To secure any charging amperes within the rating of the rheostat it is merely necessary to close the proper switches. There are five switches giving thirty-one steps of control. Each switch is marked with the approximate amperes that will pass when it is closed

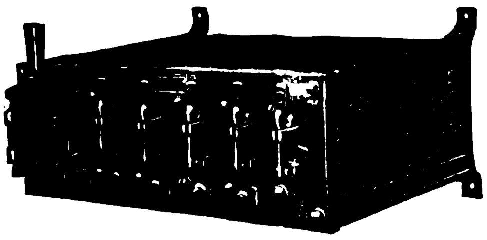


FIG. 2.—TYPE MC RHEOSTAT WITH LINE SWITCH AND FUSES.

and all the other switches are open. By reading the switch markings the approximate charging amperes are gotten at a glance. It is impossible to cause an overload through the circuit, the cells being thoroughly protected from abuse.

The resistance elements are the standard Ward Leonard enameled resistance units. They are fireproof, strong and light, and are protected against chemical, electrical and mechanical depreciation. Any rheostat of the MC type, designed for a minimum number of cells, can be used to charge a greater number of cells but at a slightly decreased charging rate.

Twelve is the minimum number of cells used in electric carriages. Therefore the minimum battery volts are approximately twenty-four. Twenty-four volts opposed to a 120-volt line circuit leaves ninety-six volts to be used up in the rheostat. For pleasure carriages forty amperes are the maximum charging amperes. An MC rheostat as described, for twelve cells and forty amperes charging rate, has each switch and its resistance designed to be connected across ninety-six volts, and when all the switches are closed forty amperes will pass through

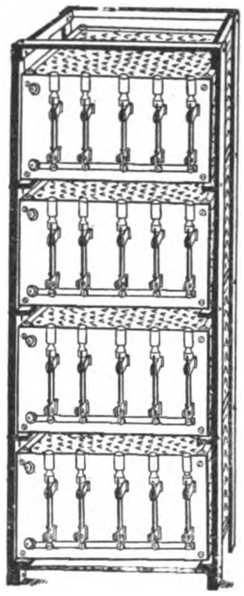


FIG. 3.—BANK OF TYPE MC SWITCHES FOR GARAGE SERVICE.

the circuit. Such a rheostat can be used to charge the following number of cells at the following charging rates:

With 12 cells in circuit a maximum charging rate of 40 amperes is obtained.
With 24 cells in circuit a maximum charging rate of 38 amperes is obtained.
With 30 cells in circuit a maximum charging rate of 28 amperes is obtained.
With 36 cells in circuit a maximum charging rate of 22 amperes is obtained.
With 40 cells in circuit a maximum charging rate of 18 amperes is obtained.
With 44 cells in circuit a maximum charging rate of 15 amperes is obtained.

Such a rheostat designed for any fixed number of cells is stated to be absolutely "fool-proof." The greater the number of cells the smaller the rheostat and the less the cost.

Fig. 1 shows the MC type rheostat as described; Fig. 2 shows this rheostat with a line switch and fuses added, making a complete installation, and Fig. 3 shows a bank of these rheostats for garage service.

Educational Plans of Boston Edison Company.

The Edison Illuminating Company of Boston have completed arrangements with Professor Sydney Whitmore Ashe to carry on next winter a comprehensive scheme of educational work for its employés. The course which will be given beginning January 1 will be along lines somewhat similar to the educational courses carried on in the past two years by the New York Edison Company and the Brooklyn Edison Company. The number of lectures to be given will be limited to twenty, sessions being held both afternoon and evening, thus affording all employés an equal opportunity to attend. The course will be given directly under the supervision of the Edison Club, a special lecture committee being appointed for the purpose. Herbert W. Moses, president of the club, will be chairman of the committee. The lectures will be one and one-half hours in length, and will be both theoretical and practical, everything being demonstrated in an experimental manner.

Changes in Electrical Engineering Course at Cornell.

At the fortieth commencement of Cornell University, occurring on Thursday, June 18, ninety-nine students completed the course in electrical engineering, a number somewhat smaller than that of last year, when 107 completed the course.

The curriculum in electrical engineering for next year has been modified somewhat. In accordance with the plan which has been followed for several years, more time and attention will be devoted to the theory of the characteristic performance of electrical circuits and machines. To provide this time in part the mechanical laboratory practice will cease at the middle of the senior year. The complete electrical course will then consist as follows:

(1) Two recitations per week and one laboratory period per week throughout the junior year.

(2) Two lectures, two recitations, two three-hour computing periods, and two laboratory periods with one recitation per week throughout the senior year.

The instruction in electrical engineering in the junior year is intended to acquaint the students with engineering practice, and to indicate the main divisions of the field. The theoretical elements are reviewed to prepare the way for more thorough work in the senior year. During the senior year the purpose is to lay a theoretical foundation for future practice, by studying the performance of circuits and machines experimentally, and by predicting their performance from their dimensions and physical constants. During the second half of the senior year the students are provided with optional courses of a more practical nature, with a view to showing them how the theory is applied in particular lines of work, such as electric railways, transmission of intelligence, design of electrical machines, and power generation and transmission.

A Fine Edison Tungsten Exhibit.

The New York Edison Company has established, at one of its branch offices in West Forty-second street, New York city, a very effective display of tungsten lamps. Across the front of the store are two windows about sixteen feet high by ten feet wide and about six feet deep. A reflector, made up of small squares of prism glass, extends for a distance of about five and one-half feet down from the top of the window. The ceiling of each window is studded with twenty-eight 100-watt tungsten lamps, each lamp being equipped with a Holophane concentrating reflector. The sides and floor of the window are painted a dead white, and the angle at which the light strikes the window glass also increases the reflected light. Luminometer measurements in these windows gave readings ranging from ninety-three to 100 foot-candles. This, of course, is an extreme in window lighting to which few merchants would care to go. As a demonstration which attracts the attention of the passersby, however, it has been a complete success. Forty-second street, around this point, is very well illuminated, and the storekeepers are disposed to keep their windows well lighted. In spite of this generally good illumination, however, the windows of the Edison company form a remarkable contrast to the illumination all about them.

The Edison Display Window on West Forty-second Street, New York City.

President Whiteside Notes Marked Improvement in Business.

While in New York city last week, Walter H. Whiteside, president of the Allis-Chalmers Company, made the following statement to a correspondent of the *Wall Street Journal:*

"There is a marked improvement in general business. Within the last ninety days the bookings of machinery orders have increased from thirty per cent to fifty per cent of normal. The business for June to date indicates that at least sixty-five per cent of normal will be reached. New inquiries received are constantly increasing in number and volume. They are of a much more substantial character than at any time since the depression began. Their general tone denoted extensive plans in contemplation and for early development; the question of prompt shipment being already regarded an important consideration.

"The immediate requirements for a larger volume of new machinery for necessary extensions and improvements to existing plants are greater than for four years. This for the reason that with many operating companies purchases which under ordinary circumstances would have been made a year or eighteen months ago were put off, due to the monetary and other conditions, until to-day the factor of safety in these plants is becoming a serious matter and new equipment must be added.

"Unlike previous depressions, following which collections for comparatively long periods continued very unsatisfactory, there was a substantial improvement within a short time after the recent flurry, and at the present time collections are exceptionally good.

"While some difficulty may still be experienced in the way of financing entirely new undertakings, yet the financial condition of the relatively small buyer is on a sound basis and credits are about normal. In fact, the improvement in new orders placed is from the smaller class of purchasers, who are, commercially, an important factor. Of course, this class of business is widely diffused, but in the aggregate it is greatly stimulating improved trade conditions.

"The business outlook is distinctly encouraging."

Current Electrical News

DOMESTIC AND EXPORT.

NEW YORK APPELLATE DIVISION DECIDES THAT TELEPHONE SHARES ARE TAXABLE—The Appellate Division at Albany, N. Y., decided on June 19, in the case of Martin H. Glynn, comptroller, against Henry W. Conklin, as referee, and the Security Trust Company, of Rochester, that shares of stock sold on a public judicial sale by a referee who appeared by the court in an action to foreclose a mortgage are taxable under the stock transfer act of 1905. Conklin, as referee, sold at auction in Rochester 322,726 shares of Rochester Telephone Company for $250,000. The court orders judgment for the comptroller for $8,454.

HUDSON RIVER ELECTRIC POWER COMPANY'S PLANS RESTRICTED—The Public Service Commission of the Second (upstate) District of New York has abrogated the order of the commission of last December giving authority to the Hudson River Electric Power Company to issue $3,232,000 bonds under a consolidated and refunding mortgage for $30,000,000 executed by the company. This closes, for the present at least, the efforts of that company to develop on its own behalf the water power of the Sacandaga River. The State Water Supply Commission is now developing plans which will be submitted to the next legislature as to the water power of the Sacandaga River.

UNFAVORABLE REPORT ON LOUISIANA TELEPHONE BILL—The senate corporations committee, by a vote of five to four, on June 16 decided to report unfavorably on Senator Stafford's bill authorizing the people of all cities over 10,000 inhabitants to nullify the action of the city councils rejecting applications for telephone franchises, by a referendum election ordered for that purpose. The bill was opposed by Mayor Behrman, Senator Voegtle, C. H. Ellis and S. Locke Breaux, who reviewed the history of telephone agitation for the past year, and explained the present *modus vivendi* under which Cumberland Telephone Company is given a year's time to improve its service and lower rates, if it be found by the board of trade committee that such reduction be justified by its revenues.

NEW ORLEANS RAILWAY AND LIGHT COMPANY'S PLANS TO RETIRE FLOATING DEBT—The New Orleans Railway and Light Company has sold to George H. Burr & Company, $1,300,000 one-year six per cent collateral notes, the proceeds of which will be used to retire the floating debt of the company. The notes are secured by the deposit of $2,400,000 of the company's general mortgage thirty-year, four and one-half per cent bonds, which have been held in the treasury. The July, 1908, and January, 1909, coupons are to remain attached to these bonds, giving them an actual face value of $2,500,000. The bonds are now selling at between seventy-two and seventy-three. The company reserves the right to retire the notes at 101 on any interest date by giving fifteen days' notice. The Whitney Central National Bank, the Hibernia Bank and Trust Company, the Canal Louisiana Bank and Trust Company and the Interstate Trust and Bank Company, all of New Orleans, have agreed to loan the company an additional $700,000 to be secured by certain real estate which the company owns not covered by the general mortgage, of a value of about $300,000, and the equity in the bonds deposited to secure the $1,300,000 loan made by Burr & Company. It is understood that about $1,000,000 of the six per cent notes have already been sold. The balance is being offered at par and interest.

THIRD RECEIVER FOR NEW YORK CITY RAILWAYS—If plans now proposed are perfected, application for a third receiver will soon be made on behalf of the protective committee of the $12,500,000 collateral trust five per cent bonds of the Metropolitan Street Railway and the $16,604,000 refunding mortgage four per cent bonds. Whether or not application will be made and receiver appointed depends upon whether the two committees can come to an understanding in the matter or not. Since the receivers took charge the Third avenue has been cut out of the system and a separate receiver for it appointed. Separate receivers have also been appointed for the Union Railway Company and for its subsidiaries and for other subsidiaries of the Third avenue. The Fulton street line has been abandoned and a receiver for the company asked. The company has outstanding $500,000 of bonds. The receivers have petitioned the court for permission to default on the rental of the Central Park, North & East River Railroad Company, and the Twenty-eighth & Twenty-ninth Streets Railroad Company, and if permission is granted separate receivers for each company are likely. The abandonment of the line of the latter company, and part, or perhaps all, of that of the former company, may also follow. Up to the present time the defaults of the receivers amount to $7,751,308. This amount does not include the seven per cent dividend on Metropolitan's $52,000,000 stock or the rentals on the Central Park, North & East River Railroad and the Twenty-eighth & Twenty-ninth Streets Crosstown Railroad. In the face of these heavy defaults it has been necessary for the receivers to sell $3,500,000 receivers' certificates in order to get funds with which to put the lines in shape for operation.

FIRST DISTRICT PUBLIC SERVICE COMMISSION, NEW YORK, DENIES APPLICATION OF LONG ACRE LIGHT AND POWER COMPANY—Denying the application of the Long Acre Light and Power Company for permission to issue $10,000,000 of preferred stock and $50,000,000 of bonds, the Public Service Commission, on June 26, took the position that practically all the advantages of competition claimed by the applicant could be secured through the powers of the commission, while actual competition would cause inconvenience and expense to the public, and would ultimately be urged as a reason why rates should not be reduced to consumers. The Long Acre company was incorporated in 1903 for the purpose of manufacturing and distributing electricity for light, heat and power. The area to be supplied was at first defined as bounded by Fifty-ninth street, Fifth avenue, Thirty-third street and the Hudson River, but in 1907 it was extended to include all of the boroughs of Manhattan and The Bronx. The intent was to enter the field as a competitor of the New York Edison Company. The Long Acre company has $50,000 in capital stock and $500,000 in bonds outstanding. The proposed new issue of preferred stock was to be non-voting. Of the $50,000,000 of bonds it was proposed to issue at the present time only $12,000,000. They were to pay interest at the rate of six per cent and run for fifty years. The company also applied for permission to execute a mortgage on all its property, present and future, to secure the bonds. The company's application, when received by the commission, was referred to Commissioner Maltbie, who held numerous hearings, at which arguments for and against the application were made. Mr. Maltbie's report, which was unfavorable to the application of the company, was made on June 26 and adopted by the commission, and on his recommendation an order denying the application was issued.

OBITUARY NOTES.

MR. M. C. MILLS, assistant superintendent of the Meadville & Cambridge Springs Street Railway Company, Meadville, Pa., died on Saturday, June 20, from injuries received in a collision on the morning before.

MR. WILLIAM HAMILTON YOUNG, manager of the Washington (D. C.) office of the Western Union Telegraph Company, and familiarly known throughout the United States as Colonel "Ham" Young, died on June 19 at the home of his son, Frank M. Young, in Chicago, Ill. Mr. Young was on duty connected with the Republican national convention, and was taken ill on the Thursday before his death at the Coliseum. He was one of the first telegraph operators of the country, and was the retiring president of the Old Time Telegraphers' Association. He entered the telegraph service in 1850, and during the Civil War served in the War Department.

ELECTRIC LIGHTING.

WATERVLIET, MICH.—The electric light plant at Manton is to be operated by power from Cedar Creek.

DETROIT, MICH.—Tekonsha has voted down a proposition to bond the town for $12,000 for the purpose of installing a municipal electric light plant.

MILFORD, N. H.—Extensive improvements are being made at the electric light plant, including the addition of new machinery and a new chimney.

MARLBORO, MASS.—The Marlboro Electric Company will furnish current to the new municipal electric light plant which is to be erected at Shrewsbury at a cost of $15,000.

FALL RIVER, MASS.—The contract for installing an electric lighting plant in the Nos. 1 and 2 Granite mills has been awarded to Potter & Earle. About 3,000 lights will be required.

HAILEY, IDA.—The Idaho Consolidated Mines Company, Limited, has completed a hydroelectric plant at a cost of over $50,000. The power used is derived from Wood River, and will develop 1,200 horse-power.

ROSALIA, WASH.—Work has been begun on the lighting system here. Practically every business house in Rosalia will be supplied and numerous residences are being wired. The work will be pushed as rapidly as possible.

BINGHAMTON, N. Y.—The board of contract and supply has awarded a three-year contract to the Binghamton Light, Heat and Power Company. This will effect a saving of $13,000 as compared with the present cost of lighting.

CARROLLTON, KY.—The city council of Carrollton has let the contract for a new electric light plant. The contract includes a new 250-horse-power engine, a 250-kilowatt dynamo, and the erection of a new building, amounting to $19,200.

HARTFORD, CT.—The following directors of the Farmington River Power Company were elected at the annual meeting: E. B. Bennett, Henry Roberts, Atwood Collins, A. C. Dunham, John S. Hunter, H. C. Judd, W. W. Smith, James Terry.

BRISTOW, OKLA.—An election has been called for July 6 at which time the electors will vote on the proposition of a $35,000 bond issue for the purpose of installing a water system. It is planned to install a municipal light plant also.

TOPPENISH, WASH.—At a meeting of the city council A. H. Campbell and M. Kramer, of Seattle, were given a franchise to furnish electric lights and power for the city of Toppenish. The work is to begin on the plant within sixty days and to be completed within six months from date.

PATCHOGUE, L. I.—The village trustees have concluded a contract with the Patchogue Electric Light Company for lighting the village streets for five years. Under the contract the light company is to furnish 125 or more twenty-five-candle-power, metallized-filament lamps for $18 per year per lamp.

ATCHISON, KAN.—A contract for rebuilding the electric lighting system of the Atchison Railway, Light and Power Company has been let to the General Electric Company, of Schenectady, N. Y., at its bid of $23,640. The changes include new generators in the power-house, new arc lights in business houses and for street lighting, etc. The work will be in charge of Leonard Schaeffer.

SPEARFISH, S. D.—The success of the electric power and lighting plant, recently installed eight miles below this city by a syndicate of Spearfish men, has led the company to seek a location for another plant. One of the largest canal systems in the Black Hills will be built. The canal will furnish power to run an electric power plant at Beulah, Wyo., developing 1,800 horse-power. The power will be used in the mines of the Black Hills.

SALT LAKE CITY, UTAH—Engineers of the Utah Light and Railway Company are busily engaged preparing plans for the power plant to be built in Weber Cañon by the Harriman system. Actual construction work will begin within a few weeks, and the plant will be completed and ready for use this fall. The plant will generate 3,000 horse-power, which will be distributed in Salt Lake and Ogden. A dam for the conservation of water will be built on the Weber River, just above Devil's Gate.

DENVER, COL.—George Pullman Sanger, J. M. Blincoe and C. W. Lathrop have secured a franchise to furnish Arvada with electric light, and filed incorporation papers with the secretary of state for the Arvada Electric Company. They will spend $32,000 on a transformer plant in the town, to be furnished with power by the Denver Gas and Electric Company. The plant will provide electricity for light and fuel purposes and for commercial service. Later the company will operate in other parts of Jefferson County.

PUEBLO, COL.—The directors of the Colorado & Kansas Power and Transmission Company at a recent meeting elected the following officers: President, S. H. Atwater, of Cañon City; vice-president, Henry Warner, of Garden City, Kan.; treasurer, W. O. Bourne, of Dodge City, Kan.; secretary, E. W. Palmer, of Pueblo, and assistant secretary, L. M. Markham, of Garden City, Kan. Andrew McClelland, of Pueblo, tendered his resignation as a director. Surveyors are in the field and it is thought that work on the Cañon City-Pueblo branch of the project will be started within the next few weeks.

LANCASTER, N. H.—The electric light company formerly owned by Jones & Linscott has passed to a stock company in which the former owners are heavy stockholders. The new company will be known as the Jones & Linscott Electric Company, and is incorporated under the general laws of the state. The new company has among its stockholders a number of business men of the town. Officers have been chosen as follows: President, Harry H. Jones; treasurer, Fred S. Linscott; clerk, Merrill Shurtleff. Directors: Mr. Jones, Mr. Linscott, Mr. Shurtleff, C. W. Sleeper and W. H. McCarten.

DOVER, N. J.—The common council has entered into a ten-year contract with the Dover Electric Light Company for lighting the streets of the town at a rate slightly in excess of the rate of the old contract which expired July 1. The new contract allows $85 a year for each arc lamp, the same as heretofore, and $17 a year for each incandescent lamp, an increase of $1 per lamp. As a partial offset to the increased rate, the lighting company is required to light the police station, fire-engine house and other municipal buildings free of cost. Heretofore the company has been charging meter rates for this service.

BOULDER, COL.—The announcement is made by Curtis & Hine, of Colorado Springs, that the Eastern Colorado Power Company will at once resume work with a full force on its power project in this county. The project contemplates the expenditure of over $2,000,000 and will ultimately furnish something like 30,000 horse-power from the waters of Middle Boulder Creek, supplemented by great reservoirs for the storage of flood waters. For about a month the force has been increased gradually, and 150 to 200 men are employed. The force will be increased as fast as room can be made for the men until the full force of 600 to 700 men is at work.

DATES AHEAD.

National Electrical Contractors' Association. Next meeting, Chicago, Ill., July 15-17.

Michigan Electric Association. Annual meeting, Grand Rapids, Mich., August 18-21.

International Association of Municipal Electricians. Annual convention, Detroit, Mich., August 19-21.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 6-7.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

PERSONAL MENTION.

MR. C. E. CORRIGAN, vice-president of the National Metal Molding Company, Pittsburg, Pa., was a New York visitor last week.

MR. T. F. SALTER, well known as an engineer in the field of hoisting and conveying apparatus, has been appointed to a new position as chief engineer of the Standard Roller Bearing Company, of Philadelphia, Pa.

MR. C. C. ADAMS, vice-president of the Postal Telegraph-Cable Company, has been receiving congratulations for the masterly and able manner in which he handled the telegraph facilities at the recent Chicago Republican convention.

MR. C. J. H. WOODBURY was the recipient of the degree of Doctor of Science, conferred by Dartmouth College, at its commencement, June 24, this being the second time he has received the same degree, the first being from Union College, New York, in 1906.

MR. AND MRS. WILLIAM J. DENVER, of Roxbury, Mass., announce the engagement of their daughter, Julia, to Mr. John W. De Crow, Yale, class of 1900. Mr. Denver is well known throughout telephone circles as the assistant general manager of the New England Telephone and Telegraph Company.

MR. W. N. RYERSON, whose election to the presidency of the Canadian Electrical Association was announced last week, was born in New York city in 1874. He was educated in the public schools and graduated in 1896 from the electrical engineering course of the School of Mines, Columbia University. After graduation he served for one year with the Sprague Electric Elevator Company in the testing and drafting departments. He then worked for six months with the Western Electric Company, in the switchboard designing department. For three years he worked with the Metropolitan Street Railway Company, New York city, in the construction and operating departments, and for three and one-half years was with the Manhattan Railway Company, New York city, and later with the Interborough Rapid Transit Company, first as chief operator of the generating station, and for the last two and one-half years as superintendent of substations for the Manhattan Elevated system and the New York city subway. Since April 1, 1905, Mr. Ryerson has been superintendent of the Ontario Power Company, of Niagara Falls, Ontario, in charge of construction, operation and local business management, including supervision of the sale of power. He is an associate member of the American Institute of Electrical Engineers, a member of the American Society of Mechanical Engineers, and a member of the Canadian Society of Civil Engineers.

MR. W. N. RYERSON.

NEW INCORPORATIONS.

LANSING, MICH.—Home Telephone Company, Mulford. $15,000.

HARRISBURG, PA.—Mount Bethel & Mount Aetna Telephone and Telegraph Company, Myerstown. $10,000.

AUSTIN, TEX.—Postal Telegraph and Cable Company, of Texas. Capital decreased from $2,000.000 to $120,000.

MADISON, WIS.—Amacoy Telephone Company, Bruce. $1,000. Incorporators: E. C. Campbell, Burt Stevens and others.

COLUMBUS, OHIO—The Falls Heat, Light and Power Company, Cuyahoga Falls. $10,000. Incorporators: W. A. Scarl, S. D. Tifft, W. B. Middleton, C. A. Davis and C. K. Fowler.

LITTLE ROCK, ARK.—People's Light, Water and Power Company, of Newport. $25,000. Incorporators: F. R. Suits, president; George O. Beebe, secretary-treasurer, and Henry Baldus.

SPRINGFIELD, ILL.—McHenry Electric Service Company. To operate an electric light and power plant. $25,000. Incorporators: G. K. Paige, L. Howell, P. J. Boonstra, Chicago.

RALEIGH, N. C.—The Green River Telephone Company, of Rutherfordton. To construct and operate a telephone line from Rutherfordton to Green River, Polk County. $10,000 capital. Incorporators: John C. Mill, Poe W. Eskridge.

ELECTRICAL SECURITIES.

In many quarters there is a well-defined impression that the stock market is due some time during the summer for another advance in prices, and this of substantial proportions. The reasons for this are not just now apparent, although reports are not disquieting, so far as business in general for this time of year is concerned. In fact the electrical field is feeling the impulse of a greater confidence in the near future, and, although business has fallen off very materially, orders in hand indicate a greater activity than was expected a month or two ago.

Dividends have been declared upon the following electrical securities: New England Investment and Security Company; regular semiannual dividend of 2 per cent on the preferred stock, payable July 1 to stock of record June 20. Washington Water Power Company, of Spokane, Wash.; regular quarterly dividend of 1¾ per cent, payable July 1 to stockholders of record June 20. Manila Electric Railroad and Lighting Company; regular quarterly dividend of 1 per cent, payable July 1 to stockholders of record June 20. Rochester (N. Y.) Street Railway Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable July 1 to stock of record June 23. Radio Telephone Company; regular quarterly dividend of 1 per cent and an extra dividend of 2 per cent, payable July 15 on stock for which full cash payment has been made prior to July 1, 1908. New York & New Jersey Telephone Company; regular quarterly dividend of 1¾ per cent, payable July 15 to stock of record July 6. Electric Storage Battery Company, Philadelphia Pa.; quarterly dividends of ¾ of 1 per cent on both common and preferred stocks. This compares with 1 per cent on each stock three months ago, and six months ago 1¼ per cent on each stock. The dividends were payable July 1. Mexican Telegraph Company; regular quarterly dividend of 2½ per cent, payable July 16. Bell Telephone Company of Pennsylvania; regular quarterly dividend of 1½ per cent, payable July 15 to stock of record July 3. Massachusetts Lighting Company; regular quarterly dividend of 1½ per cent, payable July 15 to stock of record July 1. Commonwealth Edison Company; quarterly dividend of 1¼ per cent, payable August 1. Philadelphia Company; regular quarterly dividend of 1½ per cent on the common stock, payable July 1. West India Electric Company; quarterly dividend of 1 per cent, placing the stock on a 4 per cent basis.

ELECTRICAL SECURITIES FOR THE WEEK ENDED JUNE 27.

New York:	*Closing.*
Allis-Chalmers common	10½
Allis-Chalmers preferred	34½
Brooklyn Rapid Transit	46¾
Consolidated Gas	123¾
General Electric	130
Interborough-Metropolitan common	10¼
Interborough-Metropolitan preferred	28
Kings County Electric	115
Mackay Companies (Postal Telegraph and Cables) common	63½
Mackay Companies (Postal Telegraph and Cables) preferred	63
Manhattan Elevated	132
Metropolitan Street Railway	23
New York & New Jersey Telephone	100
Western Union (ex dividend)	53
Westinghouse Manufacturing Company	55

Boston:	*Closing.*
American Telephone and Telegraph	117¾
Edison Electric Illuminating	—
Massachusetts Electric	46
New England Telephone	111
Western Telephone and Telegraph preferred	65

Philadelphia:	*Closing.*
Electric Company of America	10½
Electric Storage Battery common	29
Electric Storage Battery preferred	29
Philadelphia Electric	9⅜
Philadelphia Rapid Transit	15
United Gas Improvement	86

Chicago:	*Closing.*
Chicago Telephone	130½
Commonwealth Edison	97½
Metropolitan Elevated preferred	49¾
National Carbon common	69
National Carbon preferred	111

ELECTRIC RAILWAYS.

MARION, IND.—Surveys have been begun for the new Marion-Logansport traction line, under the direction of Henry F. Coleman, of Logansport.

DOVER, N. J.—Salmon Brothers, of Ledgewood, have the contract to build the trolley line from Silver Spring Park to Bertrand Island, on the east side of Lake Hopatcong.

SHERMAN, TEX.—The longest interurban electric railway in the Southwest was finished on June 16. It is sixty-seven miles long and runs between Sherman and Dallas.

PORTLAND, ORE.—The power plant of the Portland Railway, Light and Power Company at Cazadero was partially destroyed on June 21. The plant is valued at $750,000.

PHILADELPHIA, PA.—The Northern Cambria Street Railway Company, operating out of Johnstown, Pa., and connecting important towns, has decided to issue $100,000 bonds to build to the town of Hastings.

JANESVILLE, ILL.—Judge Grimm, in the Circuit Court, having decided that the franchise granted the Rockford & Interurban Railway Company was not properly granted, a new franchise will be prepared and submitted to the town council.

NEW YORK, N. Y.—At a meeting of the board of estimate and apportionment a resolution was adopted granting the petition of the New York & Queens County Railway for a franchise to extend its road to Eleventh avenue and Thirty-sixth street, in the old village of Whitestone.

LA JUNTA, COL.—The articles of incorporation of the Kansas-Colorado Electric Railway and Power Company have been forwarded to the secretary of state at Denver for filing. This is the company which proposes building an electric line from Dodge City, Kan., to Cañon City.

BALLSTON, N. Y.—Frederick H. Beach was appointed receiver, on June 23, of the Eastern New York Railroad Company, an electric line twelve miles long. The industrial depression and financial panic, together with the failure of the Philadelphia banking house which carried the railroad's bonds, caused the receivership.

DENVER, COL.—O. F. Olson, who has been completing arrangements for the construction of the new electric line from Fort Collins, Col., to Hudson, has signed a contract with the Burlington Railroad for the delivery of the rails and ties at Hudson to build the line from Hudson to Kersey. He also signed a contract with a construction party.

GREELEY, COL.—D. A. Camfield proposes to build an electric railway from Greeley to Pleasant Valley. To do this it is said he will interest the Home Electric Light Company and secure power from its plant. If the road is built, it will be completed in six months and may be the forerunner of other lines to operate with Greeley capital.

MONTREAL, CANADA—The Montreal & Southern Counties Railway Company has opened offices at 605 and 606 Canadian Express Building, McGill street, Montreal. W. B. Powell is manager, and J. A. Burnett, superintendent and electrical engineer. Work is now proceeding on the Montreal-St. Lambert section of this road, and entry into the city of Montreal has been arranged for.

TACOMA, WASH.—The construction crew on the Tacoma-Seattle short line has been increased and the building of the line will progress rapidly all summer. Grading crews have been at work south of Young's cove on the north end of the line since the middle of May. Merle J. Wightman, one of the promoters of the road, is authority for the statement that the right of way has been secured and the location between Seattle and Des Moines decided on.

BELLEFONTAINE, OHIO—Citizens of Degraff and Bellefontaine are planning to build an electric line between the two towns. The management of Silver Lake Park, which lies between the two places, is also interested in the enterprise, and the Schoepf syndicate, controlling the Ohio Electric Railway system, which has a trunk line through Bellefontaine, has agreed to sell the power to this proposed new line, believing it would prove a valuable feeder.

FLINT, MICH.—In accordance with an order by Circuit Judge Wisner, the Detroit, Flint & Saginaw Electric Railroad, which has fourteen miles of road in operation, has been sold at public auction. Isaac Applebaum, of Detroit, who holds the bonds of the road to the amount of $250,000, was awarded the property on his bid of $50,000. The Detroit Trust Company, of Detroit, has been acting as receiver for the property. It is said that Mr. Applebaum will complete the construction of the line to Flint.

PITTSBURG, PA.—After two years' labor and the expenditure of more than one million dollars, the Ardmore Street Railway Company has completed its road between Wilkinsburg and East Pittsburg. The initial trip was made on June 19. The officers of the Ardmore Street Railway Company are: William Flinn, president, and George H. Flinn, treasurer. The directors are: William and George Flinn, John S. Weller, H. P. Haas and M. K. McMullin. The cars will be run on a ten-minute schedule until midnight.

STUART, IOWA—The first annual meeting of the stockholders of the Red Oak & Northwestern Interurban Railway Company was held recently at Red Oak. Twenty directors were elected. They are: B. B. Clark, A. R. Tracy, H. E. Dermer, Thomas Griffith, Gordon Hayes, O. J. Gibson, George C. Boileau, of Red Oak; L. D. Foote, S. E. Smith, of Grant; F. D. Martin, W. L. Battin, of Greenfield; F. O. Hinkson, J. R. Smull, A. C. Curtis, of Stuart; D. A. Field, G. W. Curtis, of Redfield; George W. Clarke, J. W. Russell, of Adel; N. C. Wragg, Nathan Nish, of Waukee. An executive committee was elected consisting of F. O. Hinkson, Stuart; W. L. Battin, Greenfield; George C. Boileau, O. J. Gibson and Gordon Hayes, of Red Oak. B. B. Clark was elected president, George W. Curtis, vice-president; M. N. Spencer, secretary, and Thomas Griffith, treasurer. The company is formed for the purpose of building an interurban railway from Red Oak through Grant, Greenfield, Stuart, Redfield, Adel, Waukee and to Des Moines. Much interest is manifested along the proposed route.

NEW MANUFACTURING COMPANIES.

BROOKLYN, N. Y.—The Gore Arc Lamp Company has been incorporated with a capital of $50,000 to manufacture arc lamps. The incorporators are: G. I. Woolley, H. T. Berry and H. T. Asbury, Brooklyn.

JERSEY CITY, N. J.—The National Ignition Company has been incorporated to manufacture electrical devices and appliances, with a capital of $150,000. The incorporators are: F. C. Eberlin, A. Williams and G. W. Flaacke, of Jersey City.

INDUSTRIAL ITEMS.

THE H. KRANTZ MANUFACTURING COMPANY, 160 Seventh street, Brooklyn, N. Y., is distributing a series of advertising folders devoted to its water-tight floor boxes and switchboards.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is preparing to manufacture snap switches and lamp sockets in addition to the circuit-breakers and controlling devices of which it now makes a specialty.

THE F. BISSELL COMPANY, 226 Huron street, Toledo, Ohio, is celebrating the month of July with a calendar card to which is attached an imitation fire-cracker. The inference is that "it can't possibly hurt you" to give the company an order.

THE BROWN HOISTING MACHINERY COMPANY, Cleveland, Ohio, will be pleased to send to any one interested upon request its "O" catalogue, describing and illustrating "Brownhoist" machinery as adapted to the use of artificial gas, coke and electric light companies for the rapid and economical handling of coal, coke and other materials.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, has ready for distribution a circular describing its "Ferro" compound. This compound is a chemical iron cement for smoothing over and filling up blow holes, sand holes, etc., in iron and steel castings. Literature is also ready for distribution describing the company's "Anti-Sweat" pipe covering.

THE EDISON MANUFACTURING COMPANY, Orange, N. J., announces that, in the oil fields, gas engines are running twenty-four hours a day, seven days in the week, using Edison primary batteries, which do not have to be looked after, as far as their ignition is concerned, more than once or twice a year. At such times a few minutes are required to renew the cells.

THE ACHESON OILDAG COMPANY, Niagara Falls, N. Y., manufacturer of "Oildag" and "Aquadag," has elected the following officers: President, Edward G. Acheson, Jr.; secretary, W. H. Arison; treasurer, A. M. Williamson. The president is a son of the well-known inventor and electric furnace expert, Edward Goodrich Acheson, who discovered the "Oildag" and "Aquadag" processes. The company's offices and works are at Niagara Falls.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has ready for distribution a new bulletin entitled "Some Illustrations of the Triumph Motor Drives." This bulletin does not go into the details of construction, but shows particularly by means of illustrations the application of motors to the various types of machines, such as lathes, planers, printing presses, boring mills, hoists, etc. Copies of this bulletin will be furnished upon request.

W. N. MATTHEWS & BROTHER, 227 North Sixth street, St. Louis, Mo., are the selling agents for the Stombaugh guy anchors, which are in very wide use throughout the country. This anchor is operated on the corkscrew principle, going into the ground without digging a hole. Enormous strains can be put upon the anchor because it is set in the solid, undisturbed earth. Full information will be sent to those interested upon request.

THE SIMPLEX ELECTRIC HEATING COMPANY, Cambridge, Mass., has published catalogue No. 15, giving a very excellent presentation of its extensive line of heating and cooking apparatus. In addition to the descriptive matter and the large number of illustrations there is some valuable information given concerning the consumption of current and the cost of use. Copies of this catalogue will be furnished to those interested upon request.

THE GENERAL FIREPROOFING COMPANY, Youngstown, Ohio, announces the erection of an additional factory building 60 by 200 feet, which will be devoted to the manufacture of steel office furniture and office devices, including steel sections or "units," desks and tables. This furniture is finished to closely resemble oak or mahogany, and the difference can not be detected by sight alone. The steel furniture possesses advantages over wood in that it is fire-resisting, space-saving, durable and not affected by moisture.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a circular containing some valuable engineering data on the economy of the new "silico-vanadium" steel used in Pittsburg transformers. This comprehensive article is in the form of a six-page bulletin showing the difference between "high-efficiency" and "standard-efficiency" transformers, and is reduced to a dollars-and-cents basis. In computing core-loss costs the author has adopted one cent per kilowatt-hour as a basis, and a comparison is made between the actual cost of the two types of transformers.

THE SUNBEAM INCANDESCENT LAMP COMPANY, West and Bethune streets, New York city, has been meeting with great success in its exportation of American-made tungsten lamps. One of its correspondents in South Africa has recently sent the following communication to the company: "I have just heard from one of my customers, for whom you furnished the only lot of tungsten lamps for me, that those lamps which you sent are the best lamps in the market, and that in spite of the higher price he is ordering some more. This I am extremely glad to hear, and I hope that as a result of the trial he has given them a good market for the lamps out here may result. The lot which you furnished me came out with very slight breakage; in fact, there were only six lamps out of 150 which were broken in transit or in any way defective."

Record of Electrical Patents.

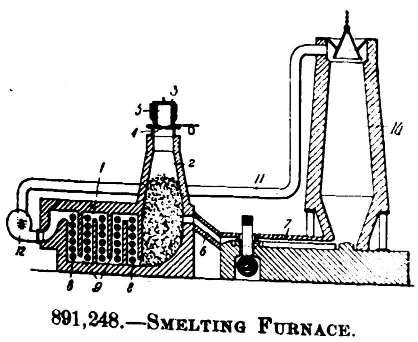
Week of June 23.

891,232. LIQUID RHEOSTAT. Herbert W. Cheney, Norwood, Ohio, assignor to Allis-Chalmers Company. The resistance is varied by raising one of the plates out of the electrolyte.

891,236. ELECTRIC-MOTOR CONTROLLER. John Dillon, Milwaukee, Wis., assignor to the Barth Elevator Company, Milwaukee, Wis. A relay switch is provided in the main circuit on each side of the motor, these being controlled by a derived circuit which includes the switches cutting out the starting resistance.

891,241. METHOD OF AND MEANS FOR STARTING DYNAMO-ELECTRIC MACHINES. Budd Frankenfield, Norwood, Ohio, assignor to Allis-Chalmers Company. The motor being driven above synchronism by an auxiliary motor.

891,248. SMELTING FURNACE. Eugen A. A. Grönwall, Ludvika, Sweden. The combination of a smelting furnace and an electrically heated refining furnace.



891,248.—Smelting Furnace.

891,254. ELECTRICAL WATER HEATER. Harry M. Hill, St. Louis, Mo., assignor to Hill Electrical Manufacturing Company, St. Louis, Mo. The water is passed between two conical electrodes.

891,263. ELECTRICAL APPARATUS. Charles J. Klein, New York, N. Y., assignor to Ralph A. Schoenberg, New York, N. Y. An outwardly opening plug receptacle.

891,264. DEVICE FOR THE PURIFICATION OF METALS. Charles T. Knipp, Urbana, Ill. A device for volatilizing a metal *in vacuo*.

891,265. PROCESS FOR PURIFICATION OF METALS. Charles T. Knipp, Urbana, Ill. The metal is volatilized in a vacuum by an electric arc and then condensed.

891,273. CLAMPING MEANS FOR CORE-PLATES OF DYNAMO-ELECTRIC MACHINES. Charles E. Lord and William H. Powell, Norwood, Ohio, assignors to the Bullock Electric Manufacturing Company. The core support is provided with an abutment and a circumferential groove in which a locking ring is seated.

891,303. SIGNALING SYSTEM FOR RAILWAYS. Louis H. Thullen, Edgewood Park, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. A block-signaling system for alternating-current railways, one rail of which serves as the return for the power current.

891,306. ROTARY OIL-SWITCH. Hermon L. Van Valkenburg, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. The contact fingers and drum are placed within a tank of oil.

891,316. DYNAMOELECTRIC MACHINE. Robert B. Williamson, Norwood, Ohio, assignor to Allis-Chalmers Company. The commutator segments are supported throughout almost their entire length and held in position by four locking rings.

891,320. INDUCTION COIL. Donald H. Yost, York, Pa., assignor of one-half to Frederick R. Yost, York, Pa. An electromagnet for bridging openings in an electric circuit.

891,323. FUSE. Bert A. Brown, Churchville, N. Y. A signal is set by the burning of the fuse.

891,339. RAILWAY SIGNAL. Franz Hirt, Berlin, Germany, assignor to General Electric Company. A railway signal responsive to polarized light only.

891,343. FLEXIBLE ELECTRICAL CONNECTION DEVICE AND THE LIKE. Charles A. Keller, Paris, France. A connection comprising a pair of laminated strips.

891,350. GENERATION AND TRANSMISSION OF MOTIVE POWER. George W. Mascord, London, England. A supplementary engine is automatically thrown in service when the load on the main engine exceeds a predetermined value.

891,352. TOWING SYSTEM. Wilbur L. Merrill, Schenectady, N. Y., assignor to General Electric Company. The barges are towed by a cable wound on a drum, the unwinding of which, due to increased pull on the cable increases the torque of the winding motor attached to the drum.

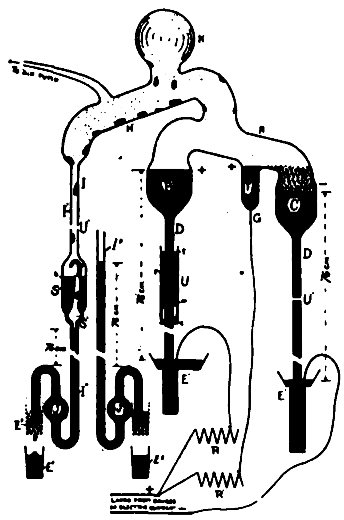
891,361. MEANS FOR ELECTROPLATING RODS, PIPES, ETC. Daniel H. Murphy, New Castle, Pa. Means are provided for rotating the pipe while plating.

891,395. TREATING SLIMES FROM ELECTROLYTIC REFINING OF LEAD. Anson G. Betts, Troy, N. Y. The slime is oxidized and then melted with a reducing agent to remove antimony.

891,400. ELECTRIC HEATER AND MEANS FOR CONTROLLING THE SAME. Peabody A. Brown, Denver, Col. The resistance elements are wound on a series of cores.

891,410. TROLLEY FOR ELECTRIC CARS AND THE LIKE. Edward J. Dacey, Prescottville, Pa. The wheel is mounted on a spring-supported swiveling cylinder.

891,414. THERMAL CUTOUT. Charles A. Ernst, Schenectady, N. Y., assignor to General Electric Company. An indicating fuse is carried on the outside of the case enclosing the main fuse.

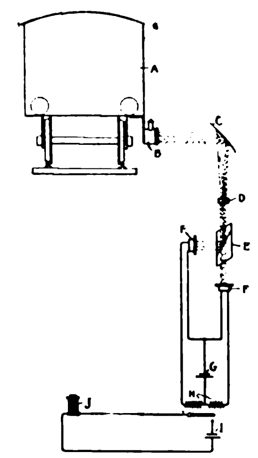


891,264.—Device for the Purification of Metals.

891,425. LIMIT-SWITCH DEVICE. Sam H. Kanmacher, Schenectady, N. Y., assignor to General Electric Company. A reversing controller with overload relays.

891,455. HOT-WATER HEATER. George L. Bennett, Trenton, N. J. A combined water heater, faucet and valve.

891,463. ELECTROTHERMAL PROTECTOR. Frank B. Cook, Chicago, Ill. A combined thermostat and lightning arrester.



891,339.—Railway Signal.

891,496. ELECTRICAL TRANSFORMER. August R. Luschka, River Forest, Ill., assignor to Western Electric Company, Chicago, Ill. An induction coil with the primary and secondary windings arranged in the form of two hollow truncated cones.

891,556. AUTOMATIC TRAIN-STOP. Joseph H. Lynch, Red Bank, N. J. A magnetically controlled pneumatically operated device for cutting off power and applying the brakes.

891,561. COMBINED ELECTRIC SERVICE CUTOUT AND METER BOARD. Henry E. McGowan and Edwin R. Ellsworth, New York, N. Y. Space is provided on the service board for the meter.

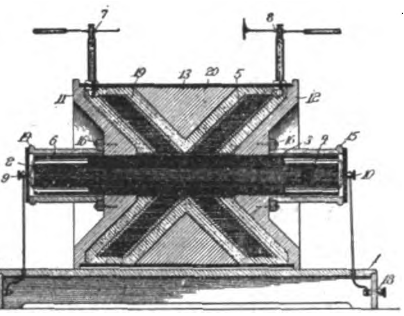
891,589. AUTOMATIC ELECTRIC REGULATOR. William L. Bliss, New York, N. Y. A regulator for controlling the voltage of a distributing system utilizing a storage battery.

891,617. ELECTRIC SWITCH-OPERATING MACHINE. Leslie A. Hedger, Mill Valley, Cal. The switch is operated by a coil and plunger magnet.

891,632. ELECTRIC BRAKE MECHANISM FOR CARS, ELEVATORS, CRANES AND OTHER PURPOSES. Michael E. Neenan, New York, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. The spring-applied brake is retracted by an electromagnet, a supplemental magnet applying additional pressure on the brake-shoes when seated.

891,657. APPARATUS FOR THE ELECTRICAL PRODUCTION OF HEAT FOR COOKING AND OTHER PURPOSES. Arthur F. Berry, Ealing, England. The heating currents are induced in the heating element.

891,712. TROLLEY. Abel Molinar, Pittsburg, Pa. Spring-controlled wire guards are attached to the wheel.



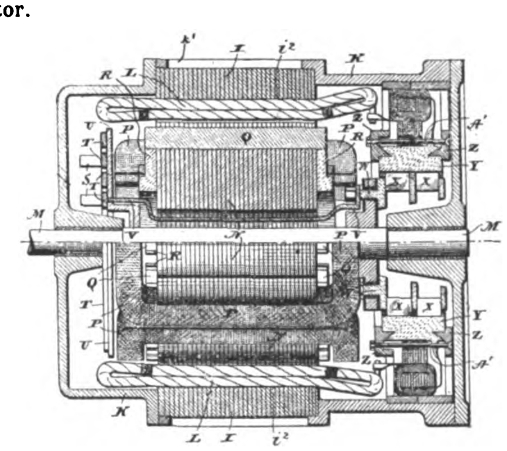
891,496.—Electrical Transformer.

891,720. MOTOR-CONTROLLING DEVICE. William C. O'Brien, Baltimore, Md., assignor to Monitor Manufacturing Company of Baltimore City, Baltimore, Md. A switch shunting the starting resistance is controlled by two solenoids, so that the resistance is cut out when the armature current has fallen to a certain value.

891,721. STARTER FOR ELECTRIC MOTORS. William C. O'Brien, Baltimore, Md., assignor to Monitor Manufacturing Company of Baltimore City, Baltimore, Md. A rocking switch controlled by two solenoids in the motor circuit which cuts out the starting resistance.

891,722. STARTER FOR ELECTRIC MOTORS. William C. O'Brien, Baltimore, Md., assignor to Monitor Manufacturing Company of Baltimore City, Baltimore, Md. A series of switches for cutting the starting resistance out of the motor circuit in steps, the action being controlled by two solenoids.

891,779. ELECTRICALLY GOVERNED AUTOMATICALLY OPERABLE TRAIN CONTROLLING SYSTEM. Harvey B. Miller, Staunton, Va., assignor of one-half to James A. Bell, Staunton, Va. An electromagnetic means for disconnecting the current collector.



891,784.—Single-Phase Commutator Motor.

891,780. AIR-BRAKE APPARATUS. Harvey B. Miller, Staunton, Va., assignor of one-half to James A. Bell, Staunton, Va. An electromagnetically controlled air-brake valve.

891,784. SINGLE-PHASE COMMUTATOR MOTOR. Stanley S. Seyfert, South Bethlehem, Pa., assignor of one-half to William S. Franklin, South Bethlehem, Pa. The commutator is attached to the outer stationary element of the motor.

891,786. TELEPHONE SYSTEM. Nathan H. Suren, Highlandville, Mass., assignor to the Gamewell Fire Alarm Telegraph Company, New York, N. Y. A combined signaling system and telephone.

891,797. METHOD OF AUTOMATIC REGULATION OF RECTIFIERS AND ROTARY CONVERTERS. Francis B. Crocker, New York, N. Y. The rectifier is regulated by introducing in the circuit inductance due to the combined effect of the alternating and direct currents.

ELECTRICAL REVIEW

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ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

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CONTENTS

IMPROVED CONDITIONS IN THE ELECTRICAL INDUSTRY.

Careful inquiry among the leading manufacturers of electrical apparatus indicates that there is an increasing feeling of confidence due to the encouraging prospect of a revival in the demand for this material. The leading houses are receiving a number of inquiries through their branch offices in all sections of the country, and the business thus indicated should aggregate a considerable volume, the stimulus thus effected having a very beneficial influence upon the trade in general. Manufacturers at the present time are keenly alive to every possibility of new business, and we find in every direction a disposition to develop new lines and to meet the demands of the user of electrical apparatus more than half way in the extension of credit and in co-operation with him in the handling of orders of every magnitude.

Just as soon as the danger signals were hoisted last October retrenchment set in. To-day it is a matter of fact that there are not in hand any large accumulations of retail supplies. During the spring there has been very little stocking-up. The disciplinary regulations which have been put in force have improved labor conditions, and in its eagerness to be kept on the pay-rolls labor has become more efficient than for many a day.

Central stations, street railways, telephone and telegraph companies have cut down their operating expenses, but have continued to take on new business. In these fields there has not been the decrease in revenue which has been experienced in other phases of industry. While there may be some complaints that these utilities are not operating up to their capacities, it must be remembered that within the last two years their capacities have been very greatly increased, so that if at the present time a company is operating at only fifty per cent of its capacity, it may be operating at more than double its capacity of a few years ago.

Owing to the fact that, notwithstanding the depression, earnings have held fairly well, with the indication that if the present rate of gain is maintained, the year will close with earnings at least comparable with those of 1907—and that was a record year—there is less timidity on the part of the managements of street railway, central station and telephone and telegraph corporations to place orders for new apparatus and to undertake still greater developments. Within the last few weeks this feeling of confidence has been placed upon a dollars-and-cents basis, the reports from the leading manufacturers of the articles entering into the conduct of this industry showing that the business has been imbued with new life.

AN EXAMPLE OF UNECONOMICAL POWER-PLANT CONSTRUCTION.

Some engineers believe that power-plant design is a matter of opinion. It is, in fact, a matter of experience. Owing to a lack of experience in this particular line such engineers adhere to the unproved opinions of themselves and others, particularly those of the engineer-salesman. To what such "opinions" may lead may be seen from the following:

The design and construction of a somewhat prominent central plant for supplying heat, light and power for manufacturing purposes has recently been closely followed. Before the plans of the substructure and superstructure were completed two tall chimneys had been erected resembling obelisks in a desert. As the buildings were of later design much of the arrangement had to be accommodated to the chimneys already in place. It was the opinion of the engineers in charge that the chimneys rested on hard-pan. However, in this case the settlement of the chimneys was enough to crack the basement walls (one crack being seventeen feet long) and it was later discovered that one of the chimneys was fully a foot out of plumb.

The whole layout of the plant was practically made without any consideration of the scheme of piping. The location of the foundations, one of the most important features in the layout of power plants, was determined from unchecked pencil drawings on cheap sketch paper. The floors were made of concrete, reinforced by rods, which in itself is not good design for power-plant work, and especially as the location of the auxiliary machinery to be carried on the engine-room floor was not determined at this time. Much of the machinery, particularly that for manufacturing purposes, is located on this floor and consequently many holes had to be cut for the necessary pipes. In fact there were so many of these holes, several of which were eighteen inches in diameter, that a pneumatic drill was brought into service to cut them. A seven-and-one-half-foot octagon hole had been provided. However, when the size of the accumulator was later determined this hole had to be enlarged to nine and one-half feet square. Cutting such holes, it will be readily understood, necessitated the cutting of the reinforcement rods.

Probably one of the worst blunders made was in the erecting of the concrete basement walls. Openings were left in the concrete division wall for the piping leading from the boiler room into the generating room before the piping layout was made. Bolts were fixed in the concrete floors for pipe-hangers, and consequently when the piping layout was made the main steam pipe, which is fifteen inches in outside diameter, and the exhaust pipe had to be arranged to suit these hangers.

The boiler units installed, which are of 500 horse-power, are provided with eight-inch steam connections giving a velocity of steam of about 1,800 feet per minute, while the common practice calls for 6,000 feet, so that six-inch pipes would have been ample. The ring system is employed, the pipe being fifteen inches outside diameter, although a twelve-inch pipe, according to common practice, would serve the purpose with much better results, reducing the amount of condensation, occupying less space and being more flexible. Furthermore, the first cost would have been reduced, and at least $2,000 could have been saved on the main steam piping alone if experience had prevailed in the matter of determining the sizes instead of "opinion." The same is true as to all the other piping in the system. The engineers in charge, probably not feeling sufficiently competent, gave out to a contractor the work of designing the layout of the piping with the above result. And there is no uniformity of design in the laying out of the piping system, as there are fourteen-inch high-pressure valves provided with by-passes which in other cases are omitted, whereas the six-inch valves are all so provided. It is common practice to provide all high-pressure valves above ten-inch with by-passes.

While an unusually large amount of time was spent on drawings and specifications for the piping system, many important features were lost sight of and much time was wasted on small details. It is safe to say that there could have been saved in first cost of the complete piping system between three and four thousand dollars out of a total cost of the piping of almost $20,000, and at the same time a better and more economical system would have been secured.

The boiler room is provided with plenty of louvres which, however, are not properly placed. The ventilation in the firing aisle is poor, as the coal bunkers, designed for eighteen-ton capacity per running foot, are carried on girders seven feet nine inches deep. These girders have a span of thirty-two feet and extend down a little below the top of the boilers, cutting off the passage for light and ventilation which is considered so necessary in power-plant practice.

The engine room has two large monitors situated directly above the turbo-generators; in case of sudden rain this might readily be the cause of short-circuits. Since in this case plenty of light is secured from the windows in three sides of the engine room, these monitor windows could have been dispensed with and less expensive and more efficient means for ventilation been provided.

By adopting practically the same type of cooling tower, but set several feet lower, the water of condensation from the condensers could have circulated by gravity and the expensive hot-well tank and additional centrifugal pump for lifting the water to the cooling tower could have been dispensed with.

A very expensive reinforced concrete track scale pit, for weighing and receiving the coal, was built, the design having been complicated to an extreme in order to save a few yards of concrete. If calculation had been made it would have been found that by the use of a few yards more of concrete the design might have been simplified and seven to eight hundred dollars easily saved.

The above are a few of the gross errors made by opinionated designers who, in this case, consumed more than a whole year's time, with a staff of draftsmen, to accomplish what expert power-plant designers would have done more effectually in three to four months, and who would have saved the company some twenty-five to thirty thousand dollars in first cost as well as a very respectable sum in the annual operating expense.

THE INSTITUTE CONVENTION.

The annual convention of the American Institute of Electrical Engineers, which was held at Atlantic City, N. J., last week, was fully as enjoyable and profitable to those attending as had been expected. The weather conditions could hardly have been improved upon, as the sun shone brightly during the entire four days of the convention, yet the temperature was not uncomfortably high. In many ways Atlantic City is an ideal place for such conventions, as the accommodations for visitors are unsurpassed and there are innumerable opportunities for enjoyment besides the main attraction—sea bathing. Under these conditions it was only natural that those who were fortunate enough to be able to go to Atlantic City should have thoroughly enjoyed the four days spent there.

The only criticism which can be made of the convention, and it can hardly be called a criticism, is the amount of work expected of the attending members. It seems to be forgotten that the main object of the convention is the discussion of papers rather than their mere presentation, but this end is always defeated when the programme is crowded; and the better and more interesting the papers, the more disappointing is the result. Another unfortunate result of the plan which crowds the convention days with business sessions is the little time left to the members to become personally acquainted. To many Institute members the annual convention is the only time during the year when they can mingle with many old friends and make more new ones, but when the mornings and afternoons are both taken up with long sessions, leaving hardly time enough in between for lunch, one is more inclined in the evening to drift off into some simple amusement rather than talk shop with his brother engineers.

Various remedies can be suggested for this evil, though not any one of them is itself free from objections. The simplest plan would be to cut down the number of papers, but when there is such a large number of good papers sent in, the selection becomes a difficult and delicate task. No one side must be given preference over any other, and all the different branches of the profession expect recognition. Naturally, with these requirements before it, the Papers Committee is only too likely to err in preparing too full a programme, and the result is the worse, the better the papers. One good paper at the beginning of a three hours' session can easily provoke discussion enough to fill profitably the entire time; consequently the following papers provoke little or no discussion, as those to whom the topic is interesting are either tired and indifferent or hesitate to prolong the session, not only by the time which they themselves would use, but frequently because the man who has something worth saying hesitates to say it lest he start the discussion in a new direction. It is true the time allowed for discussion is largely in the hands of the presiding officer, but when the latter asserts his authority in order to give each of the papers, or topics, its proper portion of the time, the discussions naturally become perfunctory and lacking in value and interest.

Another plan would be to hold parallel sessions which would be devoted to subjects but little related. To those who are specialists or who are interested in but one or two branches of the electrical industry this scheme would be quite satisfactory. On the other hand, there are a great many members, besides those who are teaching, who are interested in various and unrelated topics and who would necessarily feel that they had lost something if two important papers should be taken up by two sessions at the same time.

Still a third plan would be to hold at least two general meetings of the Institute during the year. Each of these might be limited to the consideration of certain topics, so that the member who could attend but one meeting during the year would be able to select that most profitable to him. This plan also has its objections, as it is probable that there would be fewer attending each meeting than now attend the annual convention, although one of the main objects of a convention is to bring all the members of the Institute together irrespective of their special lines of work, and any plan that would interfere with this object should have very marked advantages in other ways to lead to its consideration.

The sessions of the second day of the convention, which are reported in this issue, illustrated very well the objections to the present system. The morning session had three papers dealing with transmission line troubles, while it is well known that a single paper touching upon the topic generally classified as "lightning" in Doctor Steinmetz's use of the term, is sufficient to provoke three or four hours of discussion. There was in addition a most interesting engineering paper dealing with an important transmission system which would have called for a much more general expression of views had there been sufficient time; and there was still a fifth paper which, for the same reason, received but slight attention. Naturally, with this programme before it, the morning session considerably overran the allotted time. The programme for the evening session contained but three papers, all of them, however, of unusual interest and importance. The first to be presented dealt with some interesting high-voltage experiments and would alone have proved sufficient for the session, since its discussion took up the greater part of the evening, but the other two papers were not less important, as one dealt with the design of transmission lines and the other was a tentative specification for testing high-voltage line insulators. Under the conditions, however, they could not be given the time which they deserved. It is greatly to be hoped that some plan for alleviating the conditions will be arranged. Matters were much improved at the present convention by having all of the papers printed and distributed in advance, and in many cases the author had carefully prepared abstracts, thus insuring a brief but satisfactory presentation of his paper in the time allotted to him. It would be well for those who intend to take part in the discussions to prepare their remarks in the same way. They would then be sure of saying what they intend to say, which is not always the case when they speak without notes; and much time would be saved.

Annual Convention of the American Institute of Electrical Engineers.

Report of the Discussion on Papers Dealing with Transmission Problems.

THE twenty-fifth annual convention of the American Institute of Electrical Engineers was opened at Atlantic City, N. J., on Monday morning, June 29, at 9.30 o'clock by President H. G. Stott. The report of the first day's sessions was given in the issue of the ELECTRICAL REVIEW for July 4.

The third session was opened at 9.30 A. M., Tuesday, June 30, at the Hotel Traymore, by President Stott, and three papers dealing with transmission line troubles were taken up.

E. E. F. Creighton, in a paper on "Measurements of Lightning, Aluminum Lightning Arresters, Earth Resistances, Cement Resistances and Kindred Tests," gives the results of the past year's investigations of lightning and the operation of lightning arresters. For this purpose two lines were chosen, well up in the Rocky Mountains of Colorado, and new types of apparatus for measuring the various quantities involved in lightning discharge were developed and installed. These are described in the paper, and the methods in which they were used are discussed and a good deal of data collected during the two years of study given. The paper is divided into six parts. The first discusses the duration of lightning and describes the apparatus devised for measuring this. The records were made on a rotating sensitive film. In this section, also, the methods employed for determining the flow of current are described. By placing a group of graded fuses in the discharging circuit limiting values may be determined, and when the frequency and duration and other constants of the circuit are known the quantity of discharge may be estimated. The second division of the paper discusses the frequency of the discharge. For measuring this resonators were employed consisting of coils of German silver wire such as are used for the same purpose in wireless telegraphy. The third section of the paper discusses the experience on the two transmission lines under observation. Records were kept by means of a moving tape placed in the discharge gaps. It is suggested that since the aluminum arrester is designed to operate continuously for half an hour or more, it is feasible to attach an alarm to these arresters which will signal to the operator at the station when a discharge is taking place so that he may take precautions to clear the line should the trouble continue. On two occasions it was found that choke-coils were beneficial. On several occasions one phase of a system became grounded and in each case gave rise to vicious surges on the lines. To prevent such surges from causing damage is the most difficult problem in lightning protection. The various factors influencing the general design of the aluminum-cell arrester are discussed in the next section of the paper. One feature is the disappearance of resistance in the arrester when a discharge takes place. Another is the continual dissolution of the metal in the electrolyte. This is controlled by the choice of the electrolyte. A third feature is the ability to endure continual discharges. A properly designed arrester should have a life of several years. The design is, of course, largely influenced by the cost of the arrester. The results of an investigation of the resistance of earth connections is given in the fifth section of the paper. It was found that these could be considerably improved by saturating the ground with brine. The concluding part of this paper is a report on cement as a resister, prepared by R. H. Marvin. The specific resistance of different mixtures is from one to 3,000 ohms when wet; when dry, it is over a megohm; when again wet, the resistance falls to approximately its original value.

Ernest J. Berg presented a paper entitled "Tests with Arcing Grounds and Connections." This described a number of tests made on a twenty-five-cycle, 33,000-volt system supplied from a three-phase turbo-generator. The effects of grounding the system in various ways were examined, but no mathematical expressions for these were deduced. In one of these tests the high-potential side of a step-down transformer was grounded at both terminals and coupled with the high-potential side of a step-up transformer through a ground connection on one side and a spark-gap on the other. It was found that with this arrangement, when a discharge was taking place, the strains on the end coils of the step-down transformer were ten times normal at one end while apparently normal at the other. When the ground connection on the step-up transformer was removed, the strains were very much reduced. In another test an arcing ground was made at the terminal of the step-down transformer. It was found that the strains on the end turns at the grounded terminal were fifteen times normal. No abnormal strains were noticed at the other terminal of this transformer. Three transformers were then connected up in delta and an arcing ground established at one apex. It was found that the striking distance across the two transformers nearest to the ground was nearly double the normal, while that across the transformer opposed to the ground was twenty per cent above normal. Renewing one of the transformers so as to give an open delta grounded at one end produced very high stresses in the two transformers. In one it was fifty-five per cent above the normal; in the other, 2.2 times the normal. Grounding the middle line of the two transformers developed a stress in them of over two times the normal, and in each case the striking distance across the end coils was from fifteen to twenty times the normal. Placing an inductance in the grounding connection did not seem to affect the results, even though the reactance was twenty-five per cent of that of the transformer. Various methods of relieving these strains were investigated. One consisted in connecting condensers across the end turns, resistances being introduced in these shunts. This simply transferred the stress from the end coil to the next one. Loading the transformers did not materially affect the results. The author concludes that with increasing line voltages it will probably become desirable to resort to some new methods of protecting the windings of transformers and other apparatus connecting the high-potential lines. It is suggested that this might be accomplished by connecting a series of electrolytic cells in shunt with the end turns. He points out that in his experiments there were no transmission lines between the transformers, so that the results do not represent what would actually occur in a transmission system.

Percy H. Thomas, in a paper entitled "Critical Study of Lightning Rods on Taylor's Falls Transmission Line," discussed the two papers read by J. F. Vaughan and N. J. Neall at the May meeting of the American Institute of Electrical Engineers. These records are gone into in some detail and the lessons taught by them are summarized. They show that the extent of a lightning disturbance is readily extended over more than a mile or two and that it may charge up the line and send waves of static in both directions which are able to pass many miles and still cause arresters to discharge. It is thought that little protection is obtained from lightning rods located beside the line, and whether the protection is obtained from overhead or grounded wires or not depends entirely upon the arrangement of the wires and the frequency of grounding. Station arresters of the best types should, in the absence of severe discharges close to the station, protect adequately the station apparatus if they be properly insulated. Horn arresters, as installed, are not nonarcing without adequate series resistance, and can be relied upon occasionally to shut down the plant. Both the electrolytic and the low-equivalent arresters showed themselves properly non-arcing and caused no trouble on this score.

The discussion was opened by the reading, by P. H. Thomas, of a communication from J. F. Vaughan discussing Mr. Thomas's paper. Mr. Vaughan said there was little evidence of there being much energy in a lightning discharge, provided the successive discharges succeeded one another frequently. If one accepted the release of the bound-charge explanation offered by Mr. Thomas it would be necessary to modify our ideas concerning the effects of lightning. As indicating the value of the grounded wire, the experience with a three-phase system arranged in the usual triangular manner offered some evidence. It was found that with such an arrangement the wire facing the direction in which a storm was coming was the one to suffer first; while, as the storm passed over the transmission line, the wire at the top showed the greatest activity. In his investigations he had not noticed any direct strokes.

Dr. C. P. Steinmetz expressed his appreciation of the value of these painstaking investigations of lightning troubles. The study of transient phenomena such as lightning is exceedingly valuable, and it seems likely that before long we will be as familiar with such phenomena and be as able to predetermine their effects as we can now for ordinary alternating currents. Coming to the ground wire as a means of protection, with the exception of a few "doubting Thomases" this is now generally admitted to be the most efficacious protection. Dr. Steinmetz does not agree with Mr. Thomas's explanation of the Taylor's Falls trouble. The latter says the cause of the trouble is not a direct stroke, but the releasing of a bound charge, and Dr. Steinmetz can not see the difference between the two. Regarding the use of tell-tale papers, it would be well to fireproof these by the use of some such material as tungstate of sodium, which would prevent combustion after a discharge. This treatment in no way affects the paper nor changes its behavior with regard to the discharge through it. It simply prevents its continuing to burn.

P. M. Lincoln agreed with Dr. Steinmetz concerning the value of the grounded wire, and took issue with Mr. Thomas in his interpretation of the records given in Mr. Vaughan's previous Institute paper on the Taylor's Falls experiments.

Dr. A. E. Kennelly said the construction of an overhead line was important on account of the change in construction involved when such is used. As to its benefits, the experience of half a century in telegraph operation seemed to be of value. Although the conditions of operation and the troubles resulting from lightning on telegraph systems were different from those on transmission lines, it still was significant that the lower telegraph wires always escaped during thunder-storms. This had led to the use of a short grounded wire run up each pole as a means of protection. Nevertheless, it is not safe to hope for perfect freedom from trouble, nor is it time yet to form a definite opinion of the cause of the disturbances. There are several possible causes, and our minds should be held open until more definite and complete knowledge is obtained. There is one cause not usually recognized. This is the electromagnetic waves set up by a distant lightning discharge.

J. B. Taylor objected to the use of the term "lightning" in a broad sense, a use attributed to Dr. Steinmetz. There seemed to him no reason why the old meaning of the term should be changed. Regarding the frequency of the discharges as found in Mr. Creighton's investigation, he wished to know whether the lower frequency was not merely the natural discharge frequency of the line. Mr. Berg's experiments were valuable, but, unfortunately, no explanations of the effects there described were attempted.

Mr. Taylor also asked what authority Mr. Thomas had for his use of the term "static" in a new sense, particularly since the electrical charge referred to was one in motion.

R. H. Marriott described some experiences which he had had with electrical disturbances on a wireless telegraph antenna. Three kinds of disturbances were noticed —electromagnetic waves, such as referred to by Dr. Kennelly, produced by a distant lightning discharge; a direct discharge to the antenna, and disturbances produced by wind friction on the wires.

D. B. Rushmore cautioned the Institute against drawing conclusions from insufficient knowledge. More complete investigations must be made. In his opinion the application of the oscillograph to the study of lightning phenomena was the first real step which had been made in this direction. He did not think that a burned hole in a piece of paper could be taken as real evidence. It is only a "may be." The ground wire is generally accepted as good protection, but it is hard to prove directly its value. He thought the proper method of protecting a system is to install lightning arresters to protect the station apparatus, but not the line. To protect the latter an overhead ground wire or lightning rods should be used, and better line insulators. We are now at the point where we are able to protect the station apparatus against lightning troubles, so that the problem is being transferred from the station to the line, and here the study of line insulation is the most important question.

J. W. Fraser explained briefly the experiences of the Southern Power Company in the use of lightning arresters for protecting its transmission lines. Both multigap arresters and low-equivalent arresters are employed. Last fall a number of aluminum arresters were put in. Since then several severe storms have occurred, and the latter arresters seem certainly to be doing good work. They handled three severe grounds without damage. During last season the Southern Power Company lost but one transformer, and that one had been damaged somewhat during erection. There were a few broken bushings, indicating that a better passage to ground was necessary at certain points.

L. W. Waters took up Mr. Berg's paper, saying that if the potential at the end turns of a transformer increased toward the end, the excess potential of the last turn might easily be 100 times the normal at times of lightning troubles. If taps are introduced these simply add danger points. The only solution of the problem thus confronted is extra insulation of the end turns or the use of choke-coils. On account of the expense of the former method the latter is the only one commercial. He thought that probably the conditions are not quite so serious as Mr. Berg's paper makes out, as records of performance do not indicate that the end turns are more liable to trouble than intermediate turns.

William McClellan said that the telltale paper records should be taken merely as corroborative evidence. The method employed by Mr. Creighton is good as giving direct evidence. There are two parts to this problem—the protection of the station and the protection of the line. We are able now to protect the former, and the question is merely the amount and kind of protection to be adopted. The great problem, therefore, is to protect the line. It is impossible to do this with the station arresters, and the best solution seems to be the grounded wire.

F. Osgood asked what the limits of the disturbing influences during lightning troubles are. He also wished to know what is the value of serving the wire at the insulators so as to prevent breakage due to arcing.

D. C. Jackson thought that not enough work had yet been done in investigating lightning troubles to lead to entirely satisfactory conclusions. To-day it is merely a question of how much money a system can afford to spend to protect its lines. He is looking forward to better results in the future.

Dr. Steinmetz, replying to the question asked by Mr. Osgood, prompted by a conclusion drawn in Mr. Thomas's paper, said that that conclusion must not be accepted too literally. The statement that the effect of discharge is limited to only half a mile is not quite true, since even though the direct discharge does escape to ground within this distance, the secondary effects, such as surges, may extend over the entire line. He did not agree with Mr. Waters's statement that there was no evidence of abnormal stress on the end turns of transformers, because the continued breakdown of the end turns had forced the manufacturers to increase the insulation of these turns. Now the fact that there is no more trouble there than at other turns is merely an indication of the proper distribution of insulation and of correct design. Very high-potential transformers, however, still give trouble there.

In closing the discussion on his paper Mr. Creighton said that there were no dynamic currents on the line when his records were taken. He did not think that overhead grounded wires afforded complete protection, but they bring the potential of the system during the disturbance to a value which the line can stand. Storms vary considerably, but are largely influenced by the country. Regarding the broad use of the term "lightning" he placed the responsibility on Dr. Steinmetz, but thought this use good. As to the frequency of lightning discharges, it is hard to say. These may have almost any frequency, as high even as a million cycles per second, or no frequency at all, being simply a single discharge. He agreed with Mr. Berg that the greatest problem is to protect the system against internal surges. One important question is how many stations must be fitted with arresters to protect them all against these troubles.

Mr. Berg, replying to Mr. Taylor's criticism, said that no theory of the arcing ground can yet be given because the knowledge is incomplete. He found that during these troubles the end turns of the transformers are heated, indicating the flow of a heavy current there. Choking-coils are not completely effective for protecting transformers, and the General Electric Company insulates the end turns of its transformers for from 100 to 200 times the normal voltage.

P. H. Thomas said that caution should be used in studying Mr. Berg's results. His records are given in the distances jumped by the sparks, and not in the actual potential of the discharge. He himself objects to the wide use of the term "lightning," but thinks the term "static," as used by himself, fits the case exactly. His views on the value of the grounded wire seem to be misunderstood. He thinks that this does give the best protection, but his criticism of Mr. Vaughan's conclusions was that the evidence which the latter gave does not show that the grounded wires installed on the Taylor's Falls transmission lines gave the protection attributed to them. In his opinion there is a difference between a direct stroke and the release of a bound charge, and the means for handling the two disturbances should be different. The thing is to determine which of all the troubles is the damaging one. That can then be taken care of and the others let go. Replying to Mr. Osgood's question, he said that the effect of the direct discharge is limited to a comparatively short part of the line, but there may be a series of discharges taking place within one neighborhood. He differed with those who objected to the drawing of inferences from experiments, even when incomplete. In his opinion this is the only way in which to advance rapidly.

J. W. Fraser read a paper on "Some Engineering Features of the Southern Power Company's System." This calls attention to the large number of cotton mills situated in North and South Carolina within transmitting distance of certain large water powers. The opportunity thus offered has been seized by the Southern Power Company, which has secured ten water powers aggregating not less than 150,000 horse-power. It is estimated than the mills lying within the district of this company use approximately 200,000 horse-power, which costs them to produce on an average about $34 a year. In one or two cases the cost had been reduced to $30. Mr. Fraser then discusses the system selected by the Southern Power Company. The original plant on the Catawba River, with an output of 10,000 horse-power, was operating at sixty cycles, and a large number of the motors in use in the mills were, of course, for the same frequency. While a certain economy might have resulted from the selection of a different frequency, it was thought that, on the whole, the most economical solution would be to retain the old frequency. The voltage selected was 44,000, which was sufficiently high for the district covered, and was less expensive to install than a higher potential. The line construction, station and substation equipments are described and the reasons for installing a reserve steam station are explained. It was found at one of the plants that the minimum power was 16,000 kilowatts and that there was an increase of 2,000 kilowatts. If secondary power were to be developed for eight months, the total output could be 24,000 kilowatts. It is a question how much of this secondary power can be developed economically in a steam plant. By charging this power with the entire cost of the steam equipment, it was found that the maximum profit would be made when 2,200 kilowatts in secondary power were developed, but since the steam plant really serves as a reserve for the hydraulic system, it seems only fair to charge the latter with the cost of this reserve and to charge against the secondary power only the actual cost of producing it. On this basis it would be profitable to install a secondary station with an output of 5,500 kilowatts. For these reasons it has been decided to install an auxiliary plant to develop fifty per cent of the primary power.

The discussion was opened by J. H. Finney, who directed attention to the excellent constructive work being done by the Southern Power Company. The character of the load there makes reliability very important, and for this reason only conservative construction is adopted. A high character of work has been followed throughout the entire installation, and he believes that the system as a whole is as creditable as any in the country.

D. B. Rushmore also praised the character of the work being done by the Southern Power Company, which, he said, was unusually creditable. The 44,000 volts adopted as a maximum there was conservative when first selected, and the importance of the system did not permit any risk to be taken. He thinks that at present there is no justification for a good many of the high potentials which are being adopted. He suggested that multiples of 1,100 volts should be taken as standards, and gave the following list of suitable values: 6,600, 11,000, 22,000, 33,000, 44,000, 66,000, 88,000, 110,000 and possibly 165,000. He believed, however, that to-day there is no reason for anything less than 110,000, except for very conservative systems. The 88,000 might be left out. The Southern Power Company's system has been designed for at least 66,000 volts, so that for a 44,000-volt system the factor of safety is unusually high. There is today no reason for using a high-tension delta-connected system, because such a system can not operate with one wire down nor with one transformer cut out.

P. M. Lincoln said that while standardization before adoption is advisable, it would hardly be wise at this time to drop 88,000 volts as a proper transmission potential, because there are now a number of systems going into operation which have adopted this voltage. The selection of a delta or Y-connected system depends upon whether it is intended to operate with a grounded neutral or not.

W. S. Lee, Jr., said that another condition had arisen which might alter the Southern Power Company's decision regarding the development of secondary power. There are a number of cotton mills having highly efficient steam plants, but which would use electric power for six months if they could thereby effect a saving. Hence the company is planning to install sufficient equipment to supply this demand during the months of high water. He said also that in the selection of the voltage of the Southern Power Company the company had in anticipation the use of 88,000 volts later on, and for this reason the insulation of the lines had been particularly cared for. Replying to a question regarding the simplicity of the wiring of one of the generating stations, Mr. Lee said that there were to be three plants in that immediate neighborhood for which there would be but one large complete switching station.

Dr. Steinmetz commended the conservative selection of potential and of line construction adopted by the Southern Power Company. He said that the great results in electrical development which had been accomplished in the South were remarkable. It is noteworthy that the conditions existing there are very different from those in the West. On the Pacific Coast cheap power is very important. In the South there are many efficient steam plants with which the transmission plants must compete, and the character of the load, which is mainly cotton factories, is such that reliability is absolutely essential.

Austin Burt read a paper on "Three-Phase Power Factor." According to the commonly accepted definition of power-factor as the ratio of true power to volt-amperes, there is no single factor which will exactly express such a physical relation in a delta-connected unsymmetrical three-phase system. It is possible, however, to determine by practical methods the weighted mean of the three power-factors of the single-phase pairs of such a three-phase system and to express that value by a single factor. The power-factor of a system may be taken as the cosine of the angle whose tangent is the ratio between the wattless ampere-volts and the energy ampere-volts. The ratio of the total energy-ampere volts and the total wattless ampere-volts in a three-phase system gives a value which is the weighted mean of the similar ratios of the several single-phase pairs. The cosine of the angle whose tangent is this mean ratio may be taken as the mean power-factor of the system. The author then derives the expressions referred to and shows how a polyphase wattmeter may be utilized for measuring the quantities necessary to give the desired ratio by disconnecting first one of the pressure wires and then the other.

C. A. Adams gave a simple non-analytical method of proving that two wattmeters may be employed for measuring the true power of a three-phase system. This conclusion is reached by treating one of the wires as a common return for the other two, considering the whole system as a two-phase system without respect to the difference in phase displacement. He asked whether his solution were not rigorously true.

Dr. F. Bedell said that the proof was rigorous, and had been given by A. Blondel in his paper read before the International Electrical Congress at Chicago, in 1893.

This completed the morning session, which was then adjourned.

TUESDAY EVENING SESSION.

The Tuesday evening session was called to order by President Stott at 8 o'clock, and three papers dealing with high-potential problems were taken up.

Ralph D. Mershon, in a paper entitled "High-Voltage Measurements at Niagara," described the results of tests on an experimental line which had been carried out more or less continually from 1903 to 1907. An experimental line having a total length of 2,000 feet was erected, supported on wooden poles 140 feet apart. The wires were supported first on insulators and later on paraffin cords attached to the insulators in order to eliminate effects of insulator leakage. In addition to the longer line, a short line, a few feet in length only, built up of cross-arms, pins and insulators, was constructed so as to enable the insulator losses to be studied without bringing in losses through the air. Aluminum conductors of various sizes and one copper conductor were tested. The apparatus and methods of measuring the losses are described, the usual method being to balance the two transformer losses against each other, thus enabling the loss taking place, due to the line only, to be measured directly. The general conclusions deduced from this investigation are: With a given conductor at a given spacing, under given atmospheric conditions, there is a certain voltage or critical point at which a very appreciable loss begins to occur through the atmosphere. There may or may not be a loss below this critical point, depending upon the atmospheric conditions. Floating particles in the atmosphere, whether of moisture or solid, promote such loss, and also increase the loss above the critical point. This critical point corresponds to a partial breakdown of the dielectric and coincides with the voltage at which luminosity or hissing of the conductors begins. It depends upon the maximum value of the electromotive-force wave and the distance between conductors. It is really fixed by the potential gradient at some point in the atmosphere. There is a loss over insulators which is affected by the moisture conditions of the atmosphere. The variations in the atmospheric and the insulator loss, due to atmospheric conditions, bear a definite relation to the product obtained by multiplying the vapor pressure by the relative humidity. So far as is at present known, this relation is empiric. The loss over insulators during a fog is higher than in dry air or during a heavy rain. The smoother the surface of the conductor the less the loss, while stranding conductors decreases the loss, due to the increased equivalent diameter of the conductor. Weathering of conductors does not apparently affect the critical point. This point is the same for copper and for aluminum. Anything which increases the charging current of an insulator increases the loss of an insulator, and this loss is greater when wooden pins are used than when the pins are of metal because of the greater resistance of the wooden pin. These losses decrease with the frequency, but the law of decrease is not yet known. Neither the critical point nor the loss between cables is affected by variation in the distance of the cables from the ground.

Following the presentation of this paper, Dr. Samuel Sheldon, in an appreciative address, presented, on behalf of the board of directors of the Institute, engrossed resolutions to Charles F. Scott in acknowledgment of the work which Mr. Scott had done in securing Mr. Carnegie's gift of the Engineering Societies Building and also for Mr. Scott's valuable work as one of the Institute's trustees of the United Engineering Society.

Mr. Scott was deeply touched by this tribute and appreciation, and expressed his feelings warmly.

The discussion on Mr. Mershon's paper was opened by the reading by P. H. Thomas of a communication from H. L. Doherty which discussed the great value of such high-voltage studies.

Dr. Elihu Thomson then took up Mr. Mershon's conclusions *seriatim*. The first conclusion that there is a certain critical voltage is well known. The second is somewhat remarkable, as this states that there may be a loss below the critical voltage depending upon the weather, though there is no visible indication of such loss. The third conclusion, which states that particles in the atmosphere may produce such a loss, is perfectly logical. The effect of water vapor in producing a loss below the critical point may be explained by the fact that water vapor just above the condensation point is not a true gas. There are then some particles of water in the liquid condition. This view brings conclusions 3 and 4 together, and from this conclusion 5, which states that the presence of moisture affects the amount of loss above the critical voltage, follows logically. That the presence of moisture and other particles in the atmosphere affects the position of the critical point is explained by the fact that such particles extend the influence of the conductor.

The next five conclusions, which state that the critical point corresponds to a partial breakdown of the dielectric and coincides with the voltage at which luminosity begins; that this point depends upon the maximum value of the electromotive force; that it depends upon the distance between the conductors and their diameter, and that there is a loss at the insulators which is affected by the atmosphere, are all admitted. Mr. Mershon had apparently found a law connecting atmospheric loss with the product of the vapor pressure by the relative humidity. This is natural, since the quantity of moisture and its condition are both concerned. The greater loss due to fog, as compared with rain, may be because in the former case the entire insulator is covered with water. The conclusion that the smoother the surface of the conductor the less the loss seems logical, but it does not agree with the next two conclusions, which state that the use of a standard conductor of equivalent diameter reduces the loss. The weathering of aluminum conductors would not be expected to increase the loss, and it is also to be expected that this loss would be independent of the material of which the conductor is made. That the increase in the charging current of the insulator increases the loss is natural. The same is true of the conclusion that this loss decreases with the frequency. The fact that the distance from the ground does not seem to affect the loss may be because this distance is relatively very much greater than the distance between the wires.

Dr. Samuel Sheldon called attention to the study of the atmosphere which has been made by Professor Carl Barus, of Brown University. Investigations have been made at Providence, R. I., and at Block Island. He has always found that ions are present in the atmosphere at both places. Dr. Sheldon explained Professor C. T. R. Wilson's idea of how ionization takes place. It is due to the collision of a rapidly moving ion with a molecule. This collision splits another ion off the molecule, which, in its turn, may cause ionization of a second molecule. The effect, when once started, spreads rapidly like a conflagration. Hence the comparatively sharply defined critical voltage.

Henry Floy discussed the early experiments of Professor H. J. Ryan, on atmospheric losses, and said it is probable that the different values of the critical voltages as found by Ralph D. Mershon and Professor Ryan were due to the different methods of determination. Professor Ryan had depended upon visual observations, while Mr. Mershon had used instruments.

Dr. Steinmetz does not admit that the critical potential indicates a sudden change. The change must be gradual. The discharge would probably be started at the kinks in the wire, where brush discharges will arise. They do not represent the true critical potential of the wire. It is hard to get accurate results. He suggested that if Mr. Mershon would plot his results on logarithmic co-ordinates, thus getting straight lines, instead of the logarithmic curves he apparently obtains, that it would be much easier to extend these lines, and thus obtain the critical value accurately. The results given in the paper show that there is a loss, but more work must be done before its value can be known accurately.

P. H. Thomas said that at the present time these atmospheric losses are negligible from a commercial point of view. He suggested also that a quadrant electrometer might be used advantageously for measuring the energy of these losses, since but little energy is consumed in this device. He asked for data indicating the actual atmospheric loss during rain.

P. M. Lincoln pointed out the fact that the experiments had been conducted on a single-phase line, and since the relative potential of the line to ground of a three-phase system would be different, the results might not be directly applicable to the latter.

C. F. Scott said that laboratory experiments frequently failed to give results applicable to outside conditions. This atmospheric loss determines the limit of potential which may be employed for power transmission, and he asked how the limits as found by Mr. Mershon in his recent investigation agreed with those which the latter had assumed in an earlier Institute paper, in which the statement was made that the economical size of conductor for any length of transmission and any possible potential would bring the system below the critical potential.

P. N. Nunn thought that the subject

was more of scientific interest in its present form than of practical value. What is needed on a transmission system before all else is reliability. The insulation of a system must be considered as a whole, and the loss as due to its weakest links. He gave briefly an account of a number of systems with which he had been connected, which had given various degrees of satisfaction, and not always in proportion to the amount of protection or the expensiveness of the installation employed. The best lines have frequently given trouble, and the cheapest ones have been immune from it. Why, he could not say.

Dr. Elihu Thomson questioned the accuracy of the statement that the increase of loss due to vapor in the atmosphere is the same for the same vapor product, no matter what the size of conductor or what the spacing between conductors.

In closing the discussion Mr. Mershon said that undoubtedly Professor Ryan's high values for the critical potential were due to his method of determination. The latter depended upon the appearance of luminosity. Referring to Dr. Steinmetz's criticism, he said that even though the wire might have been kinked, the conditions obtaining were those of actual construction. He questioned whether Mr. Thomas's suggestion that a quadrant electrometer be used could be adopted, because of the loss taking place in the wire employed for splitting the potential. Readings of atmospheric loss during rain had been taken, but no consistent values had been obtained. The behavior then resembled that during a snow-storm. Mr. Lincoln's point regarding the difference between a single-phase and a three-phase system with respect to the ground was good, but this point had not been taken up, and nothing had been done as yet to determine the losses of a three-phase system.

D. R. Scholes presented a paper entitled "Fundamental Considerations Governing the Design of Transmission Line Structures." Before a tower or pole for a given transmission line can be designed, some conclusion regarding the loads to be borne must be reached. Since the towers now in use for transmission lines resemble closely windmill towers, it seems that the best guide in selecting figures to represent the problem of extreme load conditions may be gathered from a study of such structures, as they are the result of many years' experience. The various factors then affecting the strains on the towers, such as wind, sleet, low temperature and accidents due to breaking cables, etc., are considered. The author suggests that towers be designed to resist a wind pressure of forty pounds per square foot, with a factor of safety from one and one-half to two. The actual value of this factor is to be determined by experiment, and the method suggested is the erection of an experimental span as near as possible to a weather bureau station, provision being made to measure the stress. The figure of thirty pounds per square foot is commonly used in bridge calculations, but it is unsafe to assume this in localities where high winds prevail, and when it is used a factor of safety of two should be adopted. It is suggested that the structure should provide for a coating of sleet at least half an inch thick, a factor of safety of two being employed in calculating the ultimate strength of the conductor to carry this load. To insure the cross-arms against breaking, should a cable give way, it is suggested that the arms should be tested to loads equal to one and one-quarter times the elastic limit of the conductor if on pin insulators, and one and one-half times the elastic limit of the conductor if on suspension insulators. In developing the design of the foundation for a given line, tests should always be made to determine the holding power, density, etc., of the soil so that the strength of the foundation will be known as accurately as the strengths of the other parts of the line.

A communication from N. J. Neall was read by Mr. Thomas, which criticized some of the suggestions made by Mr. Scholes, and suggested that more conservative figures would be better, and that a factor of safety of two should be the least employed at any point.

C. E. Skinner presented a paper on "The Testing of High-Voltage Line Insulators," in which a specification is proposed as standard for the testing of high-voltage line insulators. This specification was prepared by request of the High-Tension Transmission Committee of the Institute and it represents, as far as possible, the harmonized information obtained from different sources, and not Mr. Skinner's personal opinion. The specification is divided into three parts: Routine tests, such as inspection, dielectric tests; design tests, for determining the mechanical strength, whether the insulator will be able to withstand its full potential, rain tests and dew tests, etc., and, finally, instructions for carrying out the various required tests. Some of the requirements of these tests, such as the rain test, are more severe than would ever be experienced in practice except under the most unusual conditions.

A communication by N. J. Neall, discussing this paper, was read, in which more severe tests are urged. At least three times the normal potential should be applied to every insulator. Objection is also raised to the suggested method of making the rain test. Mr. Skinner proposes placing the insulator at an angle of forty-five degrees and allowing the water spray to fall vertically. Mr. Neall contends this will not represent the actual conditions on account of electrostatic and gravitational forces.

P. H. Thomas said that insulators should be tested by means of a spark-gap so as to produce a high frequency, and asked what provision has been made for testing at different frequencies.

Mr. Mershon approved the use of the vertical spray with inclined insulator because of the difficulty of accurately obtaining a specified spray at an angle. There is also a good deal of trouble in finding exactly what the spray shall be. He thought that the amount of precipitation recommended was too small. That usually required is one inch per minute, and the records of the Weather Bureau show that occasionally 0.8 inch falls during an actual rainstorm.

Dr. C. H. Sharp described a spray which is used abroad, and which he purposes using in this country for testing insulators. This consists of a cylindrical tank, in the bottom of which are a number of small tubes, each plugged with asbestos wool or some similar material. By applying air pressure to this tank any rate of precipitation desired may be obtained, while this may easily be measured by means of the gauge glass on the tank.

E. M. Hewlett suggested that a steam test might be better than a rain test.

Dr. Steinmetz suggested that all insulators should be submerged for one week before applying the test. This would allow any absorption of moisture due to the appearance of hair cracks in the glaze to take place. Such absorption will, of course, take place after the insulator has been installed. He did not think it was advisable to test any insulator at less than twice the normal potential.

In closing the discussion Mr. Skinner said that in his opinion a dew test will be more severe than a rain test, and much easier to reproduce. He did not think that accurate results could be obtained by blowing the spray against the insulator. The specifications which he had proposed were intended to indicate what a performance test should be and to draw out further information.

The session was then adjourned.

(To be concluded.)

Street Railway Association of the State of New York.

Twenty-sixth Annual Meeting, Held at Niagara Falls, Ontario, June 30 and July 1.

THE twenty-sixth annual meeting of the Street Railway Association of the State of New York was held at the Clifton Hotel, Niagara Falls, Ontario, June 30 and July 1. President T. W. Wilson, general manager of the International Railway Company, Buffalo, N. Y., called the meeting to order at 10.30 A. M., June 30, in the assembly room of the hotel, and introduced the Hon. R. F. Carter, mayor of the city of Niagara Falls, Ontario, who welcomed the railroad men to the city and voiced the appreciation of the city officials upon the selection of Niagara Falls as their convention place.

The secretary made several announcements, and, on motion, the reading of the minutes of the last meeting was dispensed with.

President Wilson then delivered his annual address, saying that while the beginning of the year pointed to a most prosperous era, since last October there has been a struggle to reduce operating expenses commensurately with the falling off in gross earnings. Ninety-eight per cent of the total earnings of electric railways is derived from receipts from passengers and consequently the electric railways had not suffered as heavily as the steam roads. He reviewed the work of the association during the year and commented particularly upon the work of the Committee on Standard Classification of Accounts.

The secretary, J. H. Pardee, reported that the number of active members had remained the same during the year. Three allied members had resigned and twenty-two new allied members had joined, making a total of 100 allied members. William Sharpe and J. C. Calisch, who were elected at the last convention as members of the executive committee, were compelled to resign on account of business engagements. E. J. Cook, of Rochester, and R. J. Dyer, Jr., of Auburn, were elected to fill the vacancies.

The next item of business was the report of the treasurer. H. M. Beardsley, secretary and treasurer of the Elmira Water, Light and Railroad Company, presented his report, showing total receipts for the year amounting to $10,875.23; expenses, $6,897.05; balance, $3,978.18.

C. Loomis Allen, of the Syracuse Rapid Transit Company, presented the report of the Committee on Classification of Accounts. This report indicated that it was unsatisfactory for the street railway companies and the steam railroads to make up their accounts on the same classification. Another objection was the incorporation of a theoretical depreciation account in the classification. Still another was the keeping of such a large number of primary accounts as were called for for the electric railways. After the committee had worked with the Interstate Commerce Commission and the Public Service Commission, a final classification of accounts was submitted which had been approved by the Interstate Commerce Commission, and will be promulgated on October 1. The resulting classifications were three in number, known as A, B and C. Classification A is kept by all roads having gross receipts of more than $250,000; classification B is kept by all roads having gross receipts between $50,000 and $250,000; classification C is kept by roads having receipts of $50,000 and less. The electric railways succeeded in convincing the regulating commissions that it would not be to the best advantage for electric railways or commissions to insist that steam and electric railways should account upon an identical classification.

Concerning the question of depreciation it is stated that the Interstate Commerce Commission in its classification will not promulgate depreciation, but will depend upon the second year upon what a majority of the state commissions will do with the classification as to whether they shall incorporate it in the order for the second year's operation.

In presenting the report of the Committee on Electric Express and Freight Service Mr. Allen stated that W. C. Collins had carried on most of the work in connection with this report. The committee had held four meetings. At the first meeting Mr. Collins was elected secretary, and since that time the bulk of the work had devolved upon him. There had developed, however, several matters which he would call upon the members of the committee to talk about. These were the question of rates and the question of blanks. He asked A. Eastman to deliver the report upon the question of rates.

Mr. Eastman stated that possibly no uniform or standard form should be adopted in compiling express and freight rates. He believed, however, that it would be to the interest of all electric railway companies to adopt a uniform tariff sheet, if for no other purpose than to make the filing with the Public Service Commission more uniform and standard. Any comparison of figures concerning the freight rates established by different companies would be very misleading, and would indicate that the company having a few miles of track was getting a much higher rate per ton-mile than a company with considerable mileage. This results from the fact that a five-mile haul at a rate of ten cents per hundred gives a rate of forty cents per ton-mile, when possibly the same commodity would be hauled fifty miles at a rate of twenty cents per hundred, giving a rate per ton-mile of eight cents; while if the five-mile rate were taken as a basis, the fifty-mile haul would amount to ten times as much as a five-mile haul, or $4 per ton-mile. It can therefore be clearly seen that the length of haul controls the rate per ton-mile. A number of the electric railway companies have adopted a minimum charge of ten cents per shipment, but unless competition is such that it is absolutely necessary to do so, the author did not think that the minimum charge should be less than fifteen cents per shipment, and it should be twenty-five cents when possible.

There was no discussion upon this section of the report and W. C. Collins was called upon for his comments.

Mr. Collins suggested that the best results could be accomplished if a considerable amount of standardization should be done in order to evolve a system that should be sufficiently elastic to cover all roads and all conditions. An important point to be taken into consideration is the difference in operation. A city company operating with an express messenger on a car would not need such an elaborate system as a large interurban road operating through towns with agents. It is just such cases as these that it is necessary to harmonize. The primary blanks would be the same, however, for all companies. He then described the blanks which would be needed to carry out the different functions necessary under different regulations of service.

Edgar S. Fassett, general manager of the United Traction Company, of Albany, N. Y., stated that there were several points which should be taken into consideration concerning the Interstate Commerce Commission. He said that, judging from the most recent decision of the courts, any freight or express which is consigned to points outside of the state or which comes from points outside of the state and is consigned to a freight or express company, brings the electric railway company under the Interstate Commerce act, with all its conditions. He has recently issued an order making it impossible for his company to accept freight and express consigned to points outside of the state or to receive from any steam railroad any freight or express coming from outside of the state.

The next report was by A. R. Walsh, of the Schenectady Railway Company, on the question of freight and express departments. Mr. Walsh considered that the total operating expenses per car-mile for carrying freight varied from twenty cents per car-mile to $1.02½ per car-mile. In averaging these costs it was discovered that the company that operated for twenty cents per car-mile earned a gross of forty-four and one-half cents per car-mile, while the company that operated for $1.02½ per car-mile earned in gross a fraction over $1.28 per car-mile. The company with the operating expenses of $1.02½ per car-mile earned one and one-half cents net more per car-mile than the company which operated for twenty cents per car-mile.

There was a large variation in the mileage—196,602 miles for one company, against 30,515 for the other. The one company in ten months earned almost $50,000 gross more than the other, while the expenses were only about $8,000 more. What makes the cost of operation vary so in this particular case is the vast difference in mileage.

One company operated for thirty-three cents per car-mile, and earned net about seventeen and one-quarter cents per car-mile. Another company operated for seventy-three and three-quarters cents per car-mile and while it earned gross eighty-one cents per car-mile, it only earned net about six and one-half cents per car-mile. Neither of these companies did any delivering by wagon, both of them handling nothing but freight; consequently, they had no stable expenses to figure in.

There is no doubt that the express and freight service on electric lines is a great convenience to the merchants, as it is possible for them to get quick service at times when they find themselves short of some particular article. It enables them to carry a smaller stock, and the result is that the electric roads get a large number of shipments.

High charges against the freight department are not right. Taking a freight car and a passenger car of equal weights and equipment, on a twenty-mile run the consumption of power by the freight car will be considerably less than that of a passenger car.

It has been said that an arbitrary charge per mile should be assessed against the freight and express cars. This might be all right if the freight and express privileges were leased to another company, but where the railway company is doing the work itself or where it has a separate department, it would seem that a proportion of the operating expenses should be charged.

Where the companies carry freight in combination cars the costs, of course, decrease.

The author considers that where freight and express is given a proper chance it will be found to be a profitable business.

Mr. Allen moved that the incoming president should appoint a new committee upon freight and express to continue the work for another year. This motion was carried.

The report of the Committee on Height of Car Steps was presented by E. F. Peck, chairman.

The report stated that the committee had held several meetings and that, in so far as the question immediately related to cars now in use, it had been unable, on account of the greatly varying conditions found on many roads, to come to any decision which would be of practical value, as it was very evident that at least the roads which have been represented at the meetings had individually given the matter careful consideration, and had not been able to arrive at any definite conclusion.

The report rehearsed the evolution of the electric street railway from the days of the horse-car, and indicated how the problem was involved by the matter of the spacing of the centres of the tracks.

In the case of closed cars it had been possible to keep within limits which seemed to be reasonably convenient for passengers generally. The committee felt warranted in making the recommendation that in the design of cars to be built in the future for use in cities, the height and rise of steps be, measuring from the top of rail, not more than seventeen inches; from step to platform, fourteen inches, and from platform to floor of car not more than ten inches. In no case did it consider the use of two steps from the street to the platform advisable.

In the case of double-truck, the width of track centres is the controlling condition. This limits the width of the car body, making it necessary to so design the steps that the truck frame, as well as the wheels, in swinging at curves, will have clearance under the step.

In the case of open cars so much depends upon the size of the motors, condition of roadway over which the cars run, as affecting the clearance above rails, and maximum allowable width of car, that the committee feels that perhaps the only reasonable recommendation which can be made is that in all cases the distance from the rail to the step be made as small as possible and the height from the step to the car floor be not more than seventeen inches.

In reply to an inquiry H. A. Benedict suggested that eight inches would be a proper width for a car step.

The report of the Committee on Model Car Repair Shop was presented by H. A. Benedict, chairman. This report gave elaborate details for a model car repair shop accommodating 100 cars. It is assumed that the site is a fairly level stretch of ground having a frontage of 570 feet and a depth of not less than 450 feet. Unprotected structural steel is at the mercy of a conflagration where wooden car bodies below or adjacent to it furnish fuel to distort and weaken the vital parts of the building. If reinforced concrete is used these risks are minimized, if not entirely eliminated. Brick is used for curtain walls which support only their own weight. A unit bay thirty-two feet wide from centre to centre of columns transversely and fourteen feet centre to centre of colums longitudinally is adopted. With the width of thirty-two feet the tracks may be placed on fourteen-foot centres, allowing nine feet from the centre of the outside track to the centre of the adjacent wall. This arrangement gives ample room between and alongside tracks. To secure proper lighting in the bays, which are entirely dependent upon overhead light, and to supplement such side light as may be secured from windows in the exterior walls, a uniform continuous skylight ten feet wide is placed in the roof of each bay on its axis. A car sent to the shop for repairs is switched to certain of the tracks and brought in over the repair pit. This pit is served by pit jacks and by two ten-ton electric traveling cranes in each bay. Each crane is equipped with two five-ton electric traveling hoists. If the car body needs either carpenter repairs or painting it is moved to an adjacent track in the bay and is lowered to a pair of shop trucks. It is then hauled to the carpenter or paint shop. For ordinary repairs the trucks are left over the pit where the car body was removed, and are placed in condition to receive the body after it has been returned from the paint or carpenter shop or another car body of the same type. Oil storage is provided in a separate building adjacent to the stock room. A brass foundry and foundry shop are provided adjacent to the forge shop. To afford efficient fire protection for the contents of the shops, a thorough system of hydrants, both inside and outside of the building, is provided. All hydrants are connected to a 25,000-gallon pressure tank at the rear of the property, as well as to the city water supply. As the buildings themselves are non-inflammable, no sprinkler system is recommended.

W. W. Cole thought that the location of the repair shop should be given very careful consideration. He has found that where repair shops are located at some point considerably out of town, it creates a very large non-revenue mileage in shifting cars to the shop. There is also a tendency to hold the cars too long before sending them to the repair shop, or a tendency to increase the amount of repairs done at the car-barns.

R. E. Danforth, general manager of the Public Service Corporation of New Jersey, said that in providing shops for scattered systems it is an open question whether a central repair shop is of material value. In New Jersey his company has to shift cars forty miles to a central repair shop. Where a well-designed division repair shop is provided it is often the case that the operating expense is less than on a division where a central repair shop is located. Each division master mechanic is particularly interested in the cost of operation of his particular cars, and never spends an unnecessary dollar upon a car when he gets it in his division shop. When he sends the car to the general shop for the annual overhauling he leaves as little as possible to be done at the general shop.

TUESDAY AFTERNOON SESSION.

The Tuesday afternoon session was called to order at 2.45 o'clock by Edgar S. Fassett, first vice-president.

The first paper was entitled "Commutating-Pole Railway Motors," and was read by E. A. Anderson, of the General Electric Company. This paper described the characteristics of the commutating-pole motor and indicated the advisability of adapting this type of motor to railway work. Replying to a question concerning the comparative cost of the commutating-pole motor, Mr. Anderson said that the extra cost of manufacture would probably be about twenty-five per cent. It was a question of increasing the reliability and buying that reliability as cheaply as possible.

There was no further discussion on this paper, and the session adjourned to make a trip over the gorge route and visit points of interest on the Canadian side of Niagara Falls.

WEDNESDAY MORNING SESSION.

The Wednesday morning session was called to order at 10.40 o'clock. The first paper was entitled "Observations on the Pay-as-You-Enter Car by the Mechanical Man," by W. H. Evans, master mechanic, International Railway Company, Buffalo, N. Y. This paper described the several forms of pay-as-you-enter cars which had been installed. In making an effort to reduce the weight of the cars and to simplify the operation of the equipment, particularly in connection with the pay-as-you-enter system, it is perhaps a very opportune time for railway companies to inaugurate equipment arranged for single-end service. With comparatively slight expenditure for necessary track arrangement which will facilitate the operation of cars on the single-end plan, a very decided improvement can be made in the reduction of the weight of the cars and in designing a stronger, more comfortable and a generally more satisfactory car than can be arranged for in double-end operation. The saving in the construction per car will easily offset the expense for the rearrangement of the tracks to permit single-end operation.

Attention was called to the Buffalo plan of fare collection. This arrangement consists of a fare box, or car safe, as it is called, with a suitable receptacle for receiving fares at the top, with a tripping device from which they are dropped into an inner cash box, where the fare is securely deposited until it is conveyed directly to the counting table in the treasurer's office. The small cash boxes are received from the treasurer's office unlocked, and in that position are placed on the inside of the car safe and receive all of the fares collected on the car from the time it goes into service until it is returned to the car barn.

Following the reading of this paper the meeting was addressed by Acton Burrows, secretary-treasurer of the Canadian Street Railway Association.

The next paper was entitled "The Pay-as-You-Enter Car from an Operative Standpoint," and was presented by C. A. Coons, superintendent of transportation, International Railway Company, Buffalo, N. Y. This paper described the method of instructing the trainman for handling passengers on the pay-as-you-enter car. The company has found that the car has become highly popular with both patrons and employés. Among the various advantages and merits of this type of car from an operating standpoint the following may be mentioned: Increase in revenues due to fares previously missed and otherwise appropriated, which are now dropped into the receiver and fare box; increase in speed due to cars being able to take on and discharge passengers simultaneously; decrease in regular cars operated, which necessarily decreases mileage as well as the number of car-hours; decrease in the number of accidents due to the presence of the conductor on the rear platform at all times; alleviation of conditions leading to jostling, crowding and other discomfort to passengers formerly caused by conductor pushing through to collect fares.

Duncan McDonald, general manager of the Montreal Street Railway Company, was introduced as the father of the pay-as-you-enter car. Mr. McDonald addressed the meeting very briefly upon the advantages of this type of car and said that his company was very well satisfied with its operation.

Mr. Danforth described the operation of the pay-as-you-enter car on the system of the Public Service Corporation of New Jersey. This type of car appears to suit the patrons very well, and in spite of the fact that it is of the single-end, cross-seat type, with a large rear platform, it has won the approbation of the people on the company's lines and eliminated all trouble and annoyance formerly caused by the conductor after the passenger had once entered and taken his seat. The company finds that it can carry almost as many passengers per car with some degree of comfort, and can satisfy a greater number of passengers on each car. There has also been an improvement in the collection of fares. After the company had installed the first fifty pay-as-you-enter cars it investigated the possibility of rebuilding some of its old equipment, and it has been found that some 250 or 300 cars were so nearly of the pay-as-you-enter type that an expenditure of about $200 per car will put them in shape for that method of operation. Other cars were found well adapted for double-end construction, and the company is now putting through its shops about 300 cars, some for single-end operation and some for double-end operation.

C. R. Barnes, of the Public Service Commission for the Second District of the State of New York, was introduced and asked for a discussion on the subject, "The Use of Curtains on Front End of Suburban Cars During the Daytime."

W. R. W. Griffin, of the Rochester & Eastern Railway, stated that his company always operated with the front end closed, one of the reasons for this being that it is often possible to carry express that the traveling public would not like to ride with. In this way the company increased its revenue. Another reason was that passengers on a high-speed car, especially in a hilly country, saw too many "near accidents."

Mr. Pardee stated that where cars were operated at a very high speed it was well to keep the curtains down, as the possibility and imminence of danger always impress the passenger when looking straight ahead of the car.

E. F. Peck, general manager of the Schenectady Railway Company, stated that on the Schenectady system the curtains were always up in the daytime. No trouble had ever been experienced. He thought that it made a much pleasanter trip for the passenger, and that in case the motorman was subjected to an accident or overcome in any way it gave the passenger and conductor a chance to see what was happening on the front platform, and in that way resulted in preventing a serious accident. Of course, at night the feature of the interference of the light is a serious thing, and it is then necessary to darken the front end of the car.

The next subject for discussion was "Some Practical Means to Enable Passengers Desiring to Board Trains to Stop Them at Flag Stations."

H. S. Williams, of the Utica & Mohawk Valley Railway, stated that his company provided a system of flag-stop signals consisting simply of a cast-iron switch operating five lights. This is manipulated by the passenger by means of a rope which is pulled at the time the car approaches. There is very little trouble in the maintenance of this signal. The lamps are lighted for only a small portion of the time, and burnouts amount to practically nothing. The box is made of wood, because the experience of the company has been that this stands up better than iron. The signal costs approximately $2.95 to build. This includes the entire cost of lamps, switches, sockets and everything else connected with the signal. The maintenance does not amount to over twenty-five cents a year for each signal.

Upon the suggestion of Mr. Barnes, a motion was carried requiring the incoming president to appoint a committee of five to investigate this subject and report.

The next topic was entitled "The Equipping of City Cars with Red Flags and Lanterns on Lines which Cross Steam Tracks at Grade."

Mr. Coons did not thing that it was a good plan to carry either red flags or lanterns on electric cars. If there was time enough to get out a red flag or a lantern to flag a train, there was time to get the passengers off.

Mr. Barnes did not think that the flagman employed at a steam-road crossing by the steam road affected the operation of the electric car in any way. He did not think that he was of any benefit in safeguarding the operation of the electric system.

Mr. Fassett was of the opinion that it would pay any electric railway company to have its own flagman at all places where a steam road crosses the electric road at grade.

Upon motion it was decided to refer this topic to the Rules Committee to report at the next quarterly meeting, if possible.

The next topic, "The Practice of Carrying Musical Instruments on City Cars," referred to the annoyance which is sometimes caused by the carrying of large instruments such as horns or drums upon crowded cars. The consensus of opinion appeared to be that it was the proper plan to issue either single permits or yearly permits, subject to cancellation if the carrying of the instrument proved an annoyance.

The paper entitled "Signals for Interurban and Local Traffic" was read by title.

Mr. Cole suggested that in view of the important work of the Committee on the Classification of Accounts, it would be well for the incoming president to appoint a committee of three to carry on this work during the next year. A motion to this effect was carried.

Mr. Cole extended a vote of thanks on behalf of the association to the retiring president for the very able manner in which he had conducted the work during the past year. President Wilson responded very briefly. He then called the attention of the meeting to the fact that Mr. Cole, who had been an active member of the association for many years, serving on its committees and as an officer, was retiring from the active management of an electric railway property which was a member of the association. It seemed fitting that a resolution should be spread upon the minutes electing Mr. Cole an honorary member of the association. This resolution was adopted unanimously.

The report of the nominating committee was presented as follows:

For president, E. S. Fassett, Albany.

For first vice-president, E. F. Peck, Schenectady.

For second vice-president, C. Gordon Reel, Kingston.

For secretary, J. H. Pardee, New York.

For treasurer, H. M. Beardsley, Elmira.

Executive committee: E. J. Cook, Rochester; R. A. Dyer, Jr., Auburn; J. W. Hinkley, Jr., Poughkeepsie; T. W. Wilson, Buffalo.

This report was adopted and the secretary instructed to cast a ballot for the ticket.

President-elect Fassett was escorted to the chair by Messrs. Cole and Cook. He addressed the meeting very briefly, stating his appreciation of the honor conferred upon him in his elevation to this position.

The convention was then adjourned.

Meeting of Lamp Testers.

A meeting of all the lamp inspectors in the employ of the Electrical Testing Laboratories was held in New York on July 6, 7 and 8. The following papers were presented and discussed:

"Visual Inspections of Electric Lamps," by C. E. Currier.

"The Best Procedure in Lamp Inspection," by C. H. Stephens.

"The Selection of Life Test Samples," by H. E. Allen.

"The Effect of Varying Test Quantity Upon Rejections," by W. F. TenEyck.

"'Bugs' in Photometry," by E. L. Peck.

"Lamp Inspections at Purchasing Companies' Storehouses," by W. J. Bray.

"The Criterion of Lamp Value," by A. W. Minty.

"The Value of Laboratory Tests," by W. H. Rolinson.

"The Functions of a Lamp Inspector," by George H. St. John.

"The Responsibilities of a Lamp Inspector," by L. J. Lewinson.

THE CONTRACTOR AND ILLUMINATION.

BY VAN RENSSELAER LANSINGH.

Ten years ago when a merchant contracted with a central station for electric light, he figured the installation purely from the standpoint of cost; so many lamps would be required of so much candle-power, and his monthly bill was forecast at approximately so much.

He bargained with the contractor in the same way and the question was: How much will it cost to wire my store for ten lights? The contractor gave his price on a molding job and on open cleat work and the customer took his choice. No mention was made of illumination and if plain drop lights were not used, fixtures and glassware were selected for price and not for efficiency. The central station representative suggested that the lights be placed so many in each window, so many along the counters, etc., and the contractor, when his figures were quoted, met the cry of "too much" with such advice as to rearrangement of outlets as he calculated would secure him the job. And so throughout the transaction the installation was considered merely so many electric lamps—not light, not illumination.

With the increasing popularity of electric light for residence, store and factory lighting, came a gradual and growing enlightenment on the subject; and the matter of efficiencies and economies in the various systems of artificial illumination became of general interest to the public.

As an outgrowth of and correlative with this development and the introduction of the various lamps of higher efficiency and scientifically designed globes and reflectors, has arisen a popular demand for accurate knowledge on the subject of illumination, resulting in the evolution of the profession of illuminating engineering. Also, the central station itself is giving more and more consideration to the subject, realizing that after all what the customer is buying is illumination, not simply current, and that it is incumbent on the lighting company to see that he receives full value for his money. So to-day we find a number of the larger companies with illuminating engineers regularly attached to their commercial staffs; working out efficient lighting schemes for new customers, and rearranging old installations to reduce cost.

The contractor, however, has not yet taken up this phase of his work to the extent which might be expected. The prosperity of the contractor and the volume of his business depend largely on the demand for electric current for lighting and the satisfaction of his customer in the results obtained from each installation. It is just as important to the contractor that every lighting system he installs should give the greatest amount of useful light, and be as economical as possible in consumption of current, as it is to the central station who reads the meter.

Many contractors have the idea that illuminating engineering is too complex and too large a problem for them to handle, taking the stand that the study of scientific lighting is outside their province and that they can not give the time necessary to mastering the subject. They sell motors, however, advising their customers without hesitation on matters of speed and drive, and the details of friction load and power-factor. Also when they give an estimate on a large generator set they do not hesitate to call on the manufacturer for assistance and the job is figured for them when necessary.

Just so, the more advanced problems in illuminating engineering may be handled on the advice of an experienced illuminating engineer; but the simple daily problems which the contractor encounters in the wiring of small stores, residences and factories require only a small amount of study, if it is backed up with a large amount of observation and plenty of good common sense. No highly developed technical education is necessary, but simply a thorough understanding of the fundamental principles of good illumination.

No contractor, nowadays, can succeed who considers his work to be limited to the mere screwing up of cleats and the stringing of wires. He must be part of the wave of development which is as broad as the country, embracing all who work in the field. He must be a co-operator. He must consider his work not "wiring for lights," but "wiring for illumination" and efficient economical results must be the end in view.

There are, of course, numerous instances where contractors large and small have already taken the broader view of the matter and are striving for efficiency. We cite only random cases, but they serve to illustrate the fact that those contractors who are to-day studying illumination and applying its laws in their work, are the farsighted forerunners of this inevitable development.

Frederick C. Ross, of 255 Greenwich street, New York city, for example, is constantly working among his old customers figuring with them the economies which can be realized by the installation of tungsten and other high-efficiency lamps with proper reflectors. Mr. Ross says he realized some time ago that the most prolific field for the contractor lay in the line of redesigning present installations and reducing current consumption, and he has made a special study of the results which may be obtained in this work.

J. Francis Southgate, of Worcester, Mass., is another contractor who has made a number of installations of Holophane arcs and gem lamps, and materially reduced his customers' current costs.

Walter Kidde, of the West Street Building, New York city, though primarily a mechanical engineer engaged principally in the construction of large manufacturing plants, has considered the matter of illumination of the greatest importance, and in the plant of the Brunswick-Balke-Collender Company, in Long Island City, and their New York city show rooms has produced some exceptionally fine results. The efficiency and tone of the show-room lighting has called forth much favorable comment and attained considerable publicity.

Contractors must look the situation fair in the face and realize that the rapid strides of the last few years in this field have affected them quite as much as the lighting company itself.

Electric lights in future will be installed, not as lights, but "for illumination," and it rests with the contractor in large measure to facilitate this progression.

The Chicago Sanitary District Hydroelectric Development.

The investigating committee of the Citizens' Association, of Chicago, Ill., appointed to study conditions surrounding the Chicago Sanitary District hydroelectric development, has reported that if the district is not hampered in the future in its efforts to sell electricity its net income should amount to at least $500,000 a year. This capacity should be reached in six months. Ultimately the capacity may be increased to 80,000 horse-power, with a net annual revenue of $1,500,000. Since January the Sanitary District has installed three generators capable of producing continuously 16,500 horse-power, and for peak service 20,600 horse-power. In six months the plant should be capable of producing continuously 27,500 horse-power. This will be increased to 30,000 horse-power within two years, when the flow is increased by widening the river.

National Electrical Contractors' Association.

Eighth Annual Convention, Chicago, Ill., July 15, 16 and 17.

THE eighth annual convention of the National Electrical Contractors' Association will be held at Chicago, Ill., July 15, 16 and 17. Headquarters will be at the Auditorium Hotel, the registration department and directors' room being located on the parlor floor, the banquet room on the sixth floor being used for the business sessions. The registration department will be opened at 6 P. M., July 14. All badges and tickets for entertainment will be issued from the registration department and no badges will be issued until payment by party registering of the fee for tickets. The programme insures a pleasant and profitable meeting, and indications point to a large attendance. The general programme of the convention is announced as follows:

JAMES R. STRONG,
President National Electrical Contractors' Association.

W. H. MORTON,
Secretary National Electrical Contractors' Association.

JOHN R. GALLOWAY,
Treasurer National Electrical Contractors' Association.

JULY 15.

Open session, 10 A. M.

Business session, 2 P. M.

Men's banquet, 7 P. M., in large banquet hall of the Auditorium Annex.

Ladies' banquet, 7 P. M., in small banquet hall of the Auditorium Annex.

JULY 16.

Open session, 10 A. M.

Business session, 2 P. M.

Business session, 7 P. M.

Ladies' theatre party, 7 P. M.

Rejuvenation of the Sons of Jove, time and place to be announced later.

JULY 17.

All-day outing at Michigan City, boat leaving Chicago at 9 A. M. and returning at 6 P. M.

Both the open and business sessions will be held in the Assembly Room, on the sixth floor of the Auditorium Hotel.

There are a great many matters of importance to come before the business sessions and all of the members are requested to convene promptly and remain through the entire meeting.

The open sessions will be interesting and instructive, addresses being made by the following well-known men:

G. M. SANBORN,
First Vice-President, National Electrical Contractors' Association.

WEDNESDAY, JULY 15.

Address of welcome, president of the Electrical Contractors' Association of Illinois.

Opening address, James R. Strong, president of the National Electrical Contractors' Association.

"The Electrical Contractor's Opportunities in the Illuminating Field," George Loring.

"The Relations Between the Underwriters and the Contractor," W. H. Merrill, Jr.

THURSDAY, JULY 16.

"Illuminating Engineering," J. R. Cravath.

"The Relations Between the Lighting Company and the Contractor," Alex Dow.

"The National Electrical Contractors' Association," Seth B. Witherbee.

The local committee has practically completed all arrangements, and the following have been placed in charge of the different features of the entertainments: Registration, badges and tickets, C. R. Kreider; banquets, Ernest Freeman; entertainment and vaudeville, Arthur Frantzen; outing boat, Henry Newgard; outing grounds, Warren Orne.

The officers of the National Electrical Contractors' Association are as follows:

President—James R. Strong, New York, N. Y.

First vice-president—G. M. Sanborn, Indianapolis, Ind.

Second vice-presidents — Charles R. Kreider, Chicago, Ill.; F. C. Werk, Cleveland, Ohio.

Treasurer—John R. Galloway, Washington, D. C.

Secretary—W. H. Morton, Utica, N. Y.

Sergeant-at-arms—J. C. Sterns, Buffalo, N. Y.

IMPROVED CONDITIONS IN THE ELECTRICAL INDUSTRY.

SATISFACTORY RETURNS FROM ALL PARTS OF THE COUNTRY—INDICATIONS OF A RETURN TO NORMAL CONDITIONS.

That there is a well-defined improvement coming about in the electrical manufacturing industry is attested by the increasing volume of orders and inquiries for new material. Last week we published an interview with Walter H. Whiteside, president of the Allis-Chalmers Company, in which he spoke very encouragingly concerning the revival of business and the renewed activity in all branches of the industry. Supplementing his statement of last week, Mr. Whiteside says: "There is a continuation of the progressive conditions stated in my interview of last week. At the present rate of improvement normal conditions will again be realized within a very short time."

For the year ended June 30, 1907, the Allis-Chalmers Company showed an operating deficit of $387,298. The earnings for the year ended June 30, 1908, will show a substantial profit available for dividends on the preferred stock. The strength of the stock and bonds of the company is attributed to the better showing, not only in earnings, but in new business as well.

The business of the General Electric Company continues to show steady improvement. Gross sales of new apparatus are running now at the rate of fully $40,000,000 per annum, as against a rate of $35,000,000 per annum in February and April. The total of new orders for the three months was $10,033,172. During March several large orders were received. During the last two months there has been a steady accumulation of orders, and in the last month the company has been able to show gross sales of $3,500,000.

It is stated that there is no truth in the report that directors of the National Carbon Company are contemplating an issue of five per cent bonds to be used in retiring the $4,500,000 preferred stock and placing the common on a seven per cent basis. As a matter of fact, an increase in the National Carbon common dividend rate is an assured development for the future. Directors will not make any move, however, until the situation is more settled. Since the beginning of the current fiscal year, on February 1, National Carbon earnings have been running at the rate of about $900,000 net per annum, which compares with $924,801 for the fiscal year ended January 31.

The business of the Westinghouse Electric and Manufacturing Company is showing a gradual improvement. Recently the company received $400,000 in new orders within the course of two or three days. The orders this month are expected to show a substantial increase over the preceding month.

The hearty co-operation of the readjustment committee with the various other committees and the work performed by the former committee in making the plan successful are subjects of favorable comment on the part of the creditors and Westinghouse interests.

That the requests of the readjustment committee will be met before September 1 there is little room for doubt. The recent advance in the notes and bonds of the company indicates as much.

The Crocker-Wheeler Company reports a large increase in inquiries for motors, generators and other electrical apparatus which it is receiving through its branch offices all over the country. The company feels confident that when the great volume of business indicated by all these inquiries is under way normal conditions will again prevail.

Westinghouse Electric and Manufacturing Company Readjustment.

The readjustment committee of the Westinghouse Electric and Manufacturing Company in its report gives subscriptions to the merchandise creditors' plan as follows: By merchandise creditors, $4,135,912; by company's employés, $596,650; by stockholders, $2,214,300; by security investment company, $1,325,000; by George Westinghouse, $1,500,000. Total, $9,770,862.

Of this amount the subscriptions payable in cash as distinguished from those payable from the surrender of claims aggregate $5,634,950.

Upon the strength of these figures the reorganization committee announces its willingness to co-operate and to accept until September 1 the merchandise creditors' plan upon condition that the full conditions of the merchandise creditors be met.

The committee further recommends and requests the bank creditors to agree to accept in exchange for their claims one-half of the par value thereof in convertible sinking fund bonds of the company at par and for the other one-half either five per cent notes of the company in three equal amounts maturing respectively in four, five and six years from that date to the extent of thirty per cent of the face value of their claims and for the balance of their claims assenting stock of the company at par or at the option of the creditor in respect of the one-half of the claim not covered by the convertible bonds, five per cent notes of the company maturing fifteen years from that date.

Ohio Electric Light Association.

The fourteenth annual convention of the Ohio Electric Light Association will be held at the Hotel Victory, Put-in-Bay Island, Lake Erie, Tuesday, Wednesday and Thursday, August 25, 26 and 27. The following topics will be presented in the form of papers at the meeting:

"Should Central Stations Do Wiring?"

"Why Municipal Ownership of Lighting Stations Has Not Been a Success."

"How Can We Best Increase Our Business?"

"Experience with Luminous Arc Lamps."

"Electric Signs and Other Special Uses of Electricity as an Adjunct to Profitable Station Work."

"Gas and Gasolene Competition, and Best Ways to Meet It."

"Illuminating Engineering."

"Best Ways and Means of Keeping Out and Getting Out Private Plants in Central Station Territory."

"The Gas Engine in Central Station Work."

"Gas-Producer Plants and Oil Engines and Their Results."

Report upon the experience of a large number of central station men on the tungsten lamp.

DeForest Wireless Telephone Tests.

Lee de Forest, the well-known wireless telegraph and wireless telephone inventor, returned to New York recently after a long trip abroad. Mr. de Forest installed wireless telephone apparatus on several naval vessels for the Italian Government. During his stay in Paris he was afforded an opportunity by the French authorities of using the long antenna on the Eiffel Tower. It is stated that messages and songs by wireless telephone were picked up by warships near Marseilles, 300 miles distant. Mr. de Forest says that he heard very plainly the messages sent out from Glace Bay, on this side of the Atlantic, by the Marconi company. He believes that the Eiffel Tower tests prove that it is feasible to send messages from New York to Paris if the new tower of the Metropolitan Life Building, which is now nearing completion in New York city, can be used.

New Hydraulic Plant of Brillanne, France.

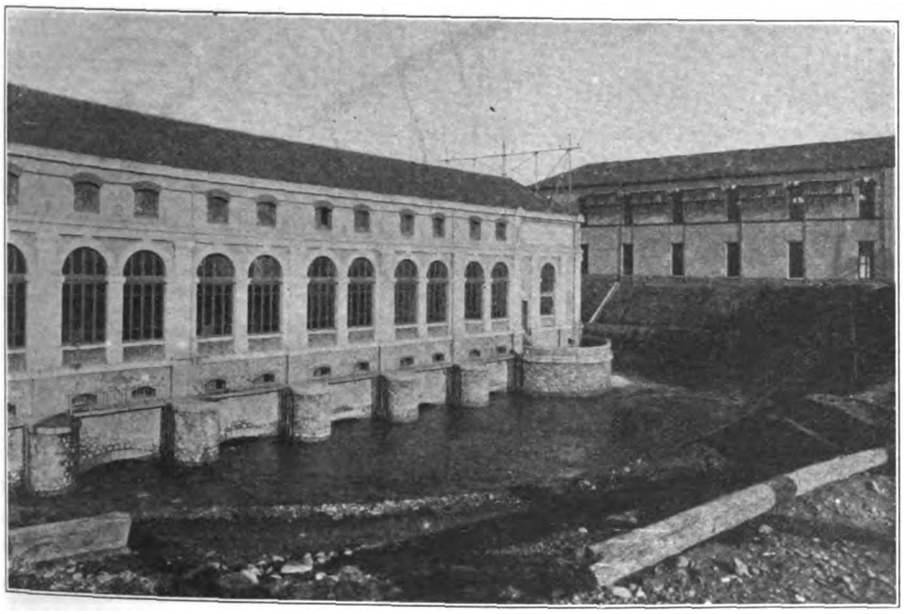
By C. L. Durand.

THERE has been recently opened in the Mediterranean region of France a hydroelectric plant which has a considerable interest from the fact that it is one of the largest to be erected in the south of France, and again, it uses the highest voltage, 52,000 volts, which has as yet been employed on the Continent.

The new plant is located on the Durance River, at Brillanne, and it forms part of the extensive system of hydraulic plants and pole-lines which are under the control of the Energie Electrique Company. Several of the already-existing power plants of this region have been described in previous issues of the ELECTRICAL REVIEW. Of late the enterprise has taken a considerable development, as it was desired to extend the system of pole-lines as far as the important centres of Marseilles and Arles. In Marseilles especially, a large amount of current is to be used, both for the lighting and motor circuits and also for the city tramways. In view of this fact the company has been engaged in constructing a number of new plants, of which the present station is the first to be finished.

Having a capacity of some 12,000 horse-power, the Brillanne plant is designed to work in connection with a second plant which is now being erected on the same river at Ventavon, about forty miles to the north, to furnish 15,000 horse-power. Following this there will be a number of other hydraulic plants finished in the near future in the same region. One of the largest of these is the Verdon plant, on the river of the same name, which is designed to give 15,000 horse-power. Other plants are the Timeé, Fontan and Sorge, etc.

Referring to the stations of Brillanne and Ventavon, located on the Durance River, these two hydraulic plants, the first of which has been in regular service for some months past, and the second in course of construction, are designed to be operated in parallel. At present they are connected together by two high-tension pole-lines. The total amount of power will be transported from the station of Brillanne by means of three high-voltage pole-lines on the one hand, which are constructed as far as Marseilles and are to end in a transformer station of large size. This latter station, which is one of the largest substations which has as yet been erected on the Continent, is located at the village of Allauch, a few miles' distance from Marseilles. An illustrated account of the Allauch plant has already appeared. Another part of the current from the hydraulic plant will be carried upon two high-tension lines which proceed in the direction of Arles and end at another substation which is to be erected in the neighborhood of that locality.



EXTERIOR VIEW OF THE BRILLANNE HYDROELECTRIC PLANT AND TRANSFORMER HOUSE.

The long distances which separate these hydraulic stations from the points of utilizing the current have resulted in the use of an unusually high voltage upon the pole-lines of the present system, the highest which has been reached as yet on the Continent. It is from 55,000 to 57,000 at the start of the pole-lines from the Ventavon plant, and 52,000 on the lines from the Brillanne station. The use of such a high voltage made it necessary to design a series of new machines and the accompanying apparatus for this tension. On account of the large amount of power which comes into play in the present case, there must be a distinct separation between the medium-tension machines and the high-tension transformers of the plant.

INTERIOR VIEW OF BRILLANNE HYDROELECTRIC PLANT.

A BANK OF THREE HIGH-TENSION TRANSFORMERS OF BRILLANNE HYDROELECTRIC PLANT.

The present account of the Brillanne hydraulic plant has been obtained from information on the subject which A. Garfield, one of the chief engineers of the

French Thomson-Houston Company, has kindly furnished the writer, and the illustrations will bring out the leading details of its construction. In general the plant is made up of two separate buildings, the first of which is designed to contain the main part of the running machinery, such as turbines and alternators, together with all their accessories for operation and regulation. The second building, which lies near the former, contains the main transformer room and here are installed the static transformers and the high-tension apparatus for regulating the lines at the point where they leave the station. The buildings are of a considerable size, and the turbine house covers an area of 1,000 square metres, while the transformer room covers 11,000 square metres.

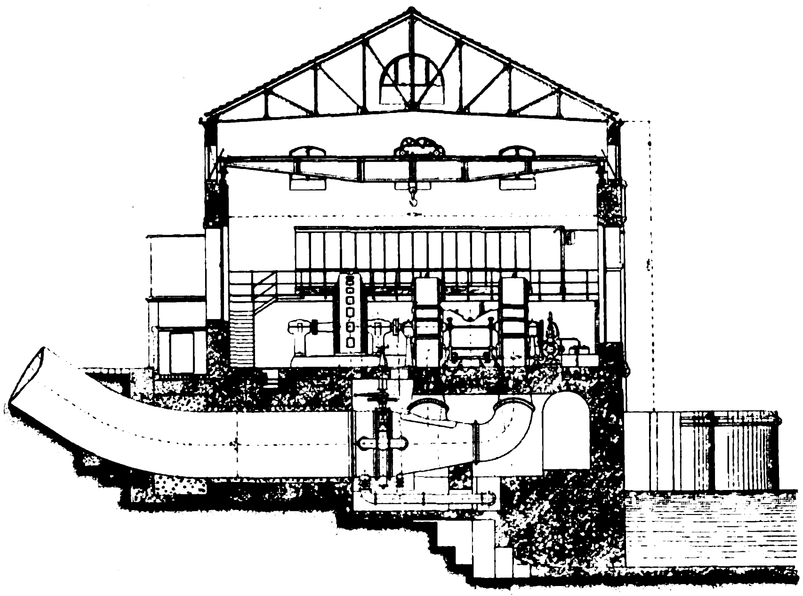
As to the hydraulic work which was carried out for the Brillanne station, it differs somewhat from the usual practice in the fact that there is no dam erected across the river at this point. The river bed is much too wide to allow of carrying this out in the present case. The water is accordingly taken off by a simple side canal, and as the current is rapid at this point, a sufficient amount of water is given by the canal for operating the station, the average flow being fifty cubic metres per second, and the minimum flow forty-five metres. The total length of the canal from the off-take point to the station is about eight kilometres, and the difference of level is thirty-eight metres. At a point midway in the canal it is enlarged considerably so as to form a vast settling basin, and here the width is forty-three metres. A dredge crane is arranged so as to take out the gravel which deposits here. Near the station the canal ends in a main basin built of masonry which has 8,000 square metres surface and is divided into two parts by a masonry wall. From here there are five penstocks of 2.7 metres inside diameter which lead to the turbine house, and a smaller one of 1.2 metres for the exciter turbines. After passing through the wheels, the water flows in an off-take canal of 1,030 metres length to the Durance River. This canal is taken across the railroad and the roads in two parallel flumes of fifty metres length.

The mechanical and electrical outfit of the plant, which was installed entirely by the present company, comprises five groups of turbine-alternators. The turbines are of the Francis pattern and are furnished by the Escher-Wyss firm, of Zurich, having two main wheels, each of which is mounted in a separate water-chamber. The two wheels have a common outlet for the water into the off-take canal. About 3,500 horse-power is the capacity of each of the present wheels, and they are designed for use upon a twenty-two-metre, net, head of water, including the height of aspiration, which varies between six and seven metres. A centrifugal governor of an improved type is provided for these machines, and it acts upon the crown containing the directing vanes by means of a relay motor. The latter is of the hydraulic type and works under oil pressure. The normal speed of the turbines is 250 revolutions per minute, but this speed can easily be raised or lowered so as to vary from 235 to 265 revolutions, either by simply working a hand-wheel or by the use of a small electric motor which can be operated from the main switchboard. This arrangement is indispensable for connecting the different machines in parallel in a rapid and efficient manner.

Each of the turbines is coupled directly and rigidly to the corresponding alternator. The latter machines have been designed specially for the present plant, and will produce three-phase current at twenty-five cycles, working at 7,500 volts normally. In this case the system of revolving field and fixed armature is used, and the field coils are formed of copper strip laid in slots in the laminated-iron field, while the armature winding is made up of lath-wound coils which are placed in the slots in the usual way. Each of the alternators has a capacity of 3,000 kilowatts.

For the exciting current of the five alternators of the plant there is provided a direct-current generator of 200 kilowatts, which delivers 110 to 125 volts to the exciter bars. There are two of these machines installed in the station, one of them acting as a standby. Both the generators are driven direct by Escher-Wyss turbines of the Francis type, of the 250-horse-power size. They are placed at one end of the dynamo room, along with a number of other groups which are used for various purposes throughout the station, including a set of motor-driven pumps for supplying the oil under pressure which is needed for operating the hydraulic motors of the governors.

Coming to the second part of the plant, the transformer post, this building is located at a hundred feet from the former. Here are installed the single-



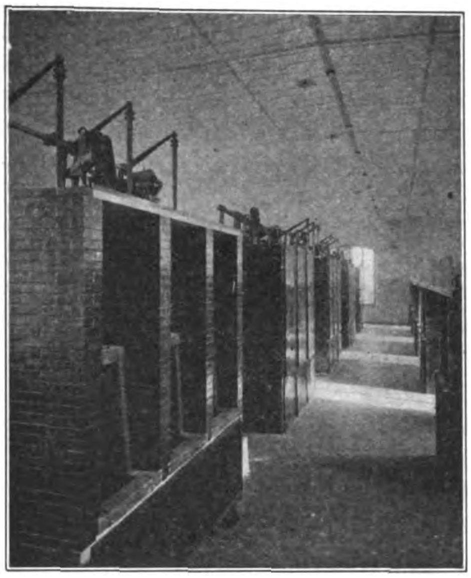
TRANSVERSE SECTION, BRILLANNE HYDROELECTRIC PLANT, SHOWING PENSTOCK AND DRAFT TUBES.

phase transformers of the plant, which are lodged in a series of cells or niches so as to be entirely enclosed when in normal service. These transformers are connected so as to deliver three-phase current, and as usual they receive the current from the alternators and are connected at the other side upon the pole-line. Each of the alternators of the plant has a three-phase, paper-insulated and lead-covered cable, which runs underground to the transformer room and is connected to a group of three of the transformers. The transformers are very well designed with respect to the high voltage employed. Each has a capacity of 900 kilowatts and a ratio of windings of 1 to 4, so that when they are connected in a set of three on the delta system on the low-tension side and on the star method on the high-tension side, they will raise the machine voltage of 7,200 to 52,000 volts between phases.

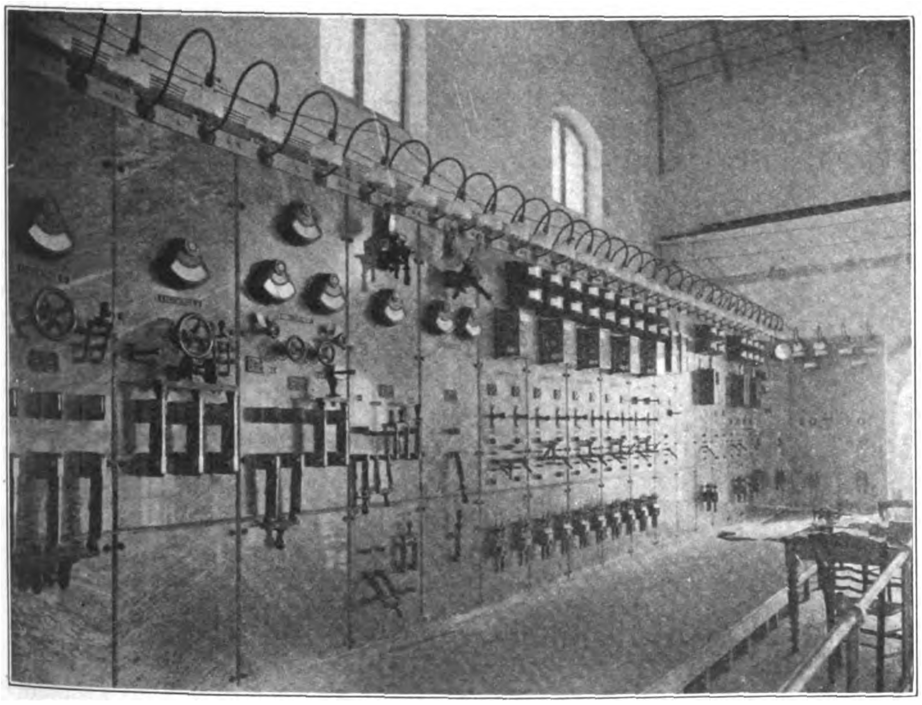
The present type of transformer required a very careful construction, and special attention was given to the insulation and to the cooling of the mass. The windings are entirely immersed in oil, and the latter is cooled in a constant manner by means of a cold-water circulation which takes place in a worm piping surrounding the body of the apparatus. A set of automatic signals has been provided for use with the transformers, and in case of an undue rise of temperature in any of the apparatus a corresponding signal is given to the attendants.

From each of the five groups of transformers corresponding to the alternators, current can be sent into the bus-bars of the switchboard. The bars are laid out in two series working at 50,000 volts, and the transformers can be switched on either set of bars. The latter are of bare copper wire of ten millimetres diameter. Each of the bars is mounted horizontally on triple-bell porcelain insulators of a special type, and is separated from the neighboring bar by a long slab of cement upon which are placed the insulators. Upon the bars are connected the starting wires for the three-phase pole-lines at 50,000 volts. The different circuits for the lines are also in bare copper. The method of mounting the transformers in the cells is seen in one of the illustrations. The overhead lines leave the station through a series of openings, and below these points is installed a series of lightning arresters of the Wunt pattern.

The different high-tension circuits (alternators, transformers and lines) are operated by special forms of high-tension switches of the company's design. These three-pole switches, whose phases are separated by brick partitions, have a double break in oil, and are operated each by a separate direct-current motor by means of suitable gearing and a set of jointed levers, which transform the rotary movement of the motor into a straight movement. This causes the operation of the switches by means of a set of rods, so as to open the three-phase high-voltage circuits. Strong springs give a quick break for the switches, preventing any arcing at the contacts. In this way it is easy to break a fully loaded line of 10,000 kilowatts working at 50,000 volts. The electric motor is started up by closing a small two-way switch which is mounted on the main switchboard and can be placed at any distance from the corresponding switch. Colored lamps on the switchboard are used to show at each instant the opening or closing position of the main switches in the other building. A set of automatic relays, which can be adjusted as desired, is used to open the main switches when the current rises too high. One of the illustrations shows the method of mounting the three-phase switches. Above will be seen part of the mechanism and the small electric motor. A set of iron covers closes the cells completely. Each set of three cells for a single switch is mounted separately, thus placing the switches a suitable distance apart. The constant value of the voltage is assured automatically at the ends of the pole-line at the substations of Arles and Allauch, that is, at a distance of about sixty miles from the hydraulic plant. This is carried out by an apparatus which is installed at Brillanne on the platform of the main switchboard. Switchboard transformers and a compensating apparatus are used in order to operate a low-tension circuit which serves as usual instead of a pilot wire. In the present case the apparatus is designed so that all the points concerning the line voltage and phases are reproduced in the indicator. The voltage of the low-tension circuit is used to operate the relay of the current-regulator, and its value corresponds at all times with that of the voltage at the distant ends of the line. The current regulator which is used in the present case is of the Thury pattern and is of double form; that is, it allows of a simultaneous and independent regulation of the voltage on each of the 50,000-volt bus-bars used for the start of the pole-lines. This takes place by the automatic working of a rheostat which is mounted in series on the exciting circuit of the alternator.



Automatic High-Tension Oil Switches in the Brillanne Hydroelectric Plant.



View of Main Switchboard and Distribution Panels, Brillanne Hydroelectric Plant.

The security of the personnel is carried out in a simple and effective manner. All the apparatus for the operation, regulation or measurement for the two buildings are, without exception, supplied at 110 to 125 volts. For the direct-current circuits this is done by the use of electric relay motors, and for the alternating-current by means of transformers of voltage and current which are connected upon the high-tension circuits for the measuring instruments. All the operations for the different machines and circuits, both direct and alternating, are carried out from the main switchboard, which carries all the needed indicators for working the station.

The Brillanne plant is now able to furnish regularly a total of 10,000 kilowatts, using a voltage of 50,000 volts between phases. At present there are four of the above-mentioned alternator groups in operation, and they have been delivering current in a regular way upon the line which passes to Marseilles at sixty miles distance. Current is used in the latter city for a number of mains, and this latter system, which is only in its first stages, will, no doubt, be increased rapidly in the near future. The first two groups and the pole-line have been working at 50,000 volts for some months past without any mishaps of any kind occurring upon the system during that time. At present the amount of power which is sent upon the line is estimated at 120,000 kilowatt-hours per day. A large part of the current is used in Marseilles by the gas and electric company of that city and also by the tramway company, which operates one of the largest systems on the Continent.

The overhead line is mounted in general upon iron trellis-work poles, which are made to take a comparatively straight course across the country and do not follow the roads. The poles are ten to twelve metres in height and are spaced seventy-five metres apart. On the poles are mounted three cables for the high-tension lines. One cable is placed at the top of the pole and the two others at the ends of a short cross-arm. Triple-bell porcelain insulators, tested at 120,000 volts, are employed.

BOOK REVIEW.

"Agenda de l'Electro." L'Electro. Brussels. Cloth. 280 pages. Illustrated. 4 by 6 inches. Price, 5 francs.

This is a useful little French handbook for engineers. It contains the usual information generally found in such works, such as the fundamental laws of electrical science, the principles of electrical applications, and practical information on electrical, steam and hydraulic machinery. Some interesting statistics of the electrical industries in Belgium are given and lists of technical societies and schools

Wireless Telegraph Companies Unite.

It is announced that the United Wireless Telegraph Company has obtained control of the International Telegraph Construction Company, one of its recent competitors. The International Telegraph Construction Company has built a number of stations in the United States and in several foreign countries. It is also stated that the United company has secured the services of Harry Shoemaker, the well-known wireless telegraph apparatus inventor.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

KANSAS CITY RAILWAY AND LIGHT COMPANY.

The Kansas City (Mo.) Railway and Light Company's earnings for the year ended May 31, 1908, are officially reported as follows: Gross, $6,144,549; expenses and taxes, $3,684,457; net, $2,460,092; deductions, $1,380,254; surplus, $1,079,838.

ASSOCIATED BELL TELEPHONE OPERATING COMPANIES.

The report of all the associated Bell Telephone operating companies, not including the long-distance lines of the American Telephone and Telegraph Company, for the month of April and four months ended April 30, shows an April gross telephone revenue of $9,882,200; general operating and maintenance expense, $7,143,500; net, $2,738,000; sundry earnings, net, $399,800; total net, $3,138,500, an increase of $216,400 over the same period in 1907; interest, $641,800; balance for dividends, $2,496,700. From January 1 to April 30 telephone revenue amounted to $38,924,400; general operating and maintenance expense, $28,771,500; net, $10,152,900; sundry earnings, net, $1,636,000; total net earnings, $11,788,900, an increase of $1,142,600 over the same period in 1907; interest, $2,615,400; balance available for dividends, $9,173,500.

UNITED RAILWAYS OF ST. LOUIS.

The report of the United Railways Company, of St. Louis, Mo., for the month of May and five months ended May 31 shows May gross of $920,765; expenses, $591,543; May net, $329,222; charges, $232,278; May surplus, $96,944. Five months' gross, $4,248,216; expenses, $2,795,250; five months' net, $1,452,966; charges, $1,154,714; five months' surplus, $298,252.

MEXICAN AND CENTRAL & SOUTH AMERICAN TELEGRAPH COMPANIES.

A résumé of the operations since organization of the Mexican Telegraph Company and of the Central & South American Telegraph Company has been issued as a joint statement by James Scrymser, president of both companies. Many inquiries have been made concerning the value of these properties, as the shares of the company have been traded in very little on the Stock Exchange. During 1907 235 shares of the Mexican Telegraph Company changed hands at prices ranging between $235 and $250 per share. In 1907 5,945 shares of the Central & South American Telegraph Company were sold at prices ranging from $105 to $110 per share.

The first cable of the Mexican Telegraph Company was laid in 1881, the second in 1889, the third in 1905, all in the Gulf of Mexico. The 1881 cable has been occasionally interrupted by abrasion on reefs, but in every instance the cable, beyond the point of interruption, has been found to be in excellent condition. The 1889 and 1905 cables have not been interrupted and are in good electrical condition. The company owns 738 miles of the New York-Colon cable laid in 1907.

From March, 1881, to December 31, 1907, the receipts of the Mexican Telegraph Company were as follows: Gross, $10,782,182; expenses, $2,717,972; net profit, $8,064,210; dividends, $4,629,264; surplus, $3,434,946; invested in plant, $1,053,051; surplus, December 31, 1907, $2,381,895. There have been issued to shareholders as dividends full-paid shares amounting to $1,734,500. The operating expenses, repairs and renewals of the company for twenty-seven years have averaged about twenty-five per cent of the gross receipts. Dividends at the rate of ten per cent have been paid for the past twenty-one years.

The cables of the Central & South American Telegraph Company are 10,617 miles in extent. Three thousand three hundred and eighty-two miles were laid in 1882; 1,544 in 1891; 2,524 in 1893; 1,659 in 1906 and 1,508 miles in 1907. The receipts of the company from 1882 to December 31, 1907, were as follows: Gross, $21,247,405; expenses, $8,108,047; net, $13,139,358; dividends, $9,536,180; surplus, $3,603,178; invested in plant, $2,583,359; surplus December 31, 1907, $1,019,819. There have been issued to shareholders as dividends full-paid shares amounting to $2,732,800. Since 1897 dividends have been paid to shareholders at the rate of six per cent per annum.

The estimated report of the Central & South American Telegraph Company for the quarter ended June 30, 1908, gives gross of $408,000; expenses, $162,000; net $246,000; other income, $5,500; total income, $251,500; dividends, $143,565; surplus for quarter, $107,935; previous surplus, $1,172,712; total surplus, $1,280,647. The directors of the company have declared the regular quarterly dividend of one and one-half per cent, payable July 9 to stock of record June 30.

London Physical Society.

At the meeting of the London Physical Society, held at the Royal College of Science on May 8, Dr. C. Chree, president, in the chair, a paper on "A Modified Theory of Gravitation" was read by Dr. C. V. Burton. If we are to regard gravitational attraction as exerted through the medium of the ether, it appears to the author difficult to avoid the conclusion that the very great (or possibly infinite) velocity with which such attractions are propagated is due to the very great (or complete) incompressibility of the ether. This conception is embodied in the pulsatory theories of Hicks and of subsequent writers; the chief outstanding difficulty has lain in providing for that agreement of phase which must be assumed to subsist among the centres of pulsatory disturbance associated with the mutually attracting masses. This difficulty is avoided if we suppose that primary waves of compressional-rarefactional type are being propagated through the ether with a velocity enormously transcending that of light. These primary waves may be traveling in directions indifferently distributed, or predominantly or exclusively in one direction; but an essential point is that all effective wave-lengths should be very great, measured even by astronomical standards. Thus the pressure changes will be sensibly in the same phase over considerable regions, and if the ethereal compressibility is locally increased (or diminished) by the presence of electrically neutral matter, every particle of such matter will act as a centre of pulsatory motion.

For the electron, so far as concerns this modification of ethereal compressibility, a specification is assumed which involves no restraint on the free mobility of the electron through the ether. Incidentally the dynamics of the problem assumes a relatively simple form, and a value which could be quite insignificant attaches to a "gravitational (or non-electromagnetic) term" appearing in the expression for the total inertia of an electron. It has to be shown that, in its primary aspect, the assumed wave motion would give rise to no observable effects. This, in fact, follows from the assumptions made, and it is only through the feeble secondary effect of gravitation that any evidence of the wave motion could be obtained. In attempting to work out the theory on a numerical basis, values have to be found for a considerable number of physical quantities, several of these requiring to be independently conjectured, before the remaining quantities can be determined. But the range of the values which could be reasonably assumed is a good deal more restricted than might be supposed. The author gives a plausible set of values for these physical constants.

C. S. Whitehead asked if the amount of energy stored in the ether was greater or less than it was in the past.

Professor C. H. Lees asked if the ether considered was the old one or a new one. He referred to an interesting point in the author's representation of gravitation—namely, that matter was produced by the absence of something from the ether. In the theory advocated by Osborne Reynolds matter was produced by a deficiency in the normal piling, and recent theories seek to explain matter and gravitation by the absence of something which is present in free ether.

Dr. C. V. Burton, in reply to Mr. Whitehead, said he was not aware whether the amount of energy in the ether varied with time or not.

A paper on "An Examination of the Formulæ for the Grading of Cables" was read by Mr. C. S. Whitehead. In the *Journal* of the Institution of Electrical Engineers, of Great Britain, both M. O'Gorman and Dr. A. Russell have shown that it would be advantageous if cables for electric lighting were constructed so that the component of the electric intensity along a radius (in cylindrical co-ordinates) was kept constant for all points in the dielectric in the same plane perpendicular to the axis. They both find that to attain this object λr ought to be kept constant if the current is alternating, and σ/r constant if the current is steady, where λ is the specific inductive capacity, σ the specific resistance and r the distance from the axis. In this paper the question is regarded from a much more general point of view. Maxwell's two curl relations are taken in cylindrical co-ordinates, and it is supposed, as is quite legitimate, that the electrical and magnetic quantities are symmetrical round the axis, and that they vary as $e^{i(mz+pt)}$. We can then solve the equation, and from the continuity of the tangential components of the electric and magnetic forces obtain an equation to find m. If P is the component of the electric intensity along a radius, β the component of the magnetic force perpendicular to a radius in a plane perpendicular to the axis, we find

$$P = -\frac{im\,\beta}{\frac{4\pi}{\sigma} + \frac{\lambda\, ip}{c^2}},$$

where c is the ratio of the electrostatic to the electromagnetic unit of electrical quantity. Also if I be the total current in the wire parallel to the axis, and we neglect the displacement-current in the wire in comparison with I, we have $\beta = 2\,I/r$. Putting $m = -a + ib$, it is found that $\sqrt{a^2 + b^2} = \sqrt{\lambda}\,.\,h$, where h involves no quantities which have reference to the dielectric. Taking the real parts and putting P_0 and I_0 for the factors of P and I which are independent of the trigonometrical factor, we obtain

$$P_0 = 2\,I_0\,e^{-bz}\frac{c^2}{\lambda r}\sqrt{\frac{a^2+b^2}{p^2+\left(\frac{4\pi c^2}{\lambda\sigma}\right)^2}}.$$

If we suppose I_0, a, b to be constants of the cable which do not vary as we vary λ or σ, we get the rules given by O'Gorman and Dr. Russell. Thus let σ be very great, then to keep P_0 constant we must make λr constant, but if $p = 0$, that is for steady currents, we must make σ/r constant. We have seen, however, that $\sqrt{a^2 + b^2}$ varies as $\sqrt{\lambda}$, so that in case σ be very great this process suggests the rule make $r\sqrt{\lambda}$ constant. When $p = 0$ it is shown that $a = 0$ and that b varies inversely as $\sqrt{\sigma}$, so that this case suggests the rule make $\sqrt{\sigma/r}$ constant. The equation for P_0 is, however, strictly true.

Dr. A. Russell complimented the author on his interesting paper and on the skill with which he had handled the mathematical equations. The question of the grading of cables was one of great importance to the electrical engineer, and it was necessary to attack it both from the mathematical and the experimental side. The author took the case of an infinitely long concentric main and assumed that the amplitude of the current remained constant. In the practical problem the main is of finite length and the amplitude of the applied voltage is constant. The mathematical difficulties in the way of getting a complete solution were great, and so he hoped the author would continue his investigations further. Dr. Russell exhibited a portion of a Jona graded cable which had successfully withstood a testing pressure of 150-kilovolts applied between the core and the lead sheath. If the dielectric had been air a disruptive discharge would have ensued at twenty-three kilovolts.

The Colorado Electric Light, Power and Railway Association.

The next annual convention of the Colorado Electric Light, Power and Railway Association will be held at Glenwood Springs, Col., September 16, 17 and 18. J. F. Dostal, 405 Seventeenth street, Denver, Col., is secretary and treasurer of the association.

Electrical Notes from Great Britain.

(From Our British Correspondent.)

IN the ELECTRICAL REVIEW for January 4, 1908, the writer gave an account of the progress that had been made with the Transcontinental Telegraph system of Africa. The length of telegraph line remains unchanged, being still 1,584 miles, and the deficiency between the cost of working and revenue continues to be advanced to the telegraph company by the British South Africa Company. There is, however, now a prospect that wireless telegraphy is going to render an important extension of the system possible. The German authorities are considering a scheme for installing wireless telegraphy in German East Africa. The telegraph company's northern terminus is at Udjidji, on the east coast of Lake Tanganyika, and if the German scheme makes co-operation possible, the company proposes to erect two wireless stations connecting Udjidji with Gondokouro, the southernmost point of the Soudanese telegraph, some 700 miles away. This would complete the Cape to Cairo system.

The Irish power scheme, the outstanding feature of which was the proposal to utilize peat as fuel, and to which reference was made in these notes a couple of months ago, when a parliamentary committee threw out the bill, has been again receiving attention. After its rejection it was ordered, in the House of Commons, that the bill be recommitted to the committee, and in a very much altered form it has now been reconsidered. As it now stands it is a far less ambitious proposal. The city of Dublin and important urban districts are excluded from its provisions, the capital powers are reduced by two-thirds to only $750,000, and the new designation is the Central Ireland Electric Power Bill. The peat-fuel proposition stands unaltered. The committee has passed the preamble and the revised scheme looks like going through.

The annual statement of our Controller of Patents shows that 29,040 applications for patents were received during 1907, and 16,272 were granted, and paid fees amounting to, roughly, $1,326,000, as compared with 30,030 applications in 1907, with only 14,700 granted, producing in fees $1,279,000. As to the trend of invention, there were signs that the great activity of the last few years in motor-car lines is falling off. If titles are a true guide there is a falling off of thirty-five per cent in motor road-vehicle patents. It appears that the occurrence of several serious railway accidents, owing to the failure of signals, turned attention largely to automatic electrical systems of signaling in which the services of signalmen are entirely dispensed with and the signals are given on the engine itself. Several applications were made for stopping trains automatically when the signals are against them. Further, owing to a number of lift accidents, inventors have been busy improving devices for preventing mine or other lift cages from falling should the hoisting cable break. In wireless telegraphy and the telegraphic transmission of portraits and designs there was also noteworthy inventive activity.

For Manchester Corporation electricity works extensions there have just been ordered a 6,000-kilowatt Zoelly turbine with Siemens three-phase alternator and a Contraflo condensing plant. The turbine will be built at the works of James Howden & Company, of Glasgow. The largest turbine of this type at present at work in this country is one of 2,000 kilowatts at Powell-Duffryn Collieries, at Aberaman, in South Wales. The last-completed turbo-alternator at Manchester was described in the ELECTRICAL REVIEW several weeks ago.

The electric-sign business in England is a small affair at present, but it is a direction in which there has been decided advance during the last winter or two. The best thing yet announced is the decision of all the principal tube and underground railways of London to place outside their stations large electric signs with the word "Underground." Altogether there will be some 700 signs of Hawkes' manufacture, the cost being more than $60,000. Each station is to have the "Underground" sign down the outside of the building, and outside either stations or booking offices there will be maps engraved on glass showing the routes followed by the different electric lines.

Lord Vaux of Harrowden, addressing shareholders the other day, told them that the Brush Electrical Engineering Company had had a record output during the year, but, owing to low prices, the profits were not commensurate with the business done. He added, however, that manufacturers were now beginning to hold out for better prices, which would at least give a reasonable prospect of a living profit being earned. Lack of working capital, the stoppage of the demand for tramcars, the unremunerativeness of motor-bus building, and other like misfortunes, formed chapters in his lordship's tale of woe. Tramcar inquiries for two years past had been so small that the company had been compelled to cultivate foreign markets, though they preferred home orders if they could be obtained at fair prices. At the same meeting Lord Vaux resigned his chairmanship, and E. Garcke takes his place. It is stated that a scheme for the reconstruction of Bruce, Peebles & Company, now in liquidation as already reported, has been prepared and has received the approval of committees of creditors and shareholders.

Arthur Wright, of demand-indicator fame, has, in his capacity as consulting electrical engineer to the Marylebone Borough Council, reported on the question of revising the present charges for electrical energy and the practicability of framing a tariff which could be applied universally throughout the borough. His observations are of special interest as bearing upon the present position of affairs. He concludes that it is "commercially inexpedient" to raise the average price per unit or to interfere during the present year with the option which the old "Metropolitan" consumers have of remaining on their original scale of charges. The whole question of electric lighting revenue is in a very critical state owing to the rapid introduction of metallic-filament lamps, and he says that the only chance of obtaining a revenue sufficiently large to meet the expenses of the undertaking is to encourage in every possible way the increase of the lighting business. The revenue this year will not warrant the council in running too great risks of the loss of business which might follow the compulsory change of tariff to 4,000 consumers, that being the number of those at present on the old "Metropolitan" scale.

The president of the Municipal Electrical Association, H. Talbot, the city electrical engineer of Nottingham (in which place the four days' convention, concluded on July 3, was held), referred in his opening address to the continued apathy of assistant engineers, who do not take sufficient interest in the association to become associates or to compete for traveling studentships. There are more than 800 assistant engineers in the United Kingdom and only sixty-one have joined. This year no associate has contributed a paper and there is a decrease in their numbers. The reason is that they are unable to attend the conventions and they can read the papers in the press. Mr. Talbot thinks that it ought to be made possible for many of them to attend if they desired, seeing that the conventions are held in the summer when stations are working at their minimum output. Concerning metal-filament-lamp progress he says that any improvement in the "present extravagant methods of producing light must eventually prove beneficial to everyone." "For the time being it may go hard with contractors for electrical plants, as extensions will not be required so soon." Speaking of the city of Birmingham's announced intention to register wiring contractors who are authorized to carry out installations there, he said that registration would be a means of minimizing, though not preventing, bad and scamped work; it would tend to guard against "the deplorable ignorance of some of the electrical workmen of to-day." He advocated an entirely national scheme of registration carried out by the Electrical Contractors' or similar association. He suggested that it should be conditional on the gaining of a certificate for the passing of a fairly elementary examination on somewhat similar lines to that instituted by the Worshipful Company of Plumbers. Referring next to the subject of town's refuse as fuel for generating stations, Mr. Talbot said that incineration was an effectual and cheap way of getting rid of refuse, but "It is a certain fact, notwithstanding, that the handling and burning of the refuse alone costs more than the same output could be obtained for at the coal-fired generating station." The necessity for placing electrical undertakings in a sound financial position by establishing reserve and depreciation funds, the question of purchasing meters out of revenue, and the desirability of having uniformity of plant in a station, if it can be secured without sacrificing efficiency, were other matters briefly touched in the address.

The members then proceeded to consider a paper written from the councillor's point of view. The following day was given up to an excursion to Dovedale. Next day, July 2, and also July 3, the following papers received attention: "Considerations on the Design of a Generating Station," by H. Richardson, city electrical engineer, Dundee; "Reconstruction of an Electric Lighting Scheme with Observations on the Working of a Combined Steam and Water-Power Plant," by C. M. Shaw, chief electrical engineer at Worcester, where both types are at work; "'A.C.' Accumulator Substations, and the Use of Accumulators for Peak Loads," by A. M. Taylor, assistant electrical engineer at Birmingham; "The Work and Equipment of a Testing and Standardizing Department," by H. A. Ratcliff, of Manchester Electricity Works.

Toward the end of May an electric locomotive which was standing at Clapham Common Station of the City & South London Railway was found to be on fire, but it seemed at the time most unlikely that the cause was electrical. The matter was promptly investigated by A. P. Trotter, the electrical adviser to the Board of Trade, and his report is now issued. He says that there seems to be no evidence to show that the occurrence was due either directly or indirectly to the electric current, and that it is impossible to connect it with any electrical cause. He gives three possible causes, which are: (1) a lighted match thrown down by a man just before leaving; (2) the emergency oil lamp which may not have been extinguished; (3) spontaneous firing of oily waste in the cupboard. The fire seems to have burned most fiercely at the corner where the cupboard stands, and at the opposite corner where there was a considerable collection of insulated cables. The locomotive contents, including the controllers and other machinery above the floor level, were destroyed. The inside of the carriage next to the locomotive was uninjured, which circumstance leads Mr. Trotter to refer to it as a point in favor of separate locomotives.

The proceedings of the committee which is dealing with the London Electric Power bills continue to drag along. The case for the London District scheme has been most patiently heard. Perhaps the most important, or at any rate the most interesting, witness against the scheme was J. D. Falconer, a financial authority, who was, with Mr. Merz, practically the leader of the administrative schemes of 1905 and later, which failed. The chief point in his evidence was that showing why there had not been another Merz administrative scheme brought forward this year. He said that he and some others had come to the conclusion that while his 1905 scheme gave good promise of being profitable at that date, because of the backwardness of the existing authorities in catering for the power-user's requirements, the case was different to-day, for the companies had had several years in which to make up for their previous shortcomings. The case for the District bill was finished before the Whitsun vacation. On June 16, when the proceedings were resumed, the particulars of, and arguments for, the joint linking-up scheme of the eight existing companies were receiving consideration.

The report of the British Electric Traction Company, which has been awaited with some interest owing to the directors' announcement some months ago deferring the payment of preference dividend until the year's accounts were completed, has been published. The company has holdings to the tune of close upon $25,000,000 in electric tramway, lighting and power companies, of most of which it is the parent. On $10,000,000 of this (four and one-half per cent and five per cent debenture stock) interest is paid as usual. There next rank for dividend $8,100,000 six per cent cumulative preference shares —on these only three per cent can be paid this year; and all the ordinary shares, $6,600,000, again receive nothing, as was the case for 1906. The importance of making further provision for depreciation and of keeping ample funds in hand with which to "start upon new enterprises when opportunity offers" are the reasons for the position. Last year's bad weather was a hindrance to all tramway companies, and efforts to raise fares to more reasonable figures did not show effect early enough. Sixty of the British Electric Traction associated undertakings have federated for co-operative purposes under the British Electrical Federation. A building is now erecting in London where they will all have their head offices; they are purchasing stores collectively, have a mutual tramway insurance system, and in other ways secure co-operative economy. The report refers to the manifold difficulties placed in the way of conductors of electrical enterprises in Great Britain, and says that the directors are giving consideration to proposals for electrical enterprise submitted to them "from countries where the conditions for the investment of capital are more favorable than in this country."

Albert H. Bridge.

London, June 27.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

On First-Aid Work in Central Stations.

The author of this article, S. Lees, criticizes the arrangements ordinarily provided in manufacturing and engineering concerns for rendering first aid in cases of injury to limb or where an employé is suddenly taken ill. During many years' experience in central stations the writer has observed that almost utter indifference is paid to the most important question of ambulance equipment. In any works where there is running machinery accidents to employés are of frequent occurrence. Although these are mostly of a trifling nature if attended to at once, yet needless suffering is frequently caused by ignorance of unskilled persons and lack of proper appliances. It is not only in the matter of lack of provision of ordinary requirements for properly taking care of injured employés that central stations are at fault, but very often the safeguards are really added menaces to life and limb. It is the duty of managing authorities to see that a complete ambulance outfit is provided, and it is equally important that they insist on their workers being efficiently trained in first-aid work. Ambulance material should be carefully handled, and the materials employed should be kept isolated from any possible contamination. A first-aid box is described, together with the materials which should be secured for properly carrying out first aid.—*Abstracted from the Electrical Engineer (London), June* 19.

Distant Electric Vision.

In a communication A. A. Campbell-Swinton makes objection to Shelford Bidwell's communication on the subject of distant electric vision which was published in the issue of June 4. He points out that though, as stated by Mr. Bidwell, it is wildly impracticable to effect even 160,000 synchronous operations per second by ordinary mechanical means, this part of the problem of obtaining distant electric vision can probably be solved by the employment of two beams of cathode rays (one at the transmitting and one at the receiving station), synchronously deflected by the varying fields of two electromagnets placed at right angles to one another and energized by two alternating electric currents of widely different frequencies, so that the moving extremities of the two beams are caused to sweep synchronously over the whole of the required surfaces within the one-tenth of the second necessary to take advantage of visual persistence. So far as the receiving apparatus is concerned, the moving cathode beam has only to be arranged to impinge on a sufficiently sensitive fluorescent screen and give suitable variations in its intensity to obtain the desired result. The real difficulties lie in devising an efficient transmitter, which, under the influence of light and shade, shall sufficiently vary the transmitted electric current so as to produce the necessary alterations in the intensity of the cathode beam of the receiver. Possibly no photoelectric phenomenon at present known will provide what is required in this respect.—*Abstracted from Nature (London), June* 18.

The Kearney High-Speed Railway.

On June 13 a public demonstration was made of the model high-speed railway designed by E. W. C. Kearney, at Aldwych, England. This is a system in which the cars are run on a monorail laid on the ground, and are steadied by wheels running under an overhead rail. The centre of gravity of the car is kept low by the motors, and the pressure on the top guide rail is therefore not very considerable. On curves the position of this rail is altered to suit the speed at which the train is intended to travel, and is more strongly supported. The inventor claims that derailment is impossible. It is in tube railways that he hopes first to apply the principle. In such cases a rigid support for the top guide rails is provided by the roof. It is also proposed to do away with the necessity of elevators by bringing the trains to a platform just below the street level, from whence the train will run down a gradient of one in seven, so that within twenty seconds of leaving the platform a speed of fifty miles an hour will have been reached. During this time it is stated that passengers will be unconscious of sitting on an inclined plane, owing to the forces due to acceleration exactly counterbalancing the effect of the gradient. For bringing the train to rest it is to ascend a similar gradient of one in seven to each station, so that braking is apparently done away with. Mr. Kearney claims that the cost of tubes built on his system will not exceed £250,000 per mile, as compared with £500,000 per mile for ordinary tubes. A scheme has also been sketched for applying the system to elevated street railways. The scheme meets with little encouragement, and it is not expected that much will develop as the result of these experiments and tests.—*Abstracted from the Electrician (London), June* 19.

The Electric Lighting of the Rotherhithe Tunnel.

On Friday, June 12, the Rotherhithe tunnel was formally opened by the Prince and Princess of Wales. The new tunnel, undertaken in 1904 by the London County Council, links up the districts on the north and south of the Thames between the Tower bridge and the Blackwall tunnel. The work was carried out to the designs and under the supervision of Maurice Fitzmaurice, chief engineer to the London County Council. The tunnel under the river is 1,571 feet long, and the approach tunnels, cut-and-cover work, and open approaches, make a total length from entrance to entrance of 1.3 miles. The tunnel is thirty feet in diameter outside the lining, the gradients at the end portions being one in 36.5. The central under-river length has a grade of one in 800. Four shafts, sixty feet in diameter, are provided, two on each side of the river, and in two of them are spiral staircases leading to the surface. The electric lighting is on a generous scale. Three rows of metallic-filament lamps run all through the covered portion of the works, the lamps being of thirty candle-power placed thirty feet apart. The candle-power provided works out at one-eighth candle per square foot. There are altogether 631 thirty-candle-power lamps and 108 fifty-candle-power lamps, the latter being used mostly in the approaches, domed shafts, etc. The London Electricity Supply Company and the Bermondsey Corporation furnish the supply. The former is alternating current at 110 volts, and is used for lighting, and the latter is direct current at 480 volts, and is used for the pumping machinery. Both supplies are made available for both purposes by the use of motor-generators. In the event of failure of the lighting supply two thirty-kilowatt motor-generators are automatically started up on the direct-current supply, and within twenty seconds of failure the lamps will be lighted by the current generated by using the Bermondsey supply. In a similar manner, the failure of the supply for the pumps is guarded against, a twelve-kilowatt set being provided in this case, working with current from the London Electricity Supply Company and generating current for the pump motors. For handling storm water flowing down the approaches and the drainage from the washing down of the roadway, three electrically driven pumps are installed, each of 200 gallons per minute capacity against a head of seventy feet. One of these pumps is held in reserve.—*Abstracted from Engineering (London), June 19.*

The Centre of Gravity of Steam and Electric Locomotives.

W. H. Booth, the author of this article, holds that in their studies of electric locomotives electrical engineers have paid too little attention to what has already been accomplished or thought out in the past or forced upon the notice of engineers by the immutable laws of mechanics. In actual practice, the centre of gravity being about sixty inches above the rail, the angle of pressure of the resultant of any swaying movement of the centre of gravity is almost exactly sixty degrees. The tendency to force outward the rails is much reduced as compared with the tendency of the low-centre-of-gravity engine to do so. It has been argued that with a high centre of gravity an engine tends more easily to overturn, but while this may be the case it should not be forgotten that in rounding a curve the lateral tendency of the centre of gravity is to press the outer wheel more firmly down upon the rail, whereby its flange is restrained from mounting the rail. Were it not for this increased pressure the wheel would more easily mount the rail and run off. When an excessive speed is run around a curve either the engine will run off the rail or it will turn over. To check one tendency is to increase the other. Designers would do well to abandon the low centre of gravity. Much help would be given by raising the whole of the motor. Direct-connection, it is true, is much valued, but it may well be wondered if too big a price has not been paid for the abolition of the gears. This price has been the use of very small wheels, the necessity for very large motors, and the fixing of the centre of gravity very low, a lowness that has been accentuated by the absence of the boiler. In the steam locomotive all the moving parts and the cylinders and valves are practically at the level of the axle centre, and only the boiler remains to produce even a height of five feet. A first-class geared electric locomotive constructed in a steam-locomotive shop would prove that the geared electric locomotive is not, after all, of necessity a poor contrivance. It would enable radical differences of design to be introduced and put a stop to the necessity which at present seems to be paramount of the small wheel. Even with the best of design, assuming that the geared system proves all that can be desired or anticipated, it is not likely that the centre of gravity of the whole machine can be raised as high as it is in the steam engine, unless special highly placed weights are added for the purpose, and this is undesirable, as, indeed is all redundant weight. The weight of the motor parts should not come upon the wheels except through the intermediary of springs. This complicates the problem of gearing, but a solution seems possible in the direction in which it has been solved by the makers of traction engines, wherein a form of Oldham's coupling seems to give satisfaction in solving the difficulty of the gear centres.—*Abstracted from the Tramway and Railway World (London), June 4.*

The Electrical Installation at the New Public Offices, Whitehall, England.

The new block of public offices at the southern end of Whitehall, England, which will be the home of the local government board and the board of education, and later of the board of trade, has been practically completed. The lighting installation includes over 6,000 lamps. The building is supplied jointly by the Westminster and the London Electricity Supply corporations. The former supplies current for power and lighting and the latter for lighting only. The installation scheme provides for two pairs of service cables from each company's mains at different parts of the building, and there will be four separate main switchboards at these intake points. The Westminster supply is three-wire, direct current, 400 volts across the outers, and each main switchboard is divided into two halves, the 200-volt lighting circuits being balanced on each side of the three-wire system. The London company's supply is alternating. Two feeders supply two sets, each of three forty-kilowatt, single-phase transformers in parallel, these sets being in different parts of the building. These transformers step down the voltage from 2,500 to the lighting pressure of 200. Transformers are in a fireproof chamber adjoining the room containing the main switchboard. The handle of the high-tension, oil-break switch projects through a slit in the wall, so that the transformers can be isolated from the high-tension mains or changed over from one pair of cables to the other without entering the transformer chamber. The transformer chamber and main switchboards are situated in the basement proper, and from the four main boards 1,000-ampere flexible rubber cables lead down through openings in the floor of the subbasement. The cables are lead-covered, paper-insulated, and the joints between these and the short lengths of rubber cable are enclosed in specially designed ceiling boxes, one for each cable. From the 1,000-ampere cables 250-ampere cables run up to the submain boards in the basement. The iron troughing widens out where the cables enter the junction boxes, to the sides of which the troughing is bolted. There are about a dozen of these submain boards, each containing a double-pole switch and eight double-pole porcelain enclosed fuses. The boards are set into the eighteen-inch wall, and the backs of the boards are accessible from the other side of the wall. From this point the wiring is entirely in three-quarter-inch galvanized-steel seamless conduit. The fittings in the corridors and rooms are all hung on gimbals from the ceiling. Ceiling rose blocks are arranged in the centre of the rooms, so that a single electrolier or five separate flexible leads can be brought through ceiling eyes to separate counterweight lamps. All rooms are well provided with wall plug sockets, which are flush with the wainscoting and are not screwed onto the wood blocks sunk in the wall, but are sprung into brass rings attached to the blocks. Four handsome standards supported on marble pillars illuminate the grand staircase. The lamps are all 200-volt carbon-filament lamps, mostly of sixteen candle-power, a few eight-candle-power lamps being used in the corridors. Four thousand of the lamps are counterweight lamps, and there are over 1,000 wall plugs for table lights, etc. For the telephone service there will be two exchange rooms, and night telephones in several rooms on each floor will admit of direct communication to the hall porter. The elevators for the lifting of paper are electrically driven with push-button control. These can hoist one hundredweight at the rate of 120 feet per minute.—*Abstracted from Electrical Engineering (London), June 18.*

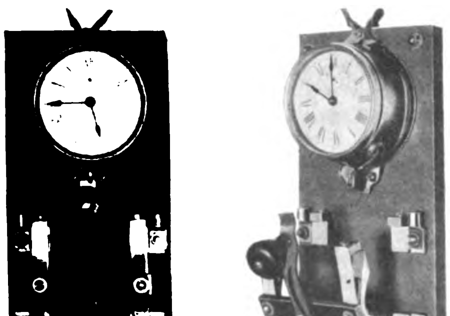
INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

IN THE following pages there will be found descriptions and illustrations of a large variety of apparatus which enters very extensively into the work of the electrical contractor. There has been a good deal of inquiry concerning the attitude of manufacturers with regard to the introduction of new appliances and the improvement of appliances for years well known in the electrical field. A great many of these devices are shown for the first time. It may be well, in passing, to state that no such eagerness to come strongly before the contracting fraternity as is evident at this time has been indicated for several years. Subsequent issues will contain further descriptions of apparatus used in this field.

The "Security" Automatic Time Switch.

In connection with the prevailing idea of increasing the hours of store lighting, contractors have frequently, within the last few years, been called upon to supply some means of arranging for the switching



"Security" Automatic Time Switch with Cover Removed.

off of the lights in a store window or, in fact, in the store equipment proper, at a predetermined time. In many of the larger cities this is accomplished by patrolmen, and it is part of the central station's work to see to it that the lights are not burned longer than the hour for which the contract is executed. In isolated cases, where the services of a watchman are not available, or where this periodic attention would cost too much, the automatic time switch fills the bill very nicely. In many cases, however, where the time switch is of elaborate construction, employing a multiplicity of contacts and an expensive clock movement, even the cost of this equipment makes it prohibitive. Where a cheap, simple, reliable and durable time switch can be secured, there is a considerable margin of profit for the contractor in handling and installing such a device.

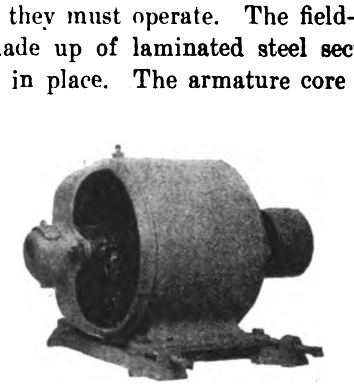
The F. Bissell Company, 226 Huron

"Security" Automatic Time Switch with Cover.

street, Toledo, Ohio, has placed on the market the "Security" automatic time switch, illustrations of which are shown herewith. This is an automatic circuit-breaker switch with an auxiliary carbon break. It operates by gravity and has no spring construction. It is impossible for the blades to stick. The back is flush, and all mechanism is on the face in plain sight. The switch is furnished for either on or off use, or for a combination of both.

Western Electric Company Direct-Current and Alternating-Current Motors.

Of particular interest to contractors are the direct-current motors of the "E" and "I" design, and the alternating-current motors of the "CP" design, manufactured by the Western Electric Company, Chicago, Ill. The "E" design comprises a line of motors ranging in size from one and one-quarter to seventy-five horsepower. These motors are furnished either open, closed with grids, or completely encased, depending on the conditions under which they must operate. The field-poles are made up of laminated steel securely bolted in place. The armature core is of



Two Horse-Power Motor, "I" Design.

a special grade of steel laminations which are carefully annealed after punching and treated with a coat of japan, insuring the lowest possible core loss.

The machines are furnished for either horizontal or vertical operation, and the bearing brackets of the horizontal machines may be shifted so that the motors can be suspended from the ceiling or walls wherever this is desirable. Especial care has been taken in the design of the brush rigging so as to insure the best brush contact and adjustment. The bearings are made especially large and strong, insuring cool operation and economical wear.

The line of small direct-current motors

Open Type Motor, "E" Design.

of the "I" design range in size from one-half to two horse-power. In the design of these motors special attention has been given to produce a motor that will be absolutely reliable in operating under the adverse conditions to which small motors are commonly subjected.

The frame and field-poles are made of a single casting of high permeability. By this construction all air-gaps, except those between the armature core and pole-faces, have been eliminated. The commutating field is made especially stiff, insuring sparkless operation for wide variations of load and speed. The bipolar type is used to prevent flashing under sudden and wide variations of load to which these motors

INDUCTION MOTOR, "CP" DESIGN.

are commonly subjected. The field coils are placed in an inclined position, so that the air currents set up by the rotation of the armature are met at all points by surfaces inclined to the direction of their motion. This feature accelerates the circulation and aids in the rapid distribution of heat generated under overloads.

The alternating-current motors are furnished either with squirrel-cage or phase-wound rotors, depending on the nature of the work they are to perform. The stator frames are of cast iron in one piece, and the section is such as to obtain the most rigid support for the laminations. The feet are broad, and the entire frame is so constructed that there can be no springing or vibration. Exceptionally high efficiencies and power-factors have been obtained for these motors by a special form of winding, liberal design, and by using the best grade of material throughout. All bearings are self-aligning and of the oil-ring type, and are housed in brackets of ample size to withstand the maximum capacities of the machines.

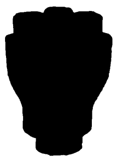
Some G & W Electrical Specialties.

The G & W Electric Specialty Company, 128 West Jackson Boulevard, Chicago, Ill., is calling attention to a number of time-saving, money-saving and trouble-saving specialties for central stations. Several of these specialties are illustrated herewith.

The type "MO" porcelain pothead is made up with single conductor tubes mounted in an iron case and with caps having one-inch holes. The lower casting is slipped over the cable and the lid and caps over the conductors. The conductors of the cable are separated, the joint is made, and the lower casting brought up in place, filled with compound to one and one-half inches from the top, and the lid set in place with the separated conductors passing through the tubes. The bottoms of the tubes are closed around the conductor by tape, and the tubes filled with compound to within one-half inch from the top. The caps are then drawn down into place and the conductors well taped down on the cap and several inches along the conductor. A few inches of braid on the wire is removed where it enters the cap, so that it will not act as a wick to lead water into the pothead.

The type "TS" porcelain pothead is a single-conductor, detachable pothead for high-tension and high-current duty. There are three porcelain members. The intermediate member provides a means of turning a threaded taper collar which

TYPE "MO" PORCELAIN POTHEAD



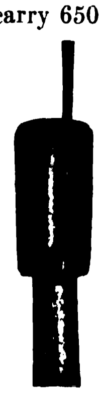
MULTIPLE-CONDUCTOR STATION TYPE POTHEAD.

TYPE "TS" PORCELAIN POTHEAD.

TYPE "S" PORCELAIN POTHEAD FOR HIGH VOLTAGE.

draws the two metal members together through the medium of the taper-headed plug and an externally threaded socket, thus insuring a tight-fitting joint. The standard size is designed to carry 650 amperes. This type of head is recommended when the disconnecting feature is required for loads above 150 amperes.

This type of pothead is well adapted to street railway work, as it will carry heavy currents, can be mounted on a pole without any protection from the weather, and can be disconnected under load by using ordinary precaution.



G & W GROUND-PIPE CAP.

The multiple-conductor stationary type of pothead has been developed to meet the demands for a station bell which is easy to install, low in first cost, and reliable. This head consists of a porcelain bowl and cover. The bowl is approximately seven inches in diameter at the top and four inches at the bottom. The bottom of the bowl is fitted with a metal plate provided with a collar drilled and tapped to size to screw upon the cable. The lid fits into the top of the bowl and is provided with the required number of holes and short tubes through which to pass the conductors. Owing to the manner in which the inside top edge of the bowl is cut away, the lid can be sealed into the bowl, thus excluding dust and moisture from inside the bell.

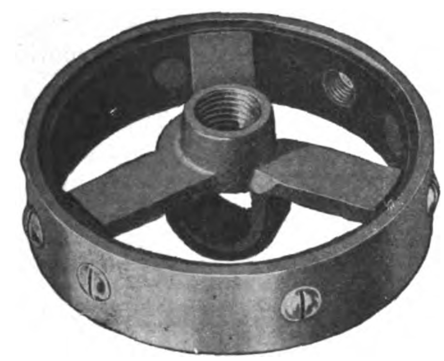
The G & W ground-pipe cap consists of a hollow galvanized malleable casting internally grooved along one side and so shaped at the mouth that the end of the ground wire can be introduced into the casting along the groove. The cap, with the wire in place, is put upon the top of the pipe and the pipe driven. In driving the pipe the cap is driven on and the copper wire wedged in securely between the inside wall of the cap and the outside of the pipe. The cap protects the top of the pipe from being battered out of shape, and saves the time required to cut off the battered end, as is often necessary in driving pipe in hard soils, and makes a joint of good conductivity between the ground wire and the pipe.

Oneida Galvanized Chain for Arc-Lamp Suspension.

One of the most important products turned out by the hardware department of the Oneida Community, Limited, Oneida, N. Y., is the Oneida galvanized chain. This is made in two sizes: No. 1, for suspending arc lamps, and No. 5, for suspending incandescent lamps. These chains can be used for any standard mast-arm. The chain is heavily galvanized and rust-proof. The fact that ice or sleet does not interfere with its ease of operation has been strikingly demonstrated at Niagara Falls, where a certain lamp was close to the cataract and the chain subjected not only to all conditions of weather, but to a continuous deposit of mist arising from the falls. The Buffalo & Niagara Falls Electric Company reported that the chains on this system worked perfectly throughout the entire winter in spite of the severe conditions.

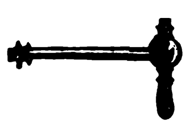
The Wakefield Standard Universal Lighting Fixtures.

The F. W. Wakefield Brass Company, Vermilion, Ohio, has placed on the market one of the greatest boons to electrical contractors in the Wakefield standard universal lighting fixtures. Recent developments in the art of electric lighting have made necessary the design of special fixtures, requiring large investments in order to carry a necessarily extensive line of designs. The adaptability of the Wakefield universal fixtures eliminates the necessity of carrying a large number of assembled fixtures, as it is possible by proper selection of stems and arms to adapt the Wakefield "body" to fit any requirement.



WAKEFIELD PATENT BODY.

WAKEFIELD CURVED ARM.



WAKEFIELD STRAIGHT ARM.

CLUSTER MADE WITH WAKEFIELD ADJUSTABLE FIXTURES.

Not only is it true that Wakefield fixtures are peculiarly adaptable to nearly all of the special needs of the trade, but it is also true that the principles of construction that are followed in building up these fixtures are such as will save the dealer and contractor much time and labor in assembling and installation.

As may be seen from the accompanying illustrations, the solid body contains no nipples whatever, and there are no inner iron bodies. A special feature which characterizes the arms and stems is that they all have a steel fish wire drawn through them, which allows the fitter to wire the arm in a very short time.

Hexagon arm backs on each arm permit the use of a wrench, removing the possibility of unsightly marks which are often left on the arms by the use of pipe pliers.

The body can be used for either two, three or four-light arm fixtures with a special provision that a light may be added to the bottom of any one of the fixtures. This feature, with the universal arms manufactured by the company, permits any style of arm on any style of stem with the various styles of plain, scroll and straight arms.

For each body either short or long stems are made for the construction of ceiling lights.

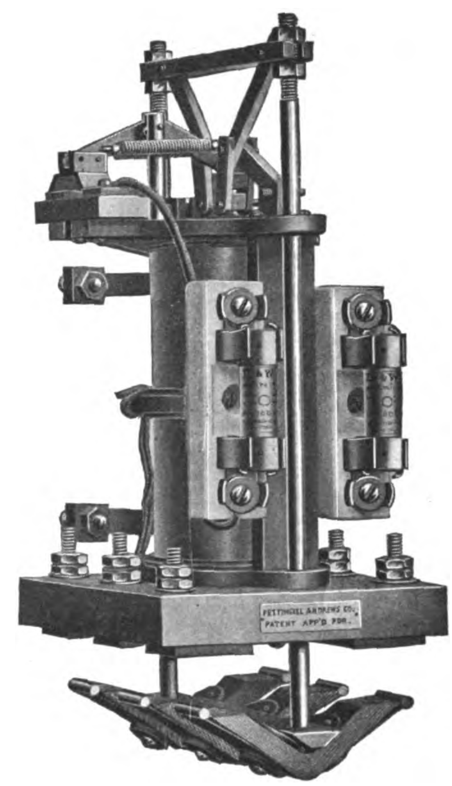
The arms and stems are made of heavy gauge stock finished in rich gilt, brushed brass or oxidized copper.

The cluster canopies are particularly important in making up special designs. These canopies are constructed of a heavy plain shell which is reinforced on the inner side by a casting, being fastened to the inner surface of the shell. The shell and castings are then drilled and tapped for either a one, two, three, four or five-light fixture. These outlets are fitted with small brass plugs which, when the shell is finished up, are left in the holes. The accompanying illustrations show a few of the many forms in which these fixtures may be assembled.

The Pettingell-Andrews Type D-2 Remote-Control Switch.

The Pettingell-Andrews type D-2 remote-control switch for either direct or alternating current has been designed along the lines of modern circuit-breaker construction, with laminated copper brushes and locking parts that are not called upon to carry current, and the entire mechanism is built up on a one-piece iron frame, so that neither rough handling in shipment nor constant pounding of operation will cause the fixed and moving parts to get out of alignment. The meritorious features of this device are well shown in the accompanying illustration.

The design of this switch precludes the possibility of the mechanism not completing its intended movement, either through a fall in the potential of the actuating circuit or due to too short a duration of the opening impulse or a careless manipulation of the control button. The switch is so assembled that it will fall open by gravity unless it is locked closed. There is no half-way point for it to hang. It is either locked closed by a steel-jointed toggle, hanging wide open, or traveling very fast toward one or the other of these positions.



PETTINGELL-ANDREWS TYPE D-2 REMOTE-CONTROL SWITCH, OPEN.

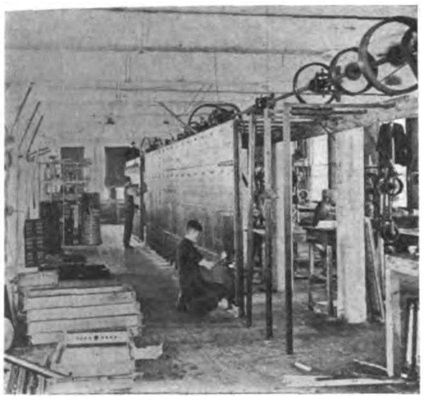
Some years of experience with arc-lamp cutouts enter into the design of the auxiliary break, and the operating current is broken with absolute certainty as the switch completes its closing movement.

These switches are made in the following capacities: Type D-2 are made with two, three or four poles up to 2,500 amperes, 250 volt, air-break, and 250 amperes, 2,500 volt, oil-break. Type D-3 and type D-4 are made for twenty-five amperes, 250 volts only.

This switch is made by the Pettingell-Andrews Company, Boston, Mass.

The Trumbull Electric Manufacturing Company.

Upon several occasions, so rapid has been the growth of the Trumbull Electric Manufacturing Company, of Plainville, Ct., as a switch specialist, it has been our pleasure to illustrate and describe in these columns the development of the company



Switchboard Department of the Trumbull Electric Manufacturing Company.

by text and with illustrations. At the present time this exploitation will suffice as far as the company's progress in the knife-switch field is concerned. There is another department, however, which is not so well known because it is of more recent development, namely, the panel-board and switchboard department. During the last year the growth of this department has equaled or even surpassed the record made

Slate Storage Department of the Trumbull Electric Manufacturing Company.

in the development of knife switches. Last summer, when the company's new factory was erected, it was intended to turn over about one-half of the four-story building, with about 22,000 square feet of floor space, to the panel-board and switchboard department. During the year, in spite of the market depression, this department has grown to such an extent that within a short time practically the entire building will be necessary for panel and switchboard work.

Familiar as the field is with the company's line of panel-boards, it is doubtful whether the great majority is acquainted with the extent to which these boards are used. A year ago the company's panels were ordered by the dozen; to-day they are sent out by the hundred, and cover every imaginable specification.

Last fall the department was entirely reorganized, and electrical engineers and assistants and other employés were recruited from the factories of some of the largest switchboard builders in the country, and a large number of successful bids were made for both government work and isolated plants.

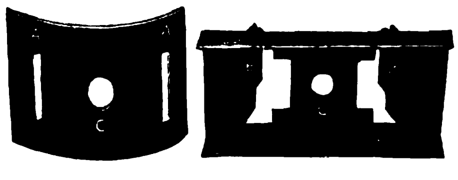
In entering this field the company realized the necessity of a thorough equipment to cover the most difficult specifications, and thousands of dollars have been spent in preparing to meet these requirements.

The company will shortly publish a list covering standard direct-current and alternating-current switchboard panels. There will be five distinct lines, covering specifications with and without circuit-breakers, with and without motors, and including complete economic arrangements for both central stations and isolated plants. With the line which the company will develop it will be possible for engineers to effect combinations to cover any kind of general requirements found in engineering practice. These boards will be kept in stock and can be shipped immediately.

Three Important Line-Construction Specialties.

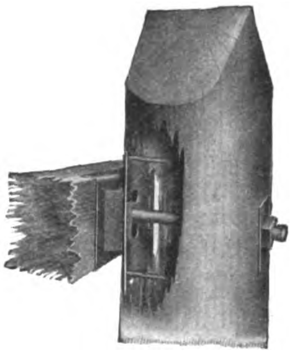
The Belden Manufacturing Company, 194 Michigan street, Chicago, Ill., has for a long time been favorably known as the manufacturer of a line of magnet wire and telephone cords. Recently the company has commenced the manufacture of several new patented devices for line construction work.

The Belden steel gain is a comparatively new device, although the construction departments of electric light, telephone, telegraph and power-transmission companies have seen the need of such a device for some time. The Belden wire test clamp or test connector has many advantages over the older forms of test clamps. The third device is known as the Belden ground clamp. This clamp possesses three features which particularly appeal to the user, namely, maximum strength, minimum price and great adaptability. One size fits all sizes of pipes. The steel gain is a steel support for the cross-arm which saves cutting gains in the pole and obviates the necessity of cross-arm braces except on longer than six-pin cross-arms. Referring to the illustrations herewith,



Component Parts of Belden Steel Gain.

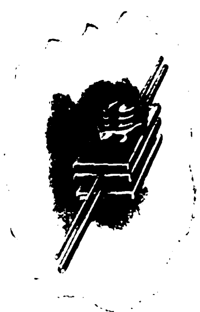
two tongues, B B, are cut from the back of the steel gain and these tongues inserted in the slots, A A. These are forced into the pole when the bolt is set up. The bolt passes through the cross-arm, the steel gain, and the holes, C C, and through the pole. This squares the cross-arm with the pole, fastening it securely in place. For power-transmission



Belden Steel Gain.

construction work extra heavy steel gains are made.

The use of the Belden wire test clamp is easily seen from the accompanying illustration. Essentially the device consists

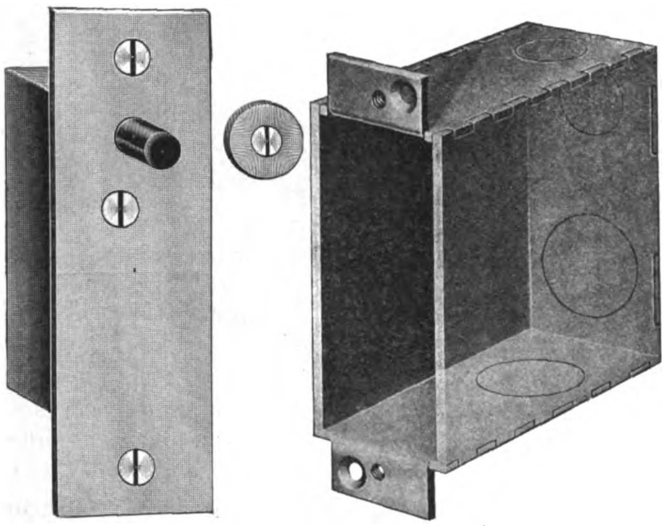


Belden Test Connector.

of a flat plate fitted with a slotted brass screw. The wire is placed in the slot in the brass screw and held in place by copper plate or leaves, one wire being placed between each pair of leaves and secured by a nut. The slot in the brass screw is large enough to receive any ordinary telephone or telegraph wire.

The "H. & H." Automatic Door Switch.

The accompanying illustrations show the automatic door switch and contain-



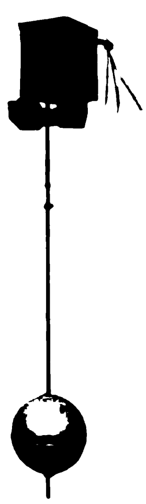
H. & H. Automatic Door Switch and Receptacle.

ing receptacle which has been placed on the market by the Hart & Hegeman Manufacturing Company, Hartford, Ct. This door switch will not only automatically operate the light, but is is so arranged that it automatically adjusts itself during the different seasons of the year to accommodate its action to the swelling or shrinking of the door.

Ward Leonard Motor-Starters.

The apparatus made by the Ward Leonard Electric Company, Bronxville, N. Y., have always been of great interest to contractors. This company manufactures so many devices which enter into in-

Ward Leonard "AS" Motor Starter.

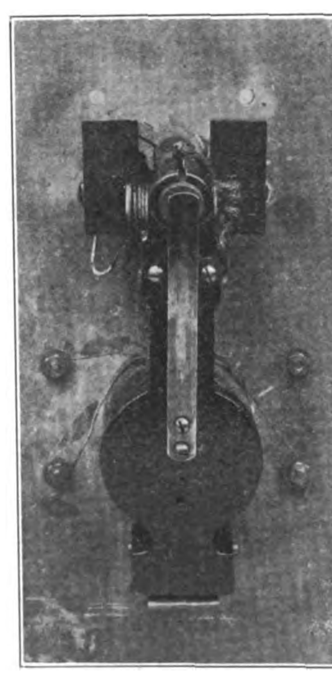


Tank Switch for Open Tank System.

stallations of every character and size that its name has long been familiar to the contracting fraternity.

The company announces recent advances in the design of automatic motor-starters and devices for regulating them, namely: Push-buttons, pressure regulators, tank switches, etc. Among the devices to which particular attention is called at the present time is the "AS" type motor-starter. This is a self-starting rheostat with a no-voltage release. This starter is for use in small sizes with main-line tank switches, and in any size with start and stop push-buttons. One of the illustrations herewith shows a self-closing switch operated by push-buttons. The combination of this switch and the "AS" starter, when mounted on one panel, forms a "CS" type self-starting rheostat with no-voltage release, equipped with a self-closing switch and a protective interlock, preventing the closure of the self-closing switch except when the resistance-controlling element is in the "all resistance in" position.

The "CS" type starter, when used with the pressure regulator, an illustration of which is shown herewith, is adapted to motor-driven pumps, etc.



Self-Closing Switch Operated by Push-Button.

The special feature in the design of this special line of apparatus is that the resistance units consist of Ward Leonard enameled units, the resistance element being thoroughly protected from any mechanical, electrical or chemical depreciation.

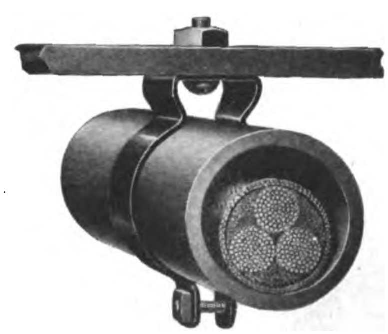
The self-starter is truly aligned, all the machine work being done at one time,

Pressure Regulator.

positively assuring that the dash-pot, plunger and magnet core are in perfect alignment. The company is giving the utmost attention to these details, and maintains an enviable position in the market by the honesty of the claims which it makes for its apparatus.

Minerallac Conduit and Cable Hangers or Cleats.

The accompanying illustration shows a cable and conduit hanger which has been placed on the market by the Minerallac Company, Monadnock Block, Chicago, Ill. These hangers are made of the best spring steel, and are easily and quickly put in place. Open wiring conduit and cable may be run with great rapidity and very compactly arranged. The hangers have been approved by the Underwriters' association for use on circuits up to 300 volts, when mounted direct on the surface



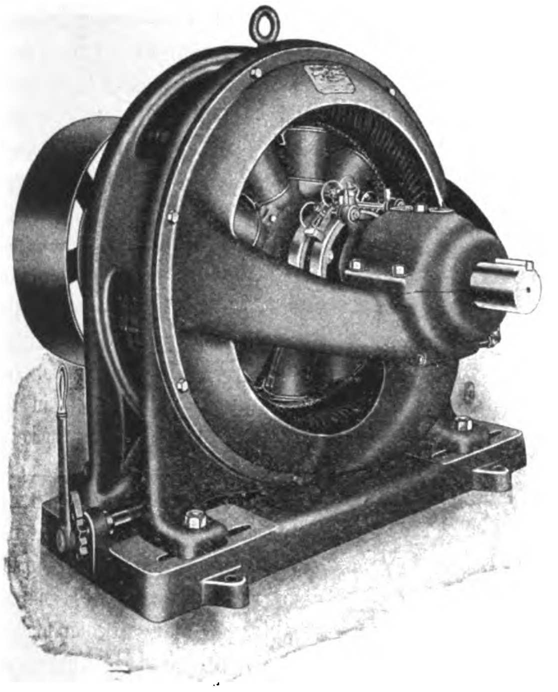
Minerallac Conduit and Cable Hanger.

wired over. For voltages from 300 to 550 the hangers must be installed with spacers under the base of the hanger or mounted on metal racks or brackets so as to hold the conductors at least one inch from the surface wired over. For voltages above 550 the hangers should be used with an appropriate insulating bushing having necessary insulation and dielectric strength, the hangers being mounted on metal racks or brackets to hold the conductors far enough from the surface wired over to preserve the required electrical clearance.

The company is prepared to furnish all styles of these bushings for high-tension work, properly designed to afford the necessary insulation and mechanical strength.

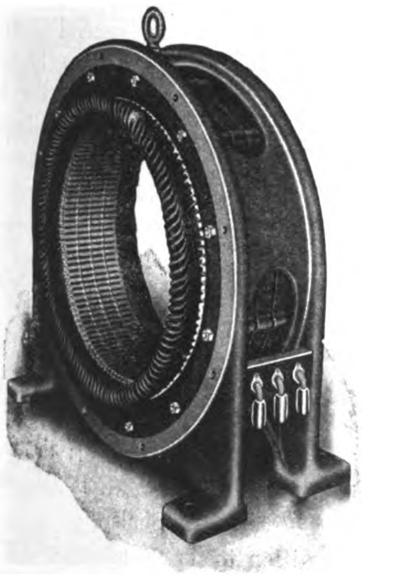
Fort Wayne Multi-Phase Belted Alternators.

The Fort Wayne Electric Works, Fort Wayne, Ind., has placed on the market a new line of multi-phase, sixty-cycle, revolving-field alternators of the belted type. These are styled TRB three-phase and QRB two-phase.



Fort Wayne Type TRB Three-Phase Belted Alternator.

These alternators are cheap, not through lack of material or through poor workmanship, but because of the reduced number of poles and the resultant speed, which permits the use of the minimum amount of material needed for the given output. The material is all of the highest quality,

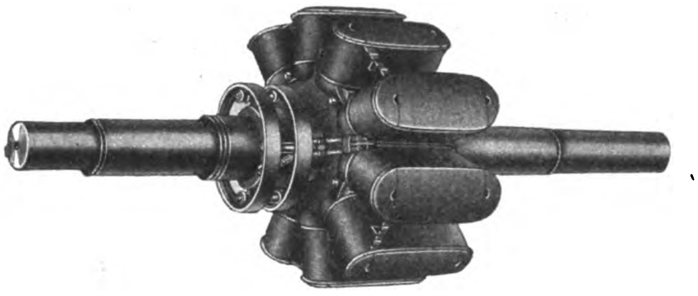


Frame of Fort Wayne Form B Alternator with Armature Winding.

and is handled by the most approved methods. The bearings are ample and cool-running, provided with oil-rings and reservoirs of ample capacity. They are supported by tripod brackets cast upon the end shields, giving great rigidity, with free access to the collector rings. The general appearance of this machine is well shown in the accompanying illustrations.

The alternator frame is of cast iron, in two parts, accurately machined and bolted together through the laminations of the armature core. The laminations are in sections and of special shape, having inwardly projecting teeth and projections extending out from the usual symmetrical outside circumference. In these projections are punched the holes through which the bolts pass, clamping the core and the two halves of the field frame firmly together. Air spaces are provided at the ends of the core and between laminations at regular intervals, to take advantage of forced ventilation produced by the fanning effect of the revolving field when the machine is in operation. An additonal advantage is taken by having the entire outer surface of the core exposed to the air.

The coils are carefully wound with highest-grade copper and insulated by superior methods of insulation. They are held in place by wooden wedges driven into grooves in the slots.



Revolving Field of Fort Wayne Form B Alternator.

The revolving field of the form B alternator is made up of a number of poles fitted into a central laminated spider with a dovetailed joint and taper keys to hold them firmly in position. After the poles are inserted in the special spider, end plates are bolted to each end of the core, closing up the joints. The poles are built up of laminations punched accurately from high-grade material and assembled under pressure.

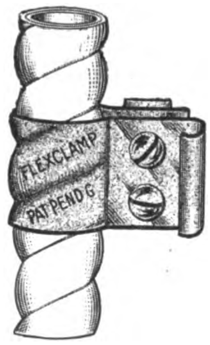
The collector rings are made of cast iron and have ample carrying capacity. Carbon brushes are used, held by the most improved type of brush-holder.

The form B multi-phase belted alternators are made with either two-phase or three-phase windings, for 2,300, 1,150, 600, 480 and 240 volts.

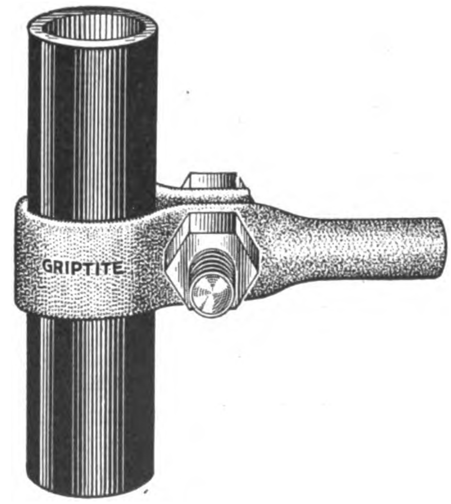
Belted exciters are furnished for all form B alternators. These exciters are known as the Fort Wayne type ML, and are belted to a small pulley mounted on an extension of the alternator shaft on the collector end.

Ground-Connection Clamps.

The Novelty Electric Company, 50-54 North Fourth street, Philadelphia, Pa., is calling attention to its "Griptite" and "Flexclamp" ground - connection clamps. The "Griptite" ground - connection clamps are for rigid conduit, and are made of rolled copper tubing in sizes to conform to the exact diameter of standard pipe from one-half to four inches. Being made of one piece of copper, the tightening of the bolt insures a perfect electrical contact



"Flexclamp" Ground-Connection Clamp.



"Griptite" Ground-Connection Clamp.

at all points on the pipe. The clamps have rounded edges, so that no possible injury can result to the lead casing of the cables when used for grounding these. The hollow tube to which the ground wire is soldered takes any size of copper wire up to and including No. 4 Brown & Sharpe gauge.

The "Flexclamp" is used for grounding Sprague flexible conduit and BX conductors. These clamps are made to fit perfectly the helical construction of the conduit. They are made of one piece of copper, and the tightening of the bolts insures a perfect electrical contact. There are five sizes—Size A, for No. 14 and No. 12 BX-2 conductors, No. 14 BX-3 and three-eighth-inch flexible conduit; size B, for No. 10 BX-2 and 3 conductors, No. 12 BX-3, No. 12 and No. 14 BXL, and No. 12 and No. 14 BM conductors; size C, for one-half-inch flexible conduit; size D, for three-quarters-inch flexible conduit, and No. 4 BX-2 conductor; size E, for one-inch flexible conduit.

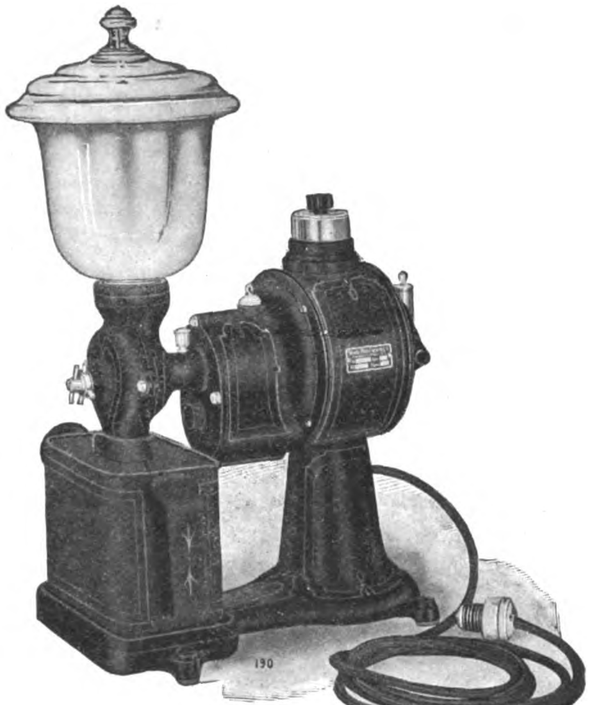
The Safety Armorite Conduit Company.

The Safety Armorite Conduit Company, Pittsburg, Pa., is the sole manufacturer under United States patents of "Loricated" and "Galvaduct" iron-armored conduits for interior construction. These conduits have found a very wide use in construction work of every character in all parts of the country. Among the important buildings in which these conduits have been exclusively installed are the following: Marshall Field Building, Commercial National Bank Building, Chicago, Ill.; Washington Terminal, Baltimore & Ohio and Pennsylvania Lines, Washington, D. C.; City Investing Building, Trinity Corporation and Annex, Hudson Terminal Buildings, Hotel Plaza, New York city; Carnegie Institute and Library, Pittsburg, Pa.; H. H. Rogers Memorial Church, parsonage, parish house and high-school group, Fair Haven, Mass.; Naval Academy buildings, Annapolis, Md.; Salt Lake Security and Trust Company Building, Salt Lake City, Utah; Denver Dry Goods Company, Denver, Col.; United States Military Hospital, Presidio, Cal.; Singer company's factories, Elizabethport, N. J.

In addition to the widespread use of these conduits in this country they have been exported for use in England, Canada, Australia, New Zealand, West Indies, the Philippine Islands, Hawaiian Islands, Mexico and the South American republics. These conduits are also installed in the majority of the warships of the United States built in recent years and in a large number of pleasure and merchant ocean-going vessels.

The Diehl Electric Coffee Mill.

The Diehl Manufacturing Company, Elizabethport, N. J., to meet a general demand for an electric coffee mill adapted to the needs of grocers, hotels, boarding houses and other users of coffee in large quantity, and which could be sold at a low price, has produced a low-priced electric coffee mill which at the same time is reliable, efficient and economical. As a maker of first-class electrical apparatus the company needs no introduction. Its large experience in the manufacture of thousands of small motors for driving fans, sewing-machines and other apparatus, places it in a unique position to supply a motor the qualities of which are unquestioned.



Diehl Electric Coffee Mill.

The general appearance of the mill as well as the arrangement of details is shown in the accompanying illustration. The grinder, gear case and back cover are combined in one unit, giving rigidity and compactness. The hopper is of spun brass, provided with a spun-brass cover, and both are heavily plated with nickel highly polished. The motor base is extended to hold the receiver, making the entire combination entirely self-contained. The mill may be readily adjusted to give any desired degree of fineness by means of a thumb-screw regulating the distance between grinders. The motor is provided with a switch for starting and stopping, and has ten feet of flexible cable attached. When the mill is put in service all that is necessary is to connect the plug to a convenient light socket and turn the switch.

The Doubleday-Hill Electric Company.

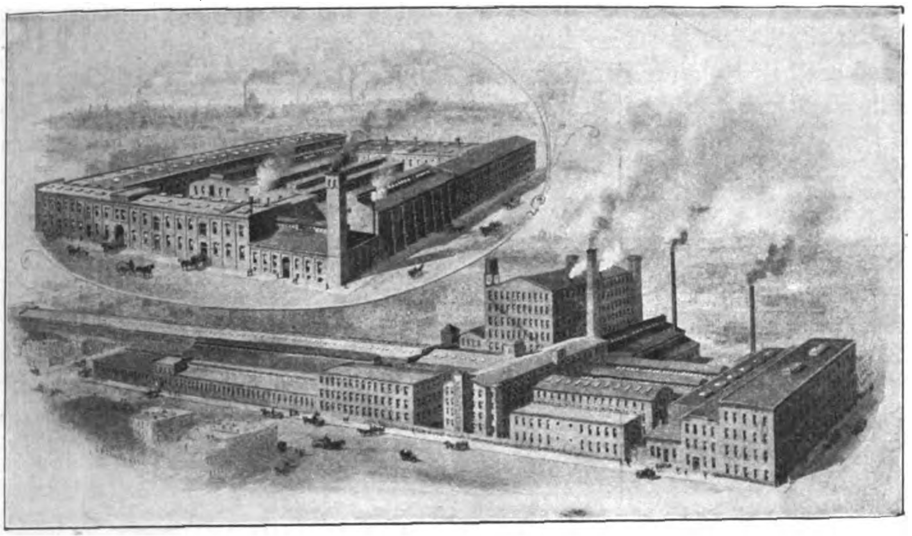
The Doubleday-Hill Electric Company, at 919 Liberty street, Pittsburg, Pa., is one of the largest electrical supply houses in the world. This company began business in one room in the Lewis Block ten years ago. The present business home of the concern is in a handsome building with eight floors, aggregating more than 50,000 square feet of space. In addition to the home office the company has two large auxiliary warehouses for the storage of surplus stock, and maintains a large branch supply house at Charlotte, N. C. The most interesting feature of this company's business is its large repair and winding shop, one of the busiest and most thoroughly equipped in point of labor and machinery to be found in the country. The company makes a specialty of the rewinding and repairing of all makes of both machine and hand-wound armatures. In its repair shop the company also refills, reinsulates and assembles all makes of commutators, and is prepared to furnish all necessary new parts for any of this apparatus, as well as arc lamps and, in fact, anything electrical that requires repairing. The company manufactures commutators, field and armature coils, switchboards, trolley wheels, and in the past has made quite a variety of special electrical equipment. In addition to the manufacturing and general distributing features of the business the company is sole agent for the Excello flaming arc lamp, A.-B. arc lamps, and includes among its exclusive specialties "O. K." weatherproof wire and cables, Triumph dynamos and motors, Emerson alternating fans and motors, Adams electric rock drills, Packard transformers, G. E. dynamos and motors.

The company is incorporated under the laws of the state of Pennsylvania with an authorized capital of $300,000. The president is C. Phillips Hill; the vice-president and treasurer, G. B. Hill, and the secretary, H. G. Shaler.

In addition to its comprehensive repair shops, factory and storehouses, the company has developed a business and office system which minimizes delays and facilitates the selection of material, and insures prompt shipping and tracing of all orders. The company maintains a large corps of traveling representatives and handles the largest orders placed in this field.

The Waterbury Company.

The Waterbury Company, with offices at 80 South street, New York city, and factories in Brooklyn, N. Y., is one of the largest manufacturers of seamless rubber-insulated wire and cables; paper-insulated, lead-encased cables; railroad signal wires, lamp cord, and flexible cords, as well as manila and sisal rope, oil-well cordage, wire rope, and music wire. The company was established in 1816, and commenced the manufacture of rubber-covered wire, telephone wires and special cables three years ago. Since the opening of this plant business has steadily increased until the company is now counted as one of the foremost manufacturers of this product.



THE BROOKLYN, N. Y., WIRE AND ROPE MILLS OF THE WATERBURY COMPANY.

The accompanying illustration shows the rubber-covered wire mill and the other mills operated by the company. Branch offices are established in Chicago, Pittsburg, New Orleans and San Francisco.

The Crouse-Hinds Condulets.

The development of condulets by the Crouse-Hinds Company, of Syracuse, N. Y., is being watched with much interest by all who are concerned with wiring propositions. The simple device, in most types, consisting of but two pieces, a cast shell and a cover, has simplified the conduit construction in such a marked degree that it is fast gaining the title of the "Key to Conduit Construction." The fittings are very simple in design, which point, together with the general neat appearance, occasions many conduit installations that would not have been undertaken in time past.

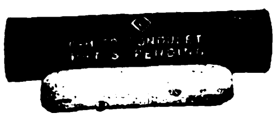
Condulets are made in many styles; in fact, it can be truthfully said there is a style for practically each and every requirement that may occur in any conduit or combination conduit and molding installation.

The illustrations which are shown herewith represent a type "A" and "C" fitting. The castings are provided with one or more threaded hubs, according to the type, into which the conduit is screwed. This form of construction insures con-

TYPE "A" CROUSE-HINDS CONDULET.

tinuity of conduit system, an important feature, and at the same time requires no more time to install than that involved in running a nut on a bolt or a nipple on a pipe.

It is not necessary to run the wires until the system is completed, as they can be drawn through the conduit to the condulets whose function is the same as that



TYPE "C" CROUSE-HINDS CONDULET.

of a manhole in a large conduit system. The covers are fastened to the castings and wires are drawn through, taps having been made, if branch wires are desired at this point. Blank metal covers are generally used where no branches are taken off. There are numerous styles of covers provided with standard nipples; also some types are provided with adjustable plates, so that fixtures, switches and various fittings can be mounted thereon.

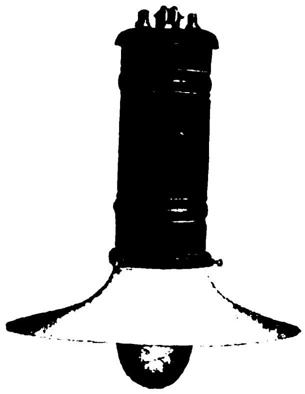
The type and location of condulets in any system are determined by the requirements of the wiring plan.

The Aurora Miniature Arc Lamp.

The Aurora Electric Company, Aurora, Ind., has placed on the market a miniature direct-current arc lamp. This lamp is simple in construction, substantial and neat in design. The resistance coil is mounted within the case, and the inner globe and guard are held in position by compression springs and permit of easy removal without the use of tools. The carbon feed works automatically, preventing burning out of the lower carbon holder. The maintenance costs are low, and an ordinary workman can easily trim the lamp.

The lamp has a consumption of two amperes at 125 volts, one and one-half amperes at 250 volts, and the carbons have a life of thirty hours.

A steady, pure-white light equaling fifty ordinary incandescent lamps is given, the current consumption being the equivalent of four incandescent lamps. The lamp



AURORA MINIATURE ARC LAMP.

is fifteen and one-half inches long by four and one-half inches in diameter. The weight complete, including porcelain shade, is seven pounds. The case is made of polished brass, or is given an oxidized metal finish. The lamp is especially adaptable for store windows, stores, halls, theatres, factories, etc.

The Aurora Electric Company is the manufacturer of an electromagnetic socket, which, by means of magnetic attraction to iron or steel, will hold an incandescent lamp in any position, allowing the light to be applied directly where desired. It can be used in any place or position where there is an iron or steel surface. It holds the lamp firmly and can be applied instantaneously.

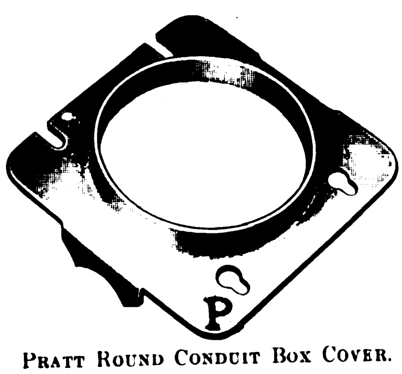
Galvanized Stamped-Steel Outlet Boxes and Covers.

The Pratt Chuck Company, Frankfort, N. Y., is the manufacturer of a fine line of galvanized stamped-steel outlet boxes and covers. Included in this line is a box for combination gas and electric fixtures, shown in the accompanying illustrations. This box is four inches square and one and

PRATT GALVANIZED SEAMLESS CONDUIT BOX.

five-eighths inches deep. It has eight conduit outlets in the sides and five in the bottom. There are two gas outlets, one in two opposite sides, for one-half-inch gas pipe only. The other side outlets are for one-half-inch or three-quarters-inch conduit only. The boxes are also arranged for gas elbows.

Other boxes which this company manufactures are the BA switch outlet or junction box, the CA outlet and junction box,



PRATT ROUND CONDUIT BOX COVER.

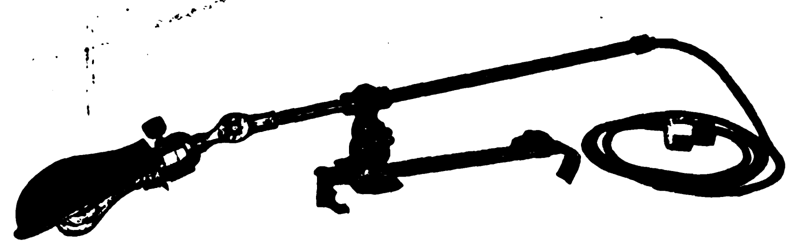
which is a round box four inches in diameter and one and five-eighths inches deep. The DA deep outlet and junction box for lath and plaster is four inches in diameter and two and one-quarter inches deep. This is equipped for four outlets in the sides and five in the bottom. The side outlets are for one-half-inch, three-quarters-inch and one-inch conduits. The boxes are drilled for fixture stems, and the flat steel cover is drilled for standard ten-ampere rotary snap switch. Other boxes are the EA box for G. E. receptacle No. 50,746 and for Bryant receptacle No. 5,050; the GA box, equipped for Norbitt, Trumbull, "P. & S." and G. E. receptacles. The company furnishes steel or polished-brass covers for Federal sockets and rotary snap switches in connection with its FA and CA boxes.

The HA, IA and KA boxes for ceiling outlets in terra-cotta are four inches or five and one-half inches in diameter, one-half inch or three-quarters inch deep.

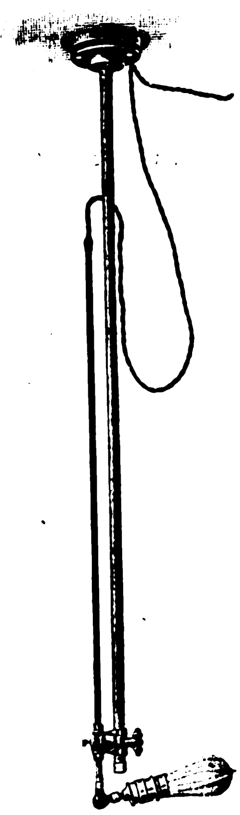
Adjustable Fixtures for Incandescent Lamps.

The O. C. White Company, Worcester, Mass., is the manufacturer of a very extensive line of standard adjustable fixtures for incandescent lamps for shops, mills and factories, drafting rooms, offices and banks, for residences, libraries and dressing rooms. These are made in plain forms and in combination with gas fixtures. These fixtures are strongly constructed and designed to withstand hard usage. They are constructed of iron and gun metal, and are listed in a variety of finishes to harmonize with the hardware and fittings generally used. The plain black finish is best adapted for shop fixtures. The plated finishes are frequently used where fixtures of rugged construction are required for offices, libraries, banks and well-appointed drafting rooms. The fixtures have been revised and approved, and can be wired easily and quickly with New Code wire. The arms are all straight and true and slide and turn freely to any adjustment.

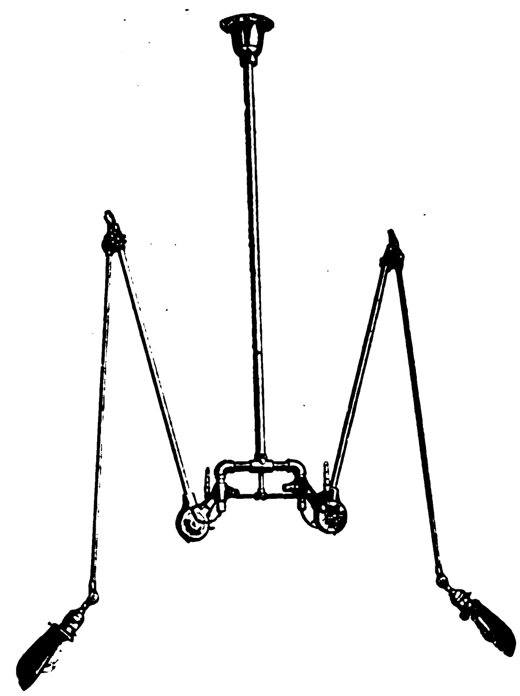
The ceiling fixtures are fitted with ball and socket base joint, swiveling and sliding cone joint and wrist joint. This adjustability permits of turning the lamp instantly into any desired position, and gives perfect protection to the cords and lamps among moving and shifting belts in shops and factories.



WHITE STRAP-CLAMP DESK LIGHTING FIXTURE.



WHITE ADJUSTABLE LIGHTING FIXTURE.

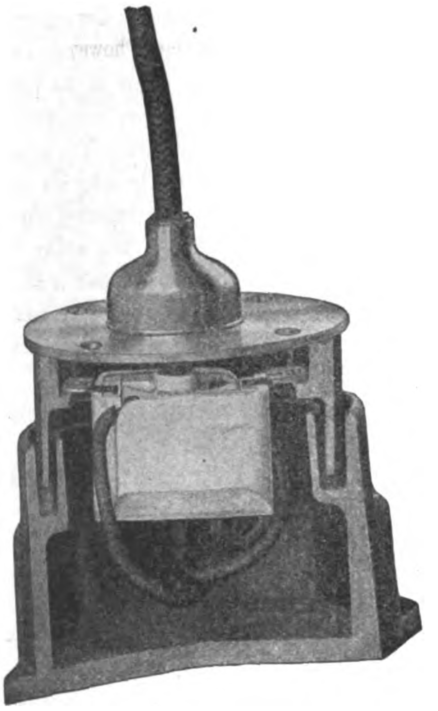


WHITE ADJUSTABLE LIGHTING FIXTURE.

One of the latest designs is the strap-clamp desk fixture. This is made for direct attachment to a roll-top desk. The main joint embodies entirely new mechanical principles and permits turning, tipping and sliding adjustments to any position or angle by frictional tension secured at one point or fastening. The standard wrist joint at the end of the lamp gives free angular adjustment to the lamp.

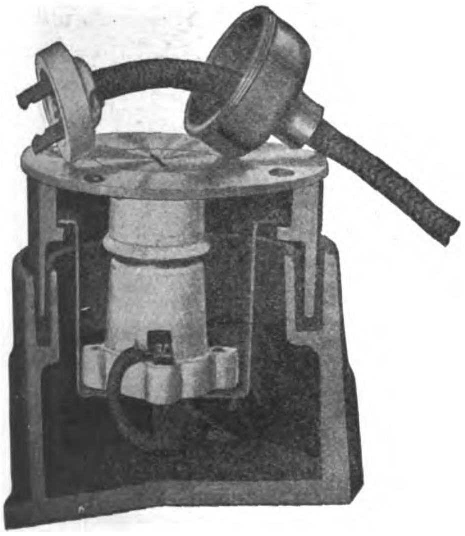
Fullman Water-Tight Outlets.

One of the popular specialties manufactured by the Steel City Electric Company, of Pittsburg, Pa., is the Fullman water-tight floor outlets. The accompanying illustrations will indicate better than



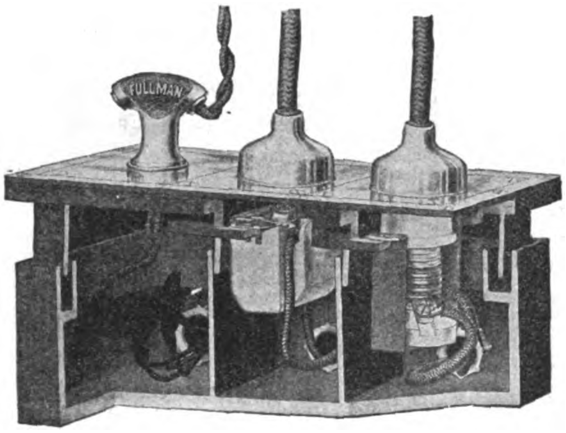
Sectional View of Fullman Floor Outlet, with Bell Nozzle.

a lengthy description the adaptability and utility of these devices. The apparatus is moisture-proof, and the universal tilting adjustment water-tight feature is peculiar to the Fullman designs. The floor plate is always flush and even with the floor, and alignment of receptacles is always correct, regardless of the crooked setting of the box body. One of the illus-



Fullman Box with Hubbell Attachment.

trations herewith shows a sectional view of the four-and-three-quarters-inch box with a bell nozzle and standard flush plug receptacle. Another illustration shows the same box with a Hubbell plug and a two-inch flush brass plug closing the opening in the floor plate. Still another illustration shows a sectional view of a rectangular gang box of three sections, showing a "drip" nozzle in use, a bell nozzle in use, and a two-inch flush

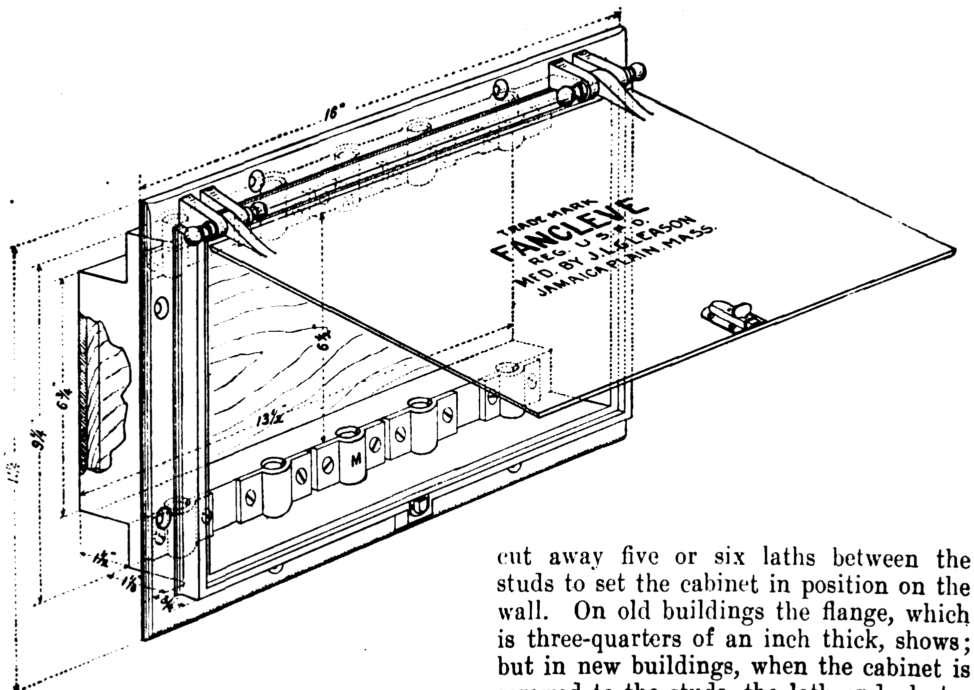


Sectional View of Fullman Rectangular Gang Box.

brass plug closing one opening. These gang boxes are furnished in two, three, four, five and six sections. The minimum height to the top of the cover is four and one-quarter inches.

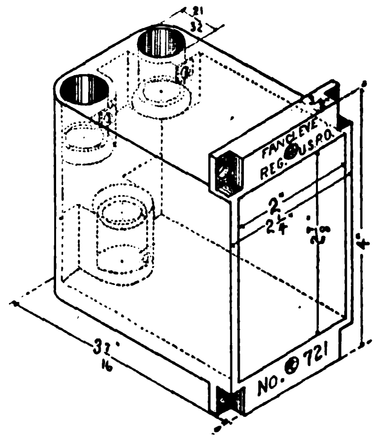
Some New "Fancleve" Specialties.

John L. Gleason, of Jamaica Plain, Mass., patentee and manufacturer of "Fancleve" specialties, has recently placed on the market two new fittings for use



New "Fancleve" Cutout Cabinet.

with Greenfield BX armored cables in old buildings. One of these fittings is a switch box which is made in sizes from one to four gangs and will fit any standard switch or receptacle. The cable pockets have a shoulder at the inside end to check the armor of the cable, and the surfaces through which the conductors project are rounded to prevent abrasion or chafing of the braid. A suitable plug is supplied in every pocket but one in each



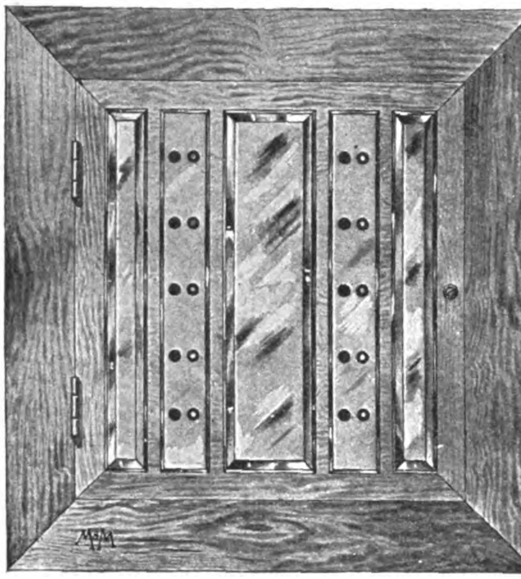
New "Fancleve" Switch Box.

box, so as to seal it if the pocket is not used.

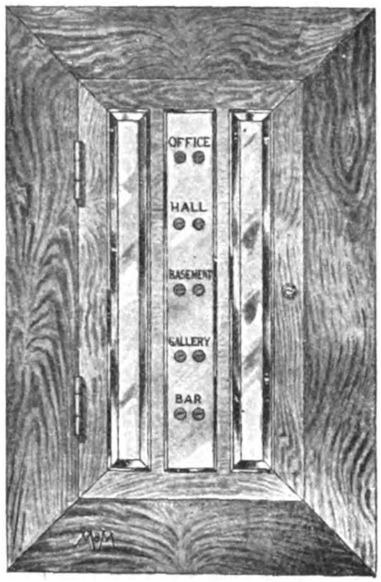
The other fitting is a cutout cabinet with a capacity of eight circuits. Four circuits enter at the top and four at the bottom. There are two entrances for the mains, opposite each other, and designated by the letter "M." The pockets are reamed to confine No. 8 or No. 10 cable, and the branches are reamed to take No. 12 or No. 14 cable. It is intended that the cables be brought up or down partitions between the studs, and the cabinet is of such a size that it is only necessary to cut away five or six laths between the studs to set the cabinet in position on the wall. On old buildings the flange, which is three-quarters of an inch thick, shows; but in new buildings, when the cabinet is screwed to the studs, the lath and plaster come out flush with the edge of the cabinet. The fitting is of iron, excepting a beading of half-inch hardwood to which the cutouts are fastened. The door raises upward, so that it tends to stay closed through the action of gravity. The fitting weighs about twenty-four pounds.

"M. & M." Panel-Boards.

The Machen & Mayer Electrical Manufacturing Company, Twelfth and Buttonwood streets, Philadelphia, Pa., has placed on the market a new type of panel-board known as the "M. & M." panel-boards of

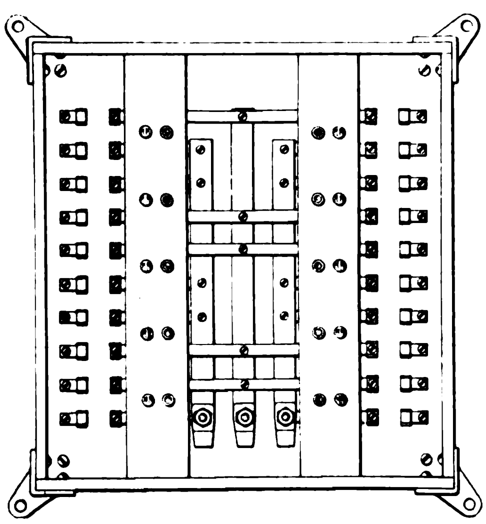


FLUSH TYPE OF "M. & M." PANEL WITH PUSH-BUTTON SWITCHES.



FLUSH TYPE OF "M. & M." PANEL WITH LOCK SWITCHES.

the push-button switch type. These panel-boards are very handsome in appearance, and are adapted to the highest class of installations. They are made in several different types. The cabinet type is adapted to use in any ordinary panel cabinet of the proper size. This type is divided into two classes, one operated by



CABINET TYPE "M. & M." PANEL.

push-button switches and the other operated by lock switches. The flush type of panel-board is furnished with door and trim. The difference between this type and the cabinet type is in the door and trim, the door having openings in it, allowing the switch face-plate to extend through, so that the switches can be operated from the outside without opening the door. This type of panel is also divided into two types, one using push-button switches, and the other lock switches.

There is no danger of the operator coming in contact with any live parts. The brass face-plate over the switches serves as a convenient directory of the various circuits.

To replace a defective switch it is not necessary to disturb the panel-board or other switches, as any switch can be replaced from the front of the panel.

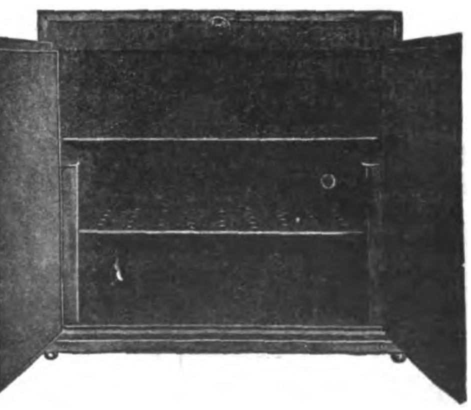
Where panel-boards are located in hallways, in public buildings, or in places where it is desirable to have the lighting circuits under the control of either the superintendent of the building or some special attendant, the lock-switch type of panel-board offers the advantage that the lights can not be turned on or off except by the attendant with a key specially designed to operate the switches.

The flush type of panel is two and one-half inches deep, while the cabinet type is three and one-half inches deep. Either of these types of panel can be made with meter loops and with four bus-bars for use on two-phase circuits; also with knife switches in the mains if desired. The Underwriters' specifications are followed in every respect in the construction of these panel-boards, and the "M. & M." shallowest flush push-button switches used in their construction have been tested and approved by the Underwriters.

The Prometheus Electric Plate-Warmer.

The electric plate-warmer is not, strictly speaking, a new device. Plate-warmers have been made for several years, and hundreds of them are in use, particularly in the large cities. Contractors outside of New York city, however, are probably not sufficiently alive to the possibilities for profitable orders represented in this branch of the business. The arguments in favor of electric heating are too well known, and have been repeated often enough, to be omitted. It will suffice to say that the electric plate-warmer is eminently convenient, no matter where used, and is a necessity wherever meals are served and electric current is available.

The accompanying illustration shows an electric plate-warmer made by the Prometheus Electric Company, 236-238 East Forty-third street, New York city. These plate-warmers are heated by means of individual electric resistances attached to the sides on the inside of the plate-warmer, and covered with flues which project but one inch into the interior of the apparatus. The electric equipment, therefore, takes hardly any room and economizes greatly in space over those plate-warmers which use gas or steam pipes for producing the heating element. This apparatus has been pronounced a very practical equipment. The arrangement of the resistance units insures a continuous



THE PROMETHEUS ELECTRIC PLATE WARMER.

circulation of heated air, and the entire inner space is heated to a uniformly high temperature.

These plate-warmers, as a rule, are made to architects' specifications, and for this reason are built to order only. Russia iron is used in the construction, and the double walls are mounted on an angle-iron frame. The intervening space is lagged with mineral wool or asbestos.

Bishop Gutta-Percha Company.

During the past year the factory of the Bishop Gutta-Percha Company, 420-430 East Twenty-fifth street, New York city, has been entirely remodeled and considerably enlarged. A new building, five stories in height and covering a plot fifty by 100 feet, has been erected adjacent to the old factory building. Special attention has been given to lighting and ventilating, it having windows on all sides. Pains have been taken in the matter of fire protection, the first two stories and basement being of up-to-date fireproof construction and the building equipped with automatic-sprinkler system, having both gravity and pressure tanks.

The power plant for the entire factory is located in the basement of the new building and all machines are now driven electrically, using a two-phase alternating current with a potential of 220 volts.

The buildings are well lighted with Nernst lamps, so that in case of necessity work can be done at night as well as day. New insulating and braiding machines of the latest type, as well as a modern lead press, have been installed. With new machinery and increased floor space, the facilities for manufacturing both rubber-covered wire and gutta-percha goods have been increased from sixty to seventy-five per cent.

The business of this company was established for the manufacture of gutta-percha goods in 1847, which has been carried on continuously ever since.

The plant for rubber-covered wire was installed early in the eighties, and the company has ever since made a specialty of high-grade insulated wires and cables, furnishing a considerable number of submarine cables for telegraph, telephone and power service, as well as gutta-percha insulated cables for submarine use.

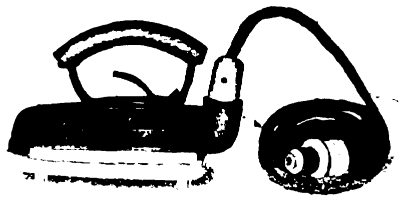
The Bishop standard high-grade wire, elevator control or traveling cables, annunciator and lighting cables and the asbestos-covered car cables of this company's make are well known throughout the country.

In the new building is installed an up-to-date testing laboratory with electrical testing set for high voltages and insulation resistance. The company is continuing to manufacture, as it has since 1847, all kinds of gutta-percha goods.

The president of the company, Henry A. Reed, who entered the telegraph field in 1849, has been nearly thirty years engaged in the Bishop factory, during which time he has been considered a leading authority on electrical insulation, is still active in the business, having associated with him in its management two of his sons, Henry D. Reed, M.E., Stevens, 1892, who has been engaged in the business for the past fifteen years, and W. Boardman Reed, C.E., Union, 1882, treasurer of the company, who was for many years connected with electrical railway work.

Economy Electric Heating Apparatus.

The Economy Electric Company, 217 Fulton street, Brooklyn, N. Y., is placing on the market a number of useful elec-



Economy Electric Flat-Iron.

trical heating and cooking devices, including soldering and branding irons, flat-irons and other heating specialties. The Economy electric soldering and branding irons are made for all standard voltages.

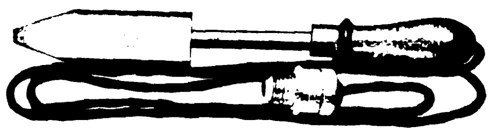
Component Parts of Economy Electric Flat-Iron.

The irons are constructed to meet the necessary requirements of the Board of Fire Underwriters, being made of the best approved material. The principle and construction of these irons are such that all the heat is concentrated in the copper, preventing the wasting of electrical energy due to the heating of shells and casings.

One of the illustrations herewith shows an electric soldering iron for medium work. This size and style is best adapted for work in shops, buildings, garages, yachts, and is serviceable for soldering connections and for making up string lights for stage lighting. This iron consumes 150 watts.

The branding iron shown herewith consumes 350 watts and is designed to meet all the necessary requirements for branding provisions in packing houses under the new inspection laws. Other forms of iron are made for soldering telephone and telegraph connections and for work in obscure places. This form of iron consumes seventy-five watts. Another iron consuming sixty watts, and still another consuming 100 watts, are made for light work. Other irons consuming 200 watts and 300 watts, and a heavy iron consuming 400 watts, are also available.

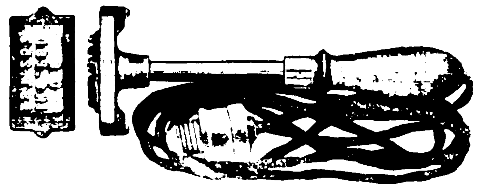
The Economy electric flat-iron, shown herewith, is equipped with a flat mica disc wound with a heating element of exceptionally long life. The company guarantees that its goods, in addition to having a long life, are very economical in the consumption of current. The internal



Economy Electric Soldering Iron for Medium Work.

electric heater covers the entire bottom of the iron, thus heating the entire surface of the iron.

The iron is equipped with a removable handle. This is an important feature, as no current is consumed in heating the handle and no protecting pad is needed.

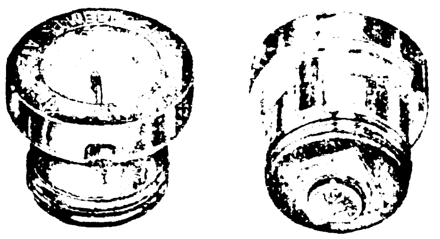


Economy Electric Branding Iron.

The handle is always cold because it can be removed when the iron is not being used.

Weber Fuse Plugs.

Henry D. Sears, 131 State street, Boston, Mass., general sales agent for Weber electric wiring specialties, announces the new Weber fuse plugs for 125 volts, with mica caps, illustrations of which are

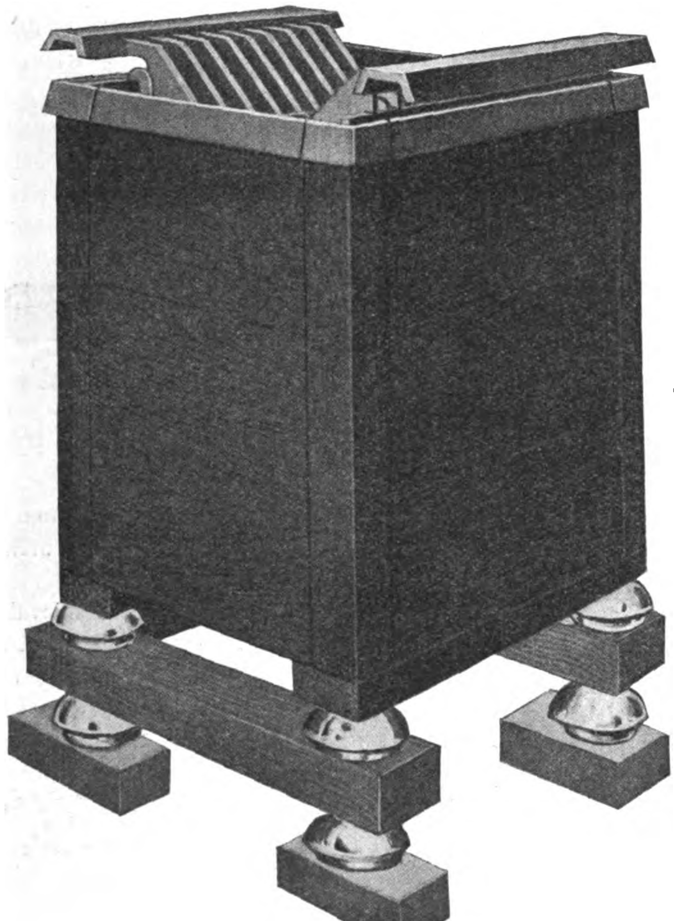


New Weber Fuse Plugs.

shown herewith. When the fuse blows there is no possibility of the escape of molten fuse metal; the large vent holes provide for the proper escape of gas, and there is no outside lump of solder to prevent proper bottoming of the plug in the cutout. These plugs are made in capacities from three amperes to thirty amperes.

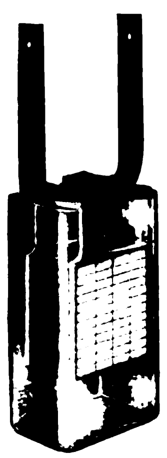
The Electric Storage Battery Company.

The Electric Storage Battery Company, Philadelphia, Pa., is the manufacturer of three general forms of storage



Type "G" Nineteen Plates in Lead-Lined Wood Tank.

batteries bearing the trade-marks respectively of the "Chloride Accumulator," the "Tudor Accumulator" and the "Exide Accumulator."



Type "B" Three Plates in Glass Jar.

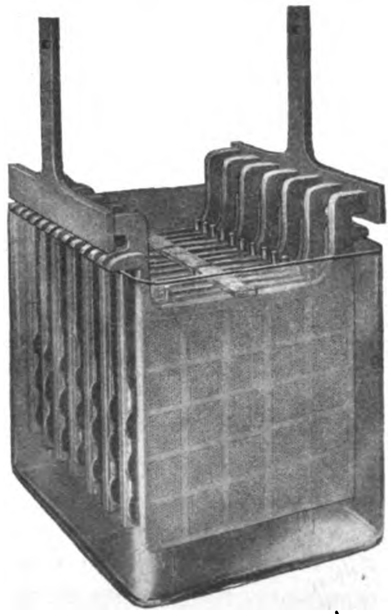
This product represents the highest development of this branch of the electrical industry. Installations of these batteries are not only found in general use throughout the United States but also in South America, Mexico and Canada.

The smaller cells of the "Chloride Accumulator," embracing the two-plate types and types B, C and D, are used where a small current capacity is required, thousands of these cells being operated for police and fire-alarm systems, telegraph, railway signals, laboratory service and for small isolated lighting plants.

The larger cells, embracing types E, F, G, R and H, are employed for lighting and power stations, street and interurban railway service, electrification of steam railroads, residential and isolated lighting, etc.

The "Tudor Accumulator" and the "Chloride Accumulator" are used in the special forms, designed by the company, for the electric lighting of railway cars. A complete description of these types is contained in a catalogue recently issued under the title of "Car Lighting Cells," Catalogue C.

The "Exide" battery is used principally for electric-vehicle propulsion and for the ignition of gas or gasolene engines in automobiles, power boats, stationary service, etc.

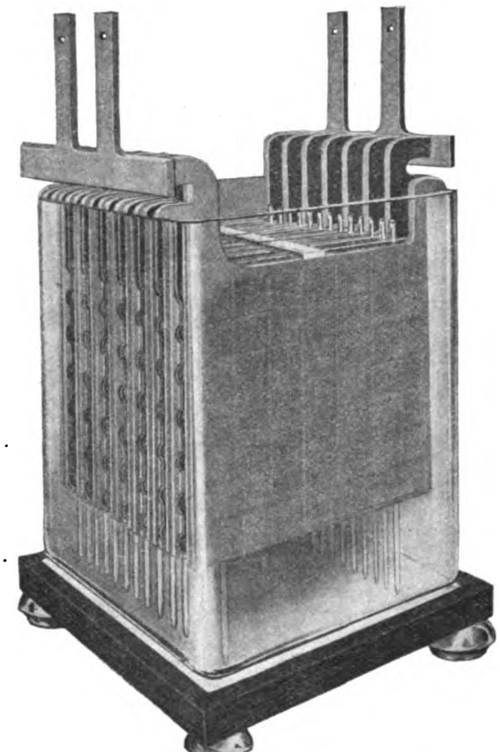


Type "E" Thirteen Plates in Glass Jar.

The extensive use of the "Exide" battery necessitated the opening of "Exide battery depots" in different cities, and about 400 "Exide distributors" throughout the country are prepared to supply and maintain "Exide" batteries and parts.

It has always been the policy of this company not only to produce the best batteries, but to devise instruments and furnish the required instructions for maintaining their cells in the best possible condition. To this end a force of operating engineers is employed in constantly superintending the working of batteries installed by this company, thus insuring their economical operation and efficiency.

The auxiliary apparatus and accessories



Type "F" Fifteen Plates Glass Jar.

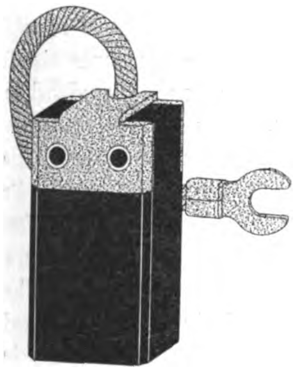
for use with storage batteries designed and constructed by this company are the result of twenty years' experience and the labors of an engineering force specially trained in battery work.

The company does a large business through electrical contractors in the installation of batteries in residential, mill, factory and similar isolated plants, and has issued bulletins especially covering these applications.

Portable "Exide" Battery.

The LeValley Vitae Carbon Brush with Pigtail Connection.

The accompanying illustration shows the new form of carbon brush which has been placed on the market by the LeValley Vitae Carbon Brush Company, 405 East Tremont avenue, New York city. The advantageous feature of this new connection is that it is indestructible. The copper plates to which the lead is attached are firmly clamped to the carbon on each side by expanded copper rivets, making a perfect contact. Solder does not enter in any way into its construction, and it can

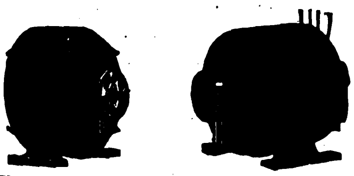


LEVALLEY VITAE CARBON BRUSH WITH IMPROVED PIGTAIL CONNECTION

not therefore melt off or become detached from the carbon. The brush maintains its even proportion throughout, fitting snugly in the brush-holder until the brush is worn out. This insures a perfect contact, and the brush can not tilt over. This invention is owned by M. W. Robertson, sales manager of the company.

Westinghouse Small Power Motors.

The small power motors supplied by the Westinghouse Electric and Manufacturing Company for either direct current or single-phase alternating current, are particularly compact and durable under all sorts of operating conditions. They are all automatic in their starting char-



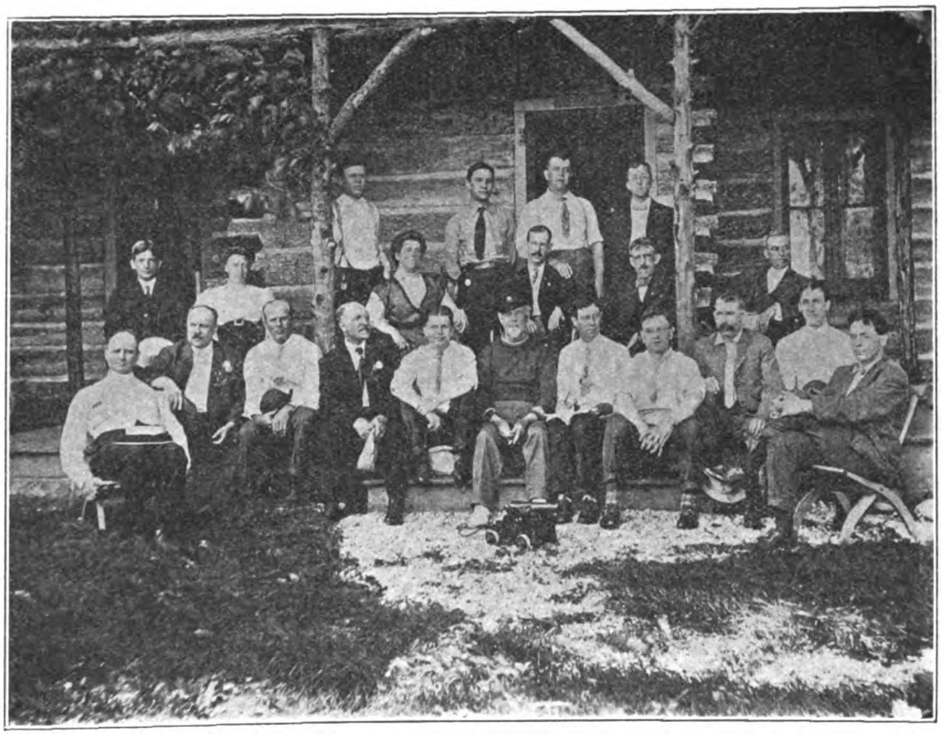
WESTINGHOUSE SMALL POWER MOTORS.

acteristics, as in starting it is only necessary to close the main switch. The motors will in all cases start full load and will stand considerable overloads.

The motors are manufactured regularly in sizes from one-twentieth to one-quarter horse-power, for either 110 or 220 volts in standard speeds. The illustrations show both the direct and alternating-current motors in the one-sixth-horse-power size. The motors are given a horse-power rating on an intermittent basis of full load for one-half of the time, with no period at full load longer than one-half hour. These motors are regularly manufactured for sixty and twenty-five cycles, although in some cases they are supplied for 133 cycles.

Annual Summer Conference of the Fostoria Incandescent Lamp Company.

The annual summer conference of the salesmen of the Fostoria Incandescent Lamp Company, Fostoria, Ohio, was held during the week of June 22 at Ballast Island, in Lake Erie, near Put-in-Bay. It was attended by about twenty-five rep-



ANNUAL SUMMER CONFERENCE OF THE FOSTORIA INCANDESCENT LAMP COMPANY'S SALESMEN, BALLAST ISLAND, LAKE ERIE.

resentatives from all parts of the United States, and an extensive programme of technical sessions and entertainment features was carried through. The meeting was pronounced a marked success, and it was especially important on account of the fact that this has been the first meeting held since all of the high-efficiency incandescent units have been commercially perfected.

The company's factory at Fostoria is now undergoing extensive alterations and enlargement. In addition to this, the construction is being strengthened throughout on account of the manufacture of tungsten lamps. Heavier material, including heavy maple flooring, etc., is being installed, and when this work is finished the factory will not only be practically as good as new, but have a considerably larger production and a correspondingly better equipment.

Meeting of the New York State Electrical Contractors.

The semiannual meeting of the Electrical Contractors' Association of New York State was held at Buffalo, N. Y., on June 22, 23 and 24. The programme included a meeting of the board of directors on June 22, a meeting of the general association, luncheon and banquet on June 23, and a private trip to Niagara Falls and inspection of the plants of the Niagara Falls Power Company, Hydraulic Power and Manufacturing Company, Canadian Niagara Falls Power Company, Ontario Power Company, Electrical Development Company of Ontario, with dinner at the Clifton Hotel, Niagara Falls, Ontario, on June 24.

For this semiannual meeting each of the various local contractors' associations send delegates or representatives. About thirty of these representatives were present. The total attendance was 110, and eighty members were present at the banquet.

The present officers of the association are: James Hilton, president, Syracuse, N. Y.; Edmond D. McCarthy, vice-president, Buffalo, N. Y.; George W. Russell, Jr., secretary, New York city; James F. Burns, treasurer, Schenectady, N. Y.

Civil Service Examinations for New York State and County Service.

The New York State Civil Service Commission will hold examinations on July 25 for the following positions: Assistant in economic geology, State Museum, $1,200; engineering examiner, Civil Service Commission, $1,000 to $1,200; leveler, $4.50 to $5 a day; structural engineer, state architect's office, $2,000.

The last day for filing applications for these positions is July 18. Full information and application forms may be obtained from Charles S. Fowler, chief examiner, Albany, N. Y.

The Society for the Promotion of Engineering Education.

The sixteenth annual meeting of the Society for the Promotion of Engineering Education was held at Detroit, Mich., June 24, 25 and 27. The address of welcome was delivered by Mayor Thompson. In the absence of President Howe the chair was occupied by Vice-President W. G. Raymond, of the University of Iowa.

Professor Dugald C. Jackson presented the report of the joint committee on engineering education. This committee is formed of representatives of the national engineering societies.

A paper was read by Professor J. Martin Telleen, of the Case School of Applied Science, on "The Course in English in Technical Schools." Another paper of the same nature was presented by Dr. William Kent, entitled "Results of an Experiment in Teaching Freshman English." Howard Frost presented a paper entitled "A Proposed Course in General Engineering." Professor W. T. Magruder presented a paper entitled "Present Curricula of the Mechanical Engineering Courses."

On Wednesday evening there was a joint session with the American Society of Mechanical Engineers, when a lecture was delivered by Professor Brashear on "Contributions of Photography to our Knowledge of Stellar Evolution."

The second session of the society was held on Thursday afternoon. The annual address of President Charles S. Howe was entitled "The Function of the Engineer in the Conservation of Natural Resources of the Country." A. L. Rice read a paper on adapting means to the end in technical education. A paper taking up the question of the place of foreign languages in the curriculum in schools of engineering was presented by Professor A. L. Wright. Professor W. F. M. Goss read a paper on second degrees for graduates of engineering courses. The subject of scholasticisms in engineering education was presented by John Price Jackson.

The Saturday morning session was devoted to a discussion of papers by Dr. Schneider, of the University of Cincinnati, and Professor Furman, of Stevens Institute of Technology.

Monument to John A. Roebling.

The entire city of Trenton, N. J., joined in paying tribute to the memory of John A. Roebling, founder of the John A. Roebling's Sons Company, Trenton's greatest industrial corporation, upon the occasion of the unveiling of a monument to Mr. Roebling at Cadwalader Park, on Tuesday, June 30. This magnificent tribute was the occasion of the dedication of the monument erected by the Roebling Memorial Association. During the afternoon practically all mercantile business in the city was at a standstill because of the gathering of thousands of people to witness the ceremonies. Preceding the formal dedicatory programme at Cadwalader Park there was a parade of 5,000 employés from the Trenton plant of the John A. Roebling's Sons Company and 1,000 from Roebling, N. J., the industrial town on the Delaware River which has been built up to carry on the overflow of the Roebling industry from the Trenton mills.

Colonel Mahlon R. Margerum was master of ceremonies. The first number of the set programme was the American overture by Winkler's Second Regiment Band. Prayer was offered by the Rev. Dr. W. Strother Jones, rector of St. Michael's Episcopal Church. The United Singing Societies of Trenton, under the direction of Dr. Carl Hoffman, sang "Der Tag Des Herrn." Miss Emily M. Roebling, daughter of Charles G. Roebling, and granddaughter of John A. Roebling, pulled the silken cord which released the United States flags which covered the bronze statue, created by William Couper, of New York. The band then played the bridal chorus from "Lohengrin." Colonel Margerum introduced former Governor Edward Casper Stokes, who, after a brief eulogistic address, introduced Henry D. Estabrook, general counsel of the Western Union Telegraph Company and father of Mrs. Karl G. Roebling, who delivered the oration.

At the close of Mr. Estabrook's address the United Singing Societies sang "The Star-Spangled Banner," which was followed by an address by former state Senator Jonathan H. Blackwell, who introduced the sculptor, William Couper, of New York. The set programme was closed with the rendition of the coronation march from "The Prophet."

During the ceremonies a cablegram from the mayor of Muhlhausen, Germany, the birthplace of Mr. Roebling, was read. A brass wreath sent by the citizens of Muhlhausen was placed on the monument.

The monument is fifteen feet seven inches high, exclusive of the four and one-half feet of concrete base, which is entirely underground. The stonework supporting the statue is nine feet high, and the statue measures six feet seven inches. The figure is modeled in a sitting position. The statue is made of bronze, and was cast in the plant of the Gorham Manufacturing Company, Providence, R. I. The cast was made from a clay model designed by Mr. Couper at his studio in New York city. The pedestal is built entirely of Bonacord red Swedish granite, which was quarried in Sweden and polished in Aberdeen, Scotland. On the right side of the granite pedestal is a bronze panel bearing a reproduction in relief of the first railroad suspension bridge ever built, over the Niagara. On the left side is another panel containing a replica in relief of the Brooklyn Bridge. The front of the pedestal is occupied by the following inscription:

John A. Roebling, Civil Engineer,
Designer and Builder of Many Suspension Bridges,
Founder of Trenton's Greatest Industry,
An Energetic Worker, Inventor and Man of Affairs,
Devoted to His Adopted Country,
In Whose Progress He Had Unswerving Faith:
A Patron of Art and Sciences,
A Benefactor of Mankind.
This Monument Is Erected by the Citizens of Trenton and His Sons in the Year 1907.

The monument in its entirety represents a cost of $14,000, of which $10,000 was expended for the statue. The greater part of this money was obtained by popular subscription, and the remainder was contributed by the sons of the distinguished bridge builder. The committee in charge of the subscription movement follows: Harry S. Maddock, president; Louis Fisher, secretary; Philip Freudenmacher, treasurer; Christian Guenther, Jonathan H. Blackwell, Samuel Walker, John C. Schweizer, General C. Edward Murray and Mahlon R. Margerum.

In connection with the dedicatory ceremonies, former Mayor Daniel J. Bechtel presented handsome souvenir medals of the Roebling monument dedication to Charles G. Roebling, Ferdinand W. Roebling and Colonel Washington A. Roebling. They are made of copper and porcelain, symbolic of two of Trenton's greatest industries.

International Congress of Inventors.

To the Editor of the Electrical Review:

A discussion having arisen in various parts of the country regarding the status of the inventor with relation to the United States Patent Office and expressive of the opinion that inventors of the country should form a national organization for the protection and advancement of their interests, permit us to state that just such an organization exists in the International Congress of Inventors, established in 1906, incorporated in 1907, and having members in several states of the Union, with branches formed or forming in Texas, Missouri, Illinois and California.

This organization was established to benefit inventors as a class by seeking to secure legislation which shall insure to the inventor the services at the Patent Office which his application fees should provide, and the protection for his invention which a government guaranty should give.

Largely through the efforts of the International Congress of Inventors the Federal congress has this year provided for an increased force of examiners in the Patent Office and for an advance in the salaries of Patent Office employés which will tend to retain in government employ those who have become expert in the treatment of applications. A patent fund of $7,000,000 has been accumulated from the sums paid to the government by inventors, and the Patent Office is the only self-sustaining Federal department. Surely the inventors of the country are entitled to the consideration which these facts warrant.

An important matter under consideration by the International Congress of Inventors is the establishment of a standard for a United States patent. The patent system purports to be a method of rewarding inventors and thereby stimulating the production of inventions of value to the public. But patentees and holders of patents find that a United States patent in order to attain a definite standing must be tried out in court. Yet a guaranty of protection issued by the government ought to be something more than a license for a law suit. The International Congress of Inventors is giving this matter careful consideration and it will seek such action by the government as will make a patent conform to its purport. This is one of the many subjects now before this organization. Suggestions in the interest of inventors and all who hold patents are solicited by this organization.

Ralph T. Olcott,
Secretary.

Rochester, N. Y., July 2.

Relation of Government Fuel Investigation to the Solution of the Smoke Problem.

At the annual convention of Smoke Inspectors, held at Cleveland, Ohio, June 24, an address entitled "The Relation of the Government Fuel Investigation to the Solution of the Smoke Problem" was delivered by D. T. Randall, engineer in charge of tests, United States Geological Survey, Fuel Testing Plant. Mr. Randall indicated the great economic waste in the present methods of handling coal as a fuel, and pointed out the savings which were being developed due to the proper utilization of the waste gases in producer plants. He described the work of the Geological Survey, which was begun at St. Louis during the exposition in 1904, and which has since been continued at St. Louis and at Norfolk, Va.

The possible benefits to the government and to the public resulting from such experiments led President Roosevelt to appoint a number of prominent engineers, some in the employ of the government and some members of the great national engineering societies, to act as an advisory board on fuel and structural materials investigations.

A study of the fuel values of coals burned while conducting some 540 boiler tests has shown that the value of the coal depends almost entirely on the number of heat units which it contains. For the coming year a large part of the coal purchased for the government will be paid for according to its heat value as determined in the government chemical laboratories. One of the largest purchases under this form of contract is for use on the Isthmus of Panama, and calls for the delivery of 400,000 tons within the year.

Investigations along other lines have indicated the possibilities of utilizing poorer grades of coal than are now commonly used. Experiments on the briquetting of coal have shown that the slack coal, which is otherwise difficult to utilize, may be made into artificial lumps and used with high efficiency.

Tests upon various furnaces have shown the influence of different methods of burning coal with relation to the reduction of smoke. These tests have pointed to possibilities of modifying furnaces so that practically all fuels may be burned without smoke under favorable conditions.

The fuel-testing department is now at work upon bulletins which deal directly with the smoke problem.

Association of Iron and Steel Electrical Engineers.

The first annual convention of the Association of Iron and Steel Electrical Engineers was held at Philadelphia, Pa., in the rooms of the Engineers' Club, on June 24, 25 and 26. The association has a membership of thirty-three, notwithstanding the fact that only the electrical engineer or the electrical superintendent of the larger iron and steel-producing plants is eligible. Addresses were made by the president, James Farrington, of the La Belle Iron Works, Steubenville, Ohio, and by the secretary, G. H. Winslow, of the National Tube Company, Pittsburg, Pa. During the meeting there were several very interesting discussions on the topics of standardization of mill motors, the Stoeckel induction clutch and drive, electric drilling and reaming, electric motors for heavy torque and rapid reversal, and electric motor drives.

On Thursday, June 25, representatives of manufacturers presented brief discussions concerning apparatus used in connection with mill work. H. D. James, of the Westinghouse Electric and Manufacturing Company, spoke on "Control of Motor-Operated Auxiliary Apparatus for Steel Mills." B. Wiley, of the same company, spoke on "Electrical Equipment of Rolling Mills."

The convention was the guest of the Westinghouse company on Thursday evening at Willow Grove. C. T. Henderson, of the Cutler-Hammer Manufacturing Company, spoke on "New Resistance Grid Interlocking Systems," describing the controlling apparatus installed by this company at Gary, Ind.

On Thursday afternoon the association was entertained at luncheon by Gano S. Dunn, vice-president and chief engineer of the Crocker-Wheeler Company. Later in the afternoon H. F. Stratton, of the Electric Controller and Supply Company, Cleveland, Ohio, described the combination manual and magnetic switch controllers of that company. R. C. Hull, of the Electric Storage Battery Company, spoke on "The Storage Battery in Steel Mills," and on "Storage Battery Regulation of Alternating-Current Circuits." David B. Rushmore, J. G. Callahan, James M. Andrews and K. A. Hawley represented the General Electric Company, and described a number of devices which have recently been brought out by that company.

Trouble for the Mexico City Tramways Company.

The minority stockholders of the Mexico City Tramways Company, Limited, have begun proceedings in the High Court of Justice of England, in London, for an accounting and for the appointment of a receiver for the company. The suit involves property valued at about $10,000,000 in gold.

Current Electrical News

DOMESTIC AND EXPORT.

A $700,000 POWER PLANT PLANNED FOR NEVADA—A movement is on foot to establish at Chalk Mountain, between Wonder and Fairview, Nev., a large power station for the distribution of electricity throughout the mining district. The originators of the plan are P. H. McLaughlin, of Fairview, and Roy Ridge, of Reno, Nev. The electricity will be transmitted a distance of 140 miles to the Chalk Mountain station. The complete plant will cost about $700,000.

PROPOSED SOUTH DAKOTA ELECTRIC ROAD—Articles of incorporation have been filed with the secretary of state for the Aberdeen & Huron Railway Company, with headquarters at Huron, S. D., and a capital of $2,500,000. The company proposes to construct an electric line from Huron to Aberdeen, a distance of eighty miles, to cross the counties of Beadle, Spink and Brown. The incorporators are all Huron men: John A. Cleaver, R. W. Clarke, L. Lapier, J. P. Stahl, G. W. Longstaff, Oscar A. Ricker, R. D. Whorton, R. C. Gibbs and H. J. Rice.

TO BUILD ELECTRIC LINE—The Mesa Valley & El Paso Railway Company, with a capital stock of $1,000,000, has been organized in El Paso, Tex., for the purpose of constructing an electric line between El Paso and Las Cruces, N. M. The incorporators of the concern are El Paso and Las Cruces business men, thirty in all. Each of the thirty has signed for $500 worth of stock in the new company. Papers of incorporation are being drawn up, and it is expected to begin work on the line within thirty days and complete the line within one year. The line will be forty-four miles in length and will traverse some of the richest country in the Rio Grande Valley.

PHILADELPHIA RAPID TRANSIT LOAN—Both branches of the Philadelphia (Pa.) City Councils have approved the plan of the Philadelphia Rapid Transit Company to negotiate a loan of $5,000,000 for extensions and improvements. The conditions of the ordinance provide for the borrowing of $5,000,000, with leaseholds and franchises to be used as pledges. Not more than one-half the total sum is to be raised at the present time, the balance to be secured as needed. New trackage, additional equipment and repairs are the principal uses to be made of the loan money. A number of pay-as-you-enter cars are now being built by the company, and if their use proves successful a part of the money may be used for the purchase of additional cars of this type.

NEW OREGON ELECTRIC RAILWAY ORGANIZED—Articles of incorporation of the Astoria, Seaside & Tillamook Railway Company have been filed in the county clerk's office at Astoria, Ore., by F. L. Evans, E. Z. Ferguson, H. G. Van Dusen and W. E. Buffum, as incorporators. The capital stock is $2,000,000, divided into 200,000 shares of $10 each. The principal office of the company is to be in Astoria, and, according to the articles, its object is to construct and operate an electric railroad and telegraph and telephone lines from Astoria to Tillamook via Warrenton, Hammond and Seaside. It is also authorized to erect and maintain elevators, docks and warehouses and to operate steamers on the Columbia and Willamette rivers, Tillamook Bay and the Pacific Ocean.

MONTANA POWER DEAL—James J. Hill and associates have sold the property of the Great Falls (Mont.) Water Power and Town Site Company to John D. Ryan and others for $1,500,000. John D. Ryan, managing director of the Amalgamated Copper Company, and John G. Marony, president of the Daly Bank and Trust Company of Butte, and of the First National Bank of Great Falls, are the heaviest stockholders. The purchasers deny that the Amalgamated Copper Company has any interest in the deal. The property embraces all of the holdings of the Great Falls Water Power and Town Site Company, a large water-power plant at Black Eagle dam, and the entire generating power of the Missouri River for a distance of twelve miles from the city of Great Falls, east of the "Big" Falls. It is probable that a large electric generating plant will be constructed at the "Big" Falls.

ELECTRIC LIGHTING.

RICHMOND, VA.—The council of Richmond has voted to direct the finance committee to issue bonds not to exceed $350,000 for the purpose of erecting an electric light plant and for improving the city's water system.

PEKIN, ILL.—G. C. Barrett, Milton Seibert and H. G. Herget, managers of the Havana Electric Company, of Pekin, have completed arrangements for the rebuilding of the local plant and the installation of more powerful machinery.

PLYMOUTH, IND.—On Monday, August 10, the city council of Plymouth will receive bids for street lighting for a term of years beginning on the first of February, 1910, according to the proposition on file in the office of the city clerk.

MITCHELL, S. D.—The Mitchell Power Company has bought a block of ground a short distance southeast of the city, upon which it will erect a new electric power-house and a gas plant at a cost of $50,000. Mitchell men are behind the enterprise.

LOGANSPORT, IND.—The board of public works has contracted with Professor Walter Esterline, of Purdue University, to supervise the purchase and putting in of the machinery for the electric light plant, for which the City Council has appropriated $30,000.

OKEMAH, OKLA.—At a mass meeting Okemah citizens approved the plan of voting bonds for the improvement of streets and the installation of a water and electric light plant. For the first proposition $7,000 will be required, and for the latter $8,000.

FORT SCOTT, KAN.—Superintendent F. D. Martin, of the Fort Scott Gas and Electric Company, states that his company is preparing to spend the sum of $50,000 to improve its plant and equipment at this point. It is expected that the work will begin some time this summer or early in the fall.

SALTILLO, MEX.—The new electric light and power plant of this city will be ready, it is stated, in August next. The plant will be a model in every respect and fitted up with new machinery, recently imported from Germany. The machinery represents an expenditure of $150,000, the company being capitalized at $200,000.

NORFOLK, VA.—In the Federal Court an order signed by Judge Waddill has been recorded authorizing the receivers of the Public Service Corporation of Virginia, at Hampton, to contract with the town officials of Phœbus to furnish twenty-one lights at a price of $30 per annum each. The contract will be for two years, subject to renewal for three years additional at the same price.

WASHINGTON, D. C.—The Potomac Electric Power Company has sold to Brown Brothers & Company, of New York, $650,000 consolidated mortgage 5 per cent bonds. The authorized amount of this issue is $7,000,000, of which $2,700,000 is now outstanding, $1,700,000 is held to retire a like amount of first mortgage bonds due in June, 1921, and the remainder, $2,600,000, is in the treasury of the company to be issued from time to time to pay for extension, betterments and improvements.

CHICAGO, ILL.—The Commonwealth Edison Company will make a general reduction in its rates for electricity August 1. The company has shown a large increase in business since the first of the year. Its contracts with the street-car companies, while the largest individual transactions, are not larger in the aggregate than the volume of smaller ones that have been obtained in the last six months. The company has more ready money on hand than at any previous time. No fresh funds will be required for new construction or further improvements this year. Sometime early in 1909, however, new securities probably will be sold. These will undoubtedly be the five per cent general mortgage bonds of the Commonwealth Electric Company. At the same time it is likely that the directors may arrange a new mortgage, and all of the underlying bonds will be refunded.

PERSONAL MENTION.

MR. ABNER COLEMAN has been reappointed manager of the municipal electric light plant of Taunton, Mass., for a period of three years from July 1. Mr. Coleman has held this position since 1891.

MR. FRANK HEDLEY, general manager of the Interborough Rapid Transit Company, has been elected a vice-president of the company. His title hereafter will be vice-president and general manager.

MR. GEORGE LORING, who has been connected for some time with the engineering department of the National Electric Association, became identified, on July 1, with the sales department of the Shelby Electric Company, of Shelby, Ohio. Mr. Loring was connected with this company in various sales capacities for eight years previous to going with the National Electric Lamp Association. Mr. Loring will devote a great deal of his time to pushing tungsten lamp sales, as the Shelby Company will be very active in the production of this type of incandescent lamp. For several years Mr. Loring has been a prominent figure at state and national electrical conventions and has contributed a number of important papers on the subject of incandescent lamps and illumination. His extensive experience, wide acquaintance and demonstrated ability make him a strong factor in the Shelby sales organization.

MR. LOUIS A. FERGUSON, who now takes up the duties of president of the American Institute of Electrical Engineers, was born in Dorchester, Mass., August 19, 1867. He was educated in the Boston public schools and graduated from the Dorchester High School in 1884. Entering the Massachusetts Institute of Technology he graduated in 1888 with the degree of bachelor of science in the electrical engineering department. Shortly after his graduation he began his association with the Chicago Edison Company in the underground department. In 1889 he was made assistant electrical engineer of the construction department, and in 1890 was appointed electrical engineer. So successful was his work in the engineering and operating departments, and so excellent his carrying out of those problems which involved commercial considerations, that in 1893 his duties were enlarged to cover the entire supervision of the company's contract business, in addition to his engineering work. In this field he was particularly successful, negotiating a number of valuable long-term contracts with some of the largest mercantile institutions in Chicago. On June 1, 1897, he was appointed general superintendent of the company, in charge of operating and electrical engineering departments as well as the central station and isolated-plant business. A year later he was appointed general superintendent of the Commonwealth Electric Company. On July 9, 1902, the directors of the Chicago Edison Company and of the Commonwealth Electric Company elected him second vice-president of both companies. This position he holds at the present time. He was elected president of the Association of Edison Illuminating Companies for the year 1901-1902, and re-elected to the same position for the year 1902-1903. He was elected president of the National Electric Light Association for the year 1902-1903, and he is now a member of the executive committees of both associations. Mr. Ferguson is credited with being the first engineer in this country to recommend a central station system generating three-phase alternating current with transmission lines to substations operating rotaries converting from alternating to direct current for general distribution. He has been prominently before the American Institute of Electrical Engineers, the Association of Edison Illuminating Companies and the National Electric Light Association as an exponent of the most progressive ideas in electrical development. His literary contributions form some of the most classical reading which is available in the electrical field. He is a member of the Commercial Club of Chicago, the University Club, the Union League Club, Chicago Athletic Club, Mid-Day Club, Evanston Country Club, and the Onwentsia and Glen View Golf clubs. He has always been interested in public-spirited work in Chicago, and, in connection with this, served three years on the executive committee of the Merchants' Club.

MR. LOUIS A. FERGUSON.

ELECTRICAL SECURITIES.

So far as the stock market is concerned, there is little to chronicle of the doings of the short week ended Friday, July 3. The apathy which set in several weeks ago continued with the dulness intensified. Notwithstanding this, the indications still hold good that each day brings a brightening prospect. Idle freight cars are decreasing, and reports come in of new life in repair shops and rolling mills. The crop outlook is very encouraging, and labor more efficient than for many a day. It appears that there are few large accumulations of commodities to be disposed of, and that of necessity the recovery will be rapid and well sustained.

Dividends have been declared upon the following electrical securities: National Light, Heat and Power Company, regular quarterly dividend of 1¼ per cent on the preferred stock, payable July 1. Manchester Traction, Light and Power Company; regular quarterly dividend of 2 per cent, payable July 15 to stock of record July 1. Scranton Electric Company; quarterly dividend of 1½ per cent on the preferred stock, payable July 1. Philadelphia City Passenger Company; a semi-annual dividend of $3.75 per share, payable July 10 to stock of record June 29. Butte Electric and Power Company; a dividend of 1½ per cent on the common stock, payable July 6 to stock of record June 30. The common dividend was passed last December, previous to which time the rate was 1¼ per cent. The directors of the Electric Company of America have declared the regular semi-annual dividend of 3½ per cent to stock of record July 10. Books close July 10 and reopen August 4.

ELECTRICAL SECURITIES FOR THE WEEK ENDED JULY 4.

New York:	*Closing.*
Allis-Chalmers common	11½
Allis-Chalmers preferred	35½
Brooklyn Rapid Transit	48
Consolidated Gas	125½
General Electric	—
Interborough-Metropolitan common	11¾
Interborough-Metropolitan preferred	30⅝
Kings County Electric	115
Mackay Companies (Postal Telegraph and Cables) common	64
Mackay Companies (Postal Telegraph and Cables) preferred	64¼
Manhattan Elevated	134
Metropolitan Street Railway	23
New York & New Jersey Telephone	100
Western Union	55
Westinghouse Manufacturing Company	53¾

Boston:	*Closing.*
American Telephone and Telegraph	115
Edison Electric Illuminating	208
Massachusetts Electric	46½
New England Telephone	112
Western Telephone and Telegraph preferred	65

Philadelphia:	*Closing.*
Electric Company of America	10½
Electric Storage Battery common	30
Electric Storage Battery preferred	30
Philadelphia Electric	9¼
Philadelphia Rapid Transit	17⅛
United Gas Improvement	85¼

It is estimated that the gross earnings of the Philadelphia Rapid Transit Company, in the fiscal year ended June 30, 1908, were $18,400,000, an increase of about $300,000.

Chicago.	*Closing.*
Chicago Telephone	135
Commonwealth Edison	100¼
Metropolitan Elevated preferred	49¾
National Carbon common	69
National Carbon preferred	111

The daily average number of passengers carried on the elevated railroads during June was as follows: Metropolitan Elevated, 144,361; decrease, 4,167. South Side Elevated, 125,876; increase, 10,190. Northwestern Elevated, 109,107; increase, 10,056.

OBITUARY NOTE.

MR. GEORGE H. DANIELS, for many years prominently identified with the New York Central & Hudson River Railroad, died at Lake Placid, N. Y., on July 1. Mr. Daniels had been ill for some time, and his death was expected for several days. He was suffering from hardening of the arteries, with other complications. Mr. Daniels was born on a farm at Hampshire, Ill., in 1842. Like many other railroad men, he began at the foot of the ladder, starting in at the age of fifteen as a rodman in the engineering corps of the North Missouri Railroad. His advance was rapid, and in 1872 he was made general freight and passenger agent of the Chicago & Pacific Railroad. He served in various offices, notably as commissioner of the Central Traffic Association, and in 1889 was made general passenger agent of the New York Central & Hudson River Railroad. He became conspicuous in this position for his advertising ability, the name "Empire State Express" being one of his inventions. It is said that during Mr. Daniels' service as general passenger agent the New York Central lines were the best and most widely advertised in the world. In 1905 Mr. Daniels was appointed international advertising manager of the New York Central lines, serving in that office until his retirement. The death of Mr. Daniels comes as a personal loss to a host of men prominent in every walk of life. No one could come in contact with him without being impressed with his great personality, and the regard in which he was held amounted in many instances to the sincerest affection. Not only did he endear himself to many, but he served the country in a noteworthy manner. The Adirondacks, the Hudson River, the Thousand Islands, Niagara Falls and other beauty spots of the United States became familiar points of interest and were impressed upon the public mind in such indelible fashion through his efforts that it might truly be said that, having done his work so well, the necessity does not remain for any one to take his place.

MR. GEORGE H. DANIELS.

NEW INCORPORATIONS.

COLUMBUS, OHIO—Cadiz Electric Company, Cadiz. Capital stock increased from $12,000 to $60,000.

SALEM, ORE.—Mollalla Power Company, Canby. $10,000. Incorporators: John B. Hurst, W. S. Hurst and Fred P. Hurst.

AUSTIN, TEX.—Cisco Light and Power Company, of Cisco. $16,000. Incorporators: G. W. Troxwell, W. C. Bedford and C. H. Free.

AUSTIN, TEX.—Luzon Telephone Company, of Clairemont, Kent County. $25,000. Incorporators: S. A. McCombs, T. G. Harkey and J. M. Kelley.

RALEIGH, N. C.—Suburban Land and Power Company. To operate railways and electric power plants, distribute electricity and gas, and engage in other business. $40,000. Incorporators: E. J. Parrish, J. M. Gregory, John Sprunt Hill, W. W. White, R. W. Winston.

SALT LAKE CITY, UTAH.—Electric Supply and Fixture Company. $20,000. Officers and directors: R. W. Nichol, president; A. T. Wright, vice-president; D. C. Eccles, treasurer; C. J. Humphris, secretary; A. E. Lawrence, director. To generate electricity and establish electric distributing systems.

JERSEY CITY, N. J.—Charlotte Power Company. Formed to manufacture and operate street and railway cars, evidently in Charlotte, N. C. $300,000 in $100 shares. Incorporators: Oscar L. Wold, Wade M. Adams and T. C. Raine. Southern Construction Company, allied with the above with $100,000 in $100 shares.

ELECTRIC RAILWAYS.

DANVILLE, PA.—The Sunbury & Selinsgrove Electric Railway has been completed and placed in operation.

DAYTON, OHIO—The Circuit Court has upheld the validity of the fifty-year franchise of the Oakwood Street Railway Company, which had been attacked by the municipality.

STEUBENVILLE, OHIO—The new $7,000,000 Ohio River Passenger Electric Railway Company's "Ohio River Scenic Route" from Vanport to Steubenville, Ohio, was thrown open to the public on June 28.

GRAND JUNCTION, COL.—The city council has granted to H. E. Devereaux, of Colorado Springs, a franchise to build a street railway in Grand Junction. Work will begin July 15 and cars must be operated on three miles of track within one year.

KANSAS CITY, MO.—The contract for the Oregon interurban railway to be built from the Burlington tracks to Oregon, Mo., has been let. The contract calls for the road to be completed with all equipments, switches and bridges, less terminal and rolling stock, within 100 days.

BISMARCK, MO.—A party of St. Louis capitalists and the Business Men's Club of Irondale have completed the preliminary arrangements for an electric railroad to extend from Belgrade, in Washington County, to Perryville, in Perry County. A dam across Big River, near Irondale, will furnish the motive power.

McKINNEY, TEX.—At a meeting of the citizens of this place, Bonham, Blue Ridge and other points, W. S. Cole, of Detroit, Mich., representing Eastern capitalists, presented a proposition for the construction of an electric railway between Fort Worth and Bonham. The proposition was accepted and an organization of the stockholders effected, with J. L. Lovejoy as chairman.

UTICA, N. Y.—The Public Service Commission has authorized the Dolgeville & Salisbury Railway Company to increase its capital stock from $100,000 to $150,000 and to issue $150,000 common capital stock. The capital stock is to be issued at not less than the par value, the proceeds to be used for building the railway between Dolgeville and the Salisbury Steel and Iron Company's plant, a distance of about four miles.

BUFFALO, N. Y.—E. H. Rogers, a wealthy Tonawanda contractor, and a number of other capitalists are understood to be organizing a company to build an eight-mile trolley line over private right of way from O'Neill street down the river front to Tonawanda, passing close to the new Wickwire Steel Plant and being partially designed to give transportation facilities to and from that plant, which is to employ upward of 500 men.

MANSFIELD, OHIO—The stockholders of the Mansfield Street Railway, Light and Power Company at their annual meeting elected the following board of directors: S. N. Ford, Mansfield; F. E. Myers, Ashland; J. A. Rutherford, F. L. Fuller and E. F. Snyder, Cleveland; T. H. Creden, Chicago; Charles W. Dupuis, Cincinnati. The board organized by electing S. N. Ford, of Mansfield, president; F. L. Fuller, of Cleveland, vice-president, and Sidney A. Foltz, of Mansfield, secretary and treasurer. Mr. Foltz was also chosen manager.

ROCHESTER, N. Y.—The Rochester, Scottsville & Caledonia Electric Railway Company, which was incorporated to build a line from Rochester to Caledonia, has decided to branch out in several directions as well as carrying the line on through to Portage, a distance of fifty-five miles, following the Genesee Valley and skirting the shores of Silver Lake. The line will cross the river between West Henrietta and Scottsville, thence will run southwesterly to Garbutt, Wheatland, Mumford and the State Fish Hatchery, thence to Caledonia, to the salt mines of Retsof and Greigsville, touching at Le Roy and passing through the Oatka Valley to Pavilion; then across Pear Creek, through La Grange and Perry Center to Perry, Silver Lake, Castile and Portage. The president of the company is David C. Salyerds, and the local incorporators are Henry C. Brewster, George C. Buell, Charles P. Ford, Charles T. Chapin, Andrew H. Brown, Isaac W. Salyerds and Edmund Lyon. The line will be known as the Scenic Route. The total cost of its construction from Rochester to Portage is estimated at $2,135,000.

TELEPHONE AND TELEGRAPH.

MARSHALL, MICH.—Improvements costing about $1,000 have been made to the local exchange of the Citizens' Telephone Company.

READING, PA.—The American Union Telephone Company has increased to a considerable extent its trunk line facilities in this section of the state.

WILMINGTON, DEL.—The Delaware & Atlantic Telegraph and Telephone Company will remove all poles within the city where possible and place its wires underground.

JOPLIN, MO.—Work has been begun on the foundation for the new Bell Telephone building, which is estimated to cost $250,000. It will be forty-six by seventy-five feet in area and three stories in height, and is expected to be completed in October.

STEPHENS, ARK.—A new telephone company composed of local citizens has been organized here and application has been made to the city council for a franchise. There are nearly 200 members of the new company and they propose to begin work early in July.

SAN MARCIAL, N. M.—T. J. Mathews is authority for the statement that the Socorro County Telephone Company, of which he is manager, will extend its system as far as the Elephant Butte dam this year, and as soon as possible connections will be made to El Paso.

NEW YORK, N. Y.—The New York & New Jersey Telephone Company announces a change of rate affecting telephone subscribers in the Coney Island, Bath Beach, Astoria and Long Island City sections. Brooklyn Borough, Astoria and Long Island City, in the Borough of Queens, are considered one local service area. The company also announces that rates for messages from public telephones in Bath Beach and Coney Island are reduced to five cents to Brooklyn, and ten cents, instead of fifteen cents, to Manhattan. The change is in effect.

INDUSTRIAL ITEMS.

THE LINCOLN MOTOR WORKS COMPANY, Caxton Building, Cleveland, Ohio, has ready for distribution a new bulletin devoted to type A Lincoln variable-speed motors.

THE NORTON COMPANY, Worcester, Mass., has published a very interesting booklet giving a great deal of information concerning the use of grinding and abrading wheels.

THE BRISTOL COMPANY, Waterbury, Ct., has issued bulletin No. 92, devoted to Bristol's recording thermometer, Class II, for temperatures between forty degrees and 500 degrees Fahrenheit.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., will be pleased to send to any one interested upon request, a new bulletin descriptive of type B direct-current motors and generators.

THE AMERICAN STEEL AND WIRE COMPANY, The Rookery, Chicago, Ill., has published a great deal of information of value and interest concerning steel wires and ropes in the "American Wire Rope News" for May.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Boston, Mass., has ready for distribution bulletins Nos. 307B, 314A and 316, descriptive, respectively, of buffing and grinding motors for direct and alternating current, type "C" motors and dynamos for direct current, and type "LM" motors for direct current.

THE FOSTORIA GLASS SPECIALTY COMPANY, Fostoria, Ohio, his issued a blotter enclosed in a folder representing a giant firecracker. In connection with the July holiday spirit the company states that the central station manager can announce a declaration of independence and celebrate this day of days by declaring for "Noblac" inner globes.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., in the July issue of "Trumbull Cheer" calls attention to its type C switches. These are made with and without fuses in all capacities for 250 and 500 volts. A supplement to this issue of "Trumbull Cheer" shows a sixty-foot switchboard made up of thirty panels, built by the Trumbull Electric Manufacturing Company.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has issued a new catalogue, No. H1a, devoted to battery charging rheostats for electric automobiles, for private plants and garage duty; also rheostats to take care of the discharge of storage cells. and a complete line of charging rheostats for ignition cells and portable batteries. Copies of the catalogue will be furnished to those interested upon request.

W. N. MATTHEWS & BROTHER, 227 North Sixth street, St. Louis, Mo., are the exclusive sales agents of an improved form of incandescent lamp changer. By means of this apparatus the operator can replace incandescent lamps in lofty or almost inaccessible places. The company suggests the advantage of central station companies making use of this lamp changer in facilitating the replacing of burned-out lamps by their customers.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a comprehensive bulletin, No. 4,593, devoted to the subject of "Railway Converter Substations." This publication gives a general description of the various pieces of substation apparatus and includes illustrations of converter stations operated by well-known railway companies. Another bulletin, No. 4,590, is devoted to automatic compensating devices for alternating-current motors.

THE PRATT & WHITNEY COMPANY, Hartford, Ct., has issued a handsome catalogue devoted to the Spline milling machine. This is an absolutely new tool embodying new principles and taking care of work for which heretofore there has been no suitable machinery. By its use the designer is enabled to take advantage of the use of slots, which many times simplify the design, but which, heretofore, have been avoided owing to the high manufacturing cost. The aim in bringing out the new tool has been to produce a machine specially built for slot milling, particularly slots with closed ends.

THE F. BISSELL COMPANY, 226-230 Huron street, Toledo, Ohio, has ready for distribution a list of second-hand machinery. This is entitled "The Little Book of Real Bargains." While this department of the Bissell Company's business has been in existence for a good many years, it was not until the last year that it entered into the second-hand machinery business on a large scale. A good deal of the success of this department can be attributed to the fact that the company buys or trades as well as sells apparatus. The Bissell Company will be pleased to place the name of any one interested on its mailing list for this booklet of bargains.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing new catalogues on malleable-iron specialties, such as anchors, feeder arms, pins, cross-arms, bolts, wall brackets, spreader brackets, strain plates, strain insulators, corner brackets, catenary hangers, etc. The catalogue includes the report of tests made by Columbia University, New York city, on the malleable-iron cross-arm bolt, these tests being made to ascertain the load required to strip or destroy the bolt threads. The catalogue contains about forty pages, and will be found of interest to consulting engineers and station managers. Copies will be furnished upon request.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., makers of electric controlling devices, has completed arrangements whereby it will be represented on the Pacific Coast by Otis & Squires, of 111 New Montgomery street, San Francisco, Cal. A large stock of standard Cutler-Hammer controllers will be carried by Otis & Squires, enabling them to make prompt delivery of apparatus. A. W. Vinson, who has for several years been connected with the engineering department of the Cutler-Hammer Manufacturing Company, has been transferred to the office of Otis & Squires, where his services will be available to those confronted with problems of electrical control which can not be met by the use of standard apparatus.

W. R. BRIXEY, manufacturer of the well-known "Kerite" wires and cables, has moved to larger and more commodious offices on the nineteenth floor of the Cortlandt Building of the Hudson Terminal, 30 Church street, New York city. Probably no pleasanter offices in this line are to be found in the city, as they overlook the Hudson River and are airy and large. R. D. Brixey, son of W. R. Brixey, is in charge of the affairs of the company. A large branch office has been established in the Railway Exchange Building, Chicago, Ill., under the direction of the company's representative, the Watson Insulated Wire Company. One of the conspicuous features of the New York office is a large and very perfect rubber biscuit, said to be the finest ever imported to this country, which came from Brazil, and is on exhibition in the ante-room, containing probably $1,000 worth of pure Para rubber.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the Second Issue of Each Month.)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Cosmos Club, Washington, D. C.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, 352 Willis avenue, New York city.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Dr. J. W. Richards, Bethlehem, Pa. Fall meeting, New York city, October 30-31.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Dr. Richard Moldenke, Watchung, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West Thirty-ninth street, New York City. Meetings, second Friday of each month.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN RAY SOCIETY. Secretary, Dr. G. C. Johnson, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Professor Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Fifty-seventh street, New York city.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 29 West Thirty-ninth street, New York city.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Park Row Building, New York city. Annual meeting, Atlantic City, N. J., October.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth street, New York city. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, Elmer M. White, treasurer Birmingham Railway, Light and Power Company, Birmingham, Ala. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION. Secretary, B. B. Davis, claim agent Columbus Railway and Light Company, Columbus, Ohio. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, J. W. Corning, electrical engineer Boston Elevated Railway Company, Boston, Mass. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION. Secretary, George B. Keegan, 2321 Park Row Building, New York city. Annual convention, Atlantic City, N. J., October 12-16.

ARKANSAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. W. Freeman, vice-president and general manager Edison Electric Illuminating Company, Brooklyn, N. Y.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington street, Newton, Mass.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Wisconsin Central Railway, Milwaukee, Wis.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION. Secretary, L. E. W. Pioda, Oak and Broderick streets, San Francisco, Cal.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Canada.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Acton Burrows, 33 Melinda street, Toronto, Ontario.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, W. F. Milholland, secretary and treasurer Indianapolis Traction and Terminal Company, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. F. Dostal, Denver, Col. Annual convention, Glenwood Springs, Col., September 16-18.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, F. W. Poole, Bridgeport, Ct.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water street, Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine street, St. Louis, Mo.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA, LIMITED. Secretary, William R. Stanley, Royal Insurance Building, Montreal, Canada.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall street, New York city. Board of directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau street, New York city.

ENGINEERS' CLUB OF PHILADELPHIA. Secretary, H. G. Perring, 1317 Spruce street, Philadelphia, Pa.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt street, New York city.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. A. Camp, Henry, Ill.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Van Rensselaer Lansingh, Engineering Societies Building, 33 West Thirty-ninth street, New York city. Annual convention, Philadelphia, Pa., October 6-7.

INDEPENDENT TELEPHONE ASSOCIATION OF TEXAS AND LOUISIANA. Secretary, C. A. Shock, Sherman, Tex.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. S. Norton, Indianapolis, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Annual meeting, Detroit, Mich., August 19-21.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ward, Grand Rapids, Mich.; assistant secretary, J. A. Harney, Monadnock Building, Chicago, Ill.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Iowa.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary C. C. Deering, Boone, Iowa.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. G. Turpine, Henderson, Ky.

MAINE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, M. E. Crow, Houlton, Me.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshal, Port Huron, Mich. Annual meeting, Grand Rapids, Mich., August 18-21.

MICHIGAN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. A. Burch, Battle Creek, Mich.

MISSOURI ELECTRIC LIGHT, GAS AND STREET RAILWAY ASSOCIATION. Secretary, Claude L. Clary, Sikeston Electric Light and Power Company, Sikeston, Mo.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, George W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee street, Utica, N. Y. Next meeting, Chicago, Ill., July 15-17.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, John F. Gilchrist, Commonwealth Edison Company, Chicago, Ill.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln.

NEBRASKA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. E. Mattison, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 60 State street, Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl street, Boston, Mass. Meetings held on fourth Thursday of every month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 West Thirty-ninth street, New York city.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, R. N. Kimball, Kenosha, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual convention, Put-in-Bay, Ohio, August 25-27.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, O. O. Welsheimer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Ballard, Cleveland, Ohio.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

OLD TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York city.

ORDER OF THE REJUVENATED SONS OF JOVE. C. B. Roulet, Mercury, Dallas, Tex.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second street, Philadelphia.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKES PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, J. A. Myler.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, J. G. White & Company, New York, N. Y.

TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Tex.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W S. Boyd, 382 Ohio street, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION. Secretary, Clement C. Smith, president Columbia Construction Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

DATES AHEAD.

National Electrical Contractors' Association. Next meeting, Chicago, Ill., July 15-17.

Michigan Electric Association. Annual meeting, Grand Rapids, Mich., August 18-21.

International Association of Municipal Electricians. Annual convention, Detroit, Mich., August 19-21.

Ohio Electric Light Association. Annual convention, Put-in-Bay, Ohio, August 25-27.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 6-7.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Record of Electrical Patents.

Week of June 30.

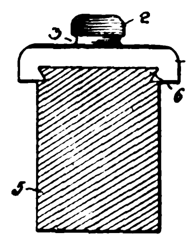
891,825. ELECTRIC-WIRE SPLICER. Conrad J. Dorff, Chicago, Ill. A connector formed of a strip of metal with beveled edges reversely bent to form four parallel tubes.

891,833. OIL-SWITCH. Edward M. Gerry, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. The resistance units and contact segments are submerged in a tank of oil.

891,847. DYNAMO-ELECTRIC MACHINE. Emil Mattman, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Means are provided for supporting the cross-connectors between the brush-holders, and independent means for locking the brush-holders.

891,906. ARMATURE CORE. John F. Card, Three Rivers, Mich., assignor to the Sheffield Car Company, Three Rivers, Mich. The core discs have registering openings arranged in series and with radial projections forming channels to receive the armature coils.

891,948. ELECTRIC FIRE ALARM AND THERMO-INDICATOR. Alfred H. McNeil, Highams Park, England. The thermostat arms move plungers and close the alarm circuit.



891,955.—INSULATOR.

891,955. INSULATOR. William C. Sandlin, Andrews, N. C., assignor of one-third to Arthur Moulton and one-third to C. W. Savage. A dovetailed insulator for slipping over a cross-arm.

891,961. TELEPHONE-CONTROLLING DEVICE. Nathan Silverson, New York, N. Y. The contact lever is released by the swinging movement of a second arm.

891,982. ELECTROLYTIC PROCESS FOR THE PRODUCTION OF METALLIC DARK COATINGS UPON METALS. Alexander Classen, Aachen, Germany. After a deposit of sufficient thickness has been obtained the applied potential is lowered.

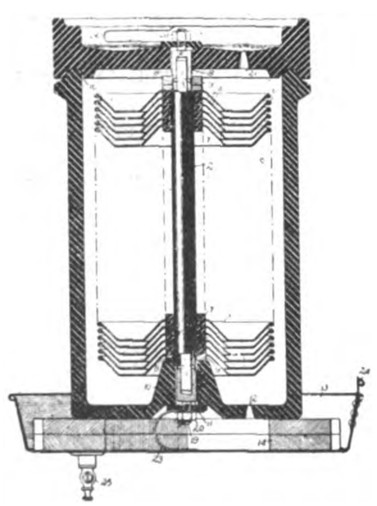
891,995. ELECTROLYTIC CELL. Ralph B. Ingram, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A cell built up of a plurality of similar frustro conical plates.

892,016. TROLLEY WHEEL. Robert P. Stark and Charles R. Klingensmith, Creighton, Pa. A wheel with a rectangular bushing.

892,065. ELECTROMAGNET. David L. Lindquist, Yonkers, N. Y. An alternating-current magnet with means for absorbing vibration.

892,167. MOUNTING FOR ELECTRICAL APPARATUS. Malcolm E. Launbranch, Chicago, Ill., assignor to Western Electric Company, Chicago, Ill. A case for holding a telephone set.

892,177. ELECTRIC ILLUMINATOR. Henry J. Mullen, Burlington, Vt. A distributor for electric signs.



891,995.—ELECTROLYTIC CELL.

892,188. PROCESS FOR SEPARATING AND SIMULTANEOUSLY EXTRACTING WATER FROM MINERAL, VEGETABLE AND ANIMAL SUBSTANCES. Botho Schwerin, Frankfort-on-the-Main, Germany, assignor to Farbwerke vorm. Meister Lucius & Brüning, Höchst-on-the-Main, Germany. An electric current is passed through the cells so as to set up electro-osmosis.

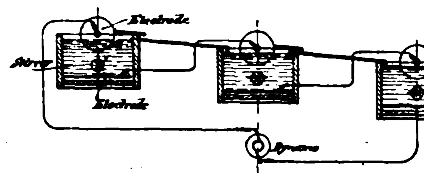
892,203. SIGNALING SYSTEM FOR RAILROADS. Max W. Zabel, Chicago, Ill. A system employing currents of different electrical character for the different signals.

892,204. RAILWAY SIGNALING APPARATUS. Max W. Zabel, Chicago, Ill. The signals are responsive to electric currents of different character.

892,211. PROCESS OF PRODUCING LOW-CARBON ALLOYS. Frederick M. Becket, Niagara Falls, N. Y., assignor to Electro Metallurgical Company. A mixture of a refractory metal and a reducing agent is smelted in an electric furnace.

892,212. ELECTRIC-FURNACE METHOD. Frederick M. Becket, Niagara Falls, N. Y., assignor to Electro Metallurgical Company. A heat-retaining crust of the solidified constituents of the bath is maintained over the surface.

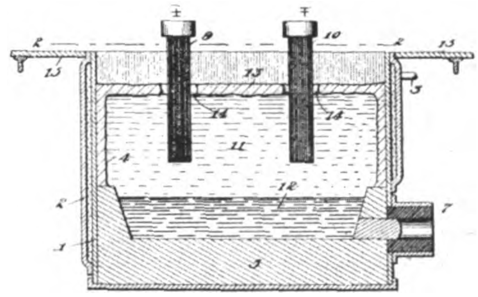
892,272. TROLLEY GUARD AND GUIDE. Charles Latsch, Cleveland, Ohio, assignor of twenty-four one-hundredths to C. A. Muoller and twenty-four one-hundredths to Jos. H. Wenneman, Cleveland, Ohio. Spring-mounted wire guards project above the wheel.



892,188.—PROCESS FOR SEPARATING AND SIMULTANEOUSLY EXTRACTING WATER FROM MINERAL, VEGETABLE AND ANIMAL SUBSTANCES.

892,311. APPARATUS FOR PLOTTING RESONANCE CURVES. Otto Scheller, Steglitz, near Berlin, Germany. A variable inductance and a variable capacity are mounted so as to be simultaneously adjustable.

892,312. SYSTEM FOR RECEIVING UNDAMPED ELECTRIC OSCILLATIONS. Otto Scheller, Steglitz, near Berlin, Germany. A system utilizing the combination of a high-frequency and a low-frequency circuit.

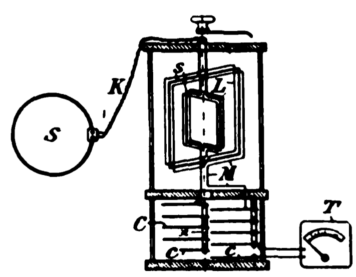


892,212.—ELECTRIC-FURNACE METHOD.

892,319. BINDING POST. Nicholas Sohl, New York, N. Y., assignor to W. R. Ostrander & Company. A spring clip.

892,332. ELECTRICAL INCANDESCENT LAMP. Orlando M. Thowless, Newark, N. J. A non-refractory core is coated with a thin shell of ductile metallic tantalum, producing a filament of high resistance.

892,355. TROLLEY WHEEL. George C. Bourdereaux, Peoria Ill., assignor, by direct and mesne assignments, to Melvin W. Swartz, Peoria, Ill. A wheel with recessed sides.



892,311.—APPARATUS FOR PLOTTING RESONANCE CURVES.

892,359. ELECTRIC-RAILWAY SIGNALING SYSTEM. Yorke Burgess, Washington, D. C., assignor, by mesne assignments, to American Signal Company, Kansas City, Mo. An electromagnetic system for producing signals on trains.

892,371. TROLLEY EAR. Charles W. Eliot, Tampa, Fla., assignor of one-half to William H. Caldwell, Tampa, Fla. A pin is provided for locking the ear boss and the shank.

892,375. ELECTRIC SOCKET SWITCH. Harvey Hubbell, Bridgeport, Ct., assignor to Harvey Hubbell, Incorporated, Bridgeport, Ct. A switch formed of a contact bar and a contact plate, one of the parts being provided with alternate projections and depressions.

ELECTRICAL REVIEW

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CONTENTS

THE STEINMETZ STANDARD OF LIGHT.

The science of photometry and the art of illumination have been considerably handicapped by the lack of a really scientific standard of light. The problem of providing a perfectly satisfactory standard is one of the most troublesome that has been encountered by science in recent years. Lord Kelvin said that we know but little about any science until we can measure the factors involved in satisfactory units; and if there be no reliable standard available, the rating of quantities in terms of unsatisfactory standards, while better than no rating at all, still leaves that science in a position where progress is difficult.

In the science of photometry this condition has prevailed for several reasons, the principal one being the difficulty, if not the impossibility, of obtaining a satisfactory physical measure of a physiological effect. This difficulty has been overcome, or minimized, by accepting the situation and agreeing to take as the unit a quantity measurable by its physical effects or properties. Up to this time we have been compelled to be satisfied with light standards not defined by the physiological effect which they produce, but by their physical constants. In other words, we simply say that the light produced by such and such a lamp or candle is to be considered the unit. Such an arbitrary definition can hardly be considered satisfactory and is only acceptable so long as there is none better.

The next step was the suggestion to define the unit of light in terms of the energy radiated by some particular source under specified conditions. This is a decided step forward, yet it does not eliminate all of the disadvantages of the older method. Each source of light has its own peculiarities and gives light of a special quality, and since the eye is more sensitive to certain light rays than to others, a scientific definition on this basis requires that the quality of the radiation as well as its intensity be defined. In other words, the definition of the unit of light on this basis must state not only the amount of luminous energy radiated, but also the relative proportions of the rays of different color. Various suggestions for doing this have been made, the most recent of which, and the one which seems to offer the most promise of success, is that described in the paper read by Dr. C. P. Steinmetz at the recent convention of the American Institute of Electrical Engineers. This method endeavors to define clearly the amount of luminous radiation which is to be the unit and its quality, and suggests a means by which the unit of light thus built up may be obtained.

Dr. Steinmetz's paper is given elsewhere in this issue. His plan is to combine in suitable proportions red, green and blue lights of specified wave-lengths, the rays selected being about equally distant in the spectrum and having ratios in geometrical proportion. These lights are to be mixed in specified proportions so as to produce a white light, though, of course, the exact quality of the light thus produced will be under control and a light differing somewhat from pure white may seem desirable.

To produce the three components, Dr. Steinmetz suggests the use of three mercury lamps, each operated so as to give one of the desired colors. Such a source can, without much difficulty, be brought under the control of the observer and should be much less liable to disturbing influences than any of the arbitrary standards now employed.

Whether such a standard of light is feasible remains to be seen. It would not be simple to use, but if it can be used satisfactorily under the best conditions and in the best-equipped laboratories, its complexity is not a serious objection. Such a source could only be adopted as a primary standard, which would be used at the most but a very few times a year, and for this purpose reproducibility is the most important consideration and outweighs all others. It is certainly to be hoped that the suggestion will be tried at those laboratories where the necessary skill and facilities exist. Its investigation will not be easy, but, on the other hand, there is no apparent reason why the plan should not be successful, and success would mark a big advance in photometric science.

THE DISCUSSION ON EDUCATION.

The discussion on engineering education which took place at the recent convention of the American Institute of Electrical Engineers brought out a good number of interesting ideas on this important subject. It also showed the wide divergence of opinion among the manufacturers, as well as among the teachers. These ideas seem to result from the different views held of the object of such training. There were, on the one hand, those who, it appeared, looked upon the engineering school as a bureau for supplying factory workers; while, on the other hand, there were those who seemed to think that the development of the student, the turning out of men well prepared to become engineers, was the chief end of the technical school.

These two ideas of the aim of the college training explain the different views expressed regarding the value of the scheme produced in Mr. M. W. Alexander's paper. Those who approved of the plan of oscillating the students between the college and the factory approved of it apparently because it seemed to them likely to give a training of the kind which would enable the student more quickly to fall into place in a factory. It should be said that those taking this side of the question do not expect the man thus trained to remain always in subordinate positions, but they argued that the more intimately acquainted the young man becomes with manufacturing methods, and the more he knows of subjects which would be of value to him when connected with a factory, the more likely is he to rise to a position of responsibility and trust. There is, of course, some justice in the position thus taken. The method, no doubt, would, in some cases at least, quickly produce men useful to manufacturing companies—men who would probably quickly become proficient in commercial methods.

On the other hand, is it the main object of the technical school to supply skilled labor for the factory? Is not the purpose of the school to produce trained minds, men fitted to develop into engineers whose work is just as likely to be in some other field as in the factory; and, moreover, since no technical school to-day pretends to turn out skilled engineers, is it not more important to produce a thoroughly trained, logically working brain than one so congested with the details of any special line of work that it finds it impossible to grasp clearly the great problems with which other divisions of engineering have to do, so that its owner would find himself helpless should he not happen to find a berth in some factory? It is not because such practical information is not valuable, but because it could only be acquired by a young man at considerable sacrifice, that the co-operative plan seems undesirable for general adoption. Should not the school direct its efforts toward giving the young man first of all a thorough training in those branches of science which are essential, and should it not, in doing this, guard against such narrow training as will prevent the student from seeing the larger side of his profession? If this part of his education is provided for, then whatever else may be added is so much gained. And it must be remembered that in teaching the applications of science, a certain amount of practice must itself be taught. Nevertheless, the main object of such instruction is to teach principles and develop a capacity for thinking. Practice should be taught to illustrate the application of principles, but principles should not be taught merely to explain the operation of machines. The latter method may produce good followers; the first method only will produce the leaders.

Given time enough, well-trained men could doubtless be produced by any method, but, unfortunately, the time which the young man can devote to his college work is limited. Hence, as Dr. Steinmetz said, he must get at his college what he can not get elsewhere; and, as Professor Morgan Brooks and Mr. C. F. Scott said, in giving him this training care should be taken that the object of the school, which is primarily to train the man, should not be forgotten. No method of cramming him with science, or other subjects, will suffice, and if he can not be taught to think logically and clearly he should be advised to change his study. When dealing with natural forces and engineering material, a false deduction is fatal.

On the other hand, in the endeavor to do as much as possible for the young man in his four short years at college, there is danger that in spreading his attention over too many related lines of work, training in thoroughness and accuracy, so essential for the engineer, will not be given. This point was taken by Mr. B. A. Behrend in the short paper which he read at the convention. It is unfortunately true that too many instructors prefer to have the student stride over a fairly wide field in their work, rather than to cover painstakingly a smaller part of the ground. This is principally true in laboratory instruction, in which the student is expected to become familiar with typical characteristics of certain machines rather than to be able to trace these characteristics with accuracy and certainty. Yet the former knowledge he may obtain in many ways, and he must adjust his knowledge from time to time as the types of machines change, but skill in laboratory work or in computation can only be secured through practice, and if not gained at the school the man is very seriously handicapped until he makes up his deficiencies in these respects, which can usually be done only under considerable difficulty.

In conclusion, it must be said that on the whole the technical schools are really doing excellent work. There is no question that the results might be better, but the schools are improving every year, and if there is such wholesale dissatisfaction as some would have us think, the dissatisfaction is probably because too much is expected. Not every man who is given a degree upon the completion of an engineering course is destined to become a great engineer, and perhaps there would be some economy in sifting out the students more vigorously. On the other hand, there are large numbers of men who wish to obtain training in certain professions, and if these men are earnest and do really learn the essentials of engineering, may they not with some justice demand a degree, the usual recognition for such work?

THE AUTOMATIC PROTECTION OF HIGH-TENSION FEEDERS.

There are a number of protective systems for high-tension feeders and other high-potential apparatus depending for their operation upon different principles. Many years ago, when the alternating system was introduced, a ground indicator was installed showing when the insulation of one side of a circuit was defective. This was generally merely a static voltmeter connected to the two wires and to the ground, and its indications showed simply when the difference in potential between one side of the circuit and the ground was considerably less than that of the other. As the transmission systems increased in size and importance, the necessity of protecting the apparatus from the consequences of heavy grounds or short-circuits became more important, and various other methods have been employed, depending upon the character of trouble to be protected against. Thus, the reverse-current relays are used to prevent damage from the forcing of a current in the wrong direction through the apparatus, while the various types of overload and underload relays are used generally to disconnect feeders or other apparatus when the load exceeds or falls below certain values.

Another system of protection is attracting a good deal of interest in England at this time, as the principle it operates upon is different from those which have been mentioned. This is known as the Merz-Price system. It was referred to briefly in the ELECTRICAL REVIEW of June 20 and at greater length in the issue for June 13. The principle depended upon is the unbalancing of the load at the two ends of a single feeder. A differential relay is installed, the current through one coil, or set of coils, depending upon the load at one end of the feeder, while the current through the other coil or set depends upon the load at the far end of the feeder. For this purpose it is necessary to run a pilot wire the length of the feeder. The objection to this is not very serious, since such wires are often installed anyhow. The advantages obtained by this system are that it insures the disconnecting of a feeder whenever it becomes short-circuited or grounded, while it renders the same feeder capable of carrying considerable overloads without being disconnected. The system is thus selective in the sense that it picks out trouble on the feeder and ignores all troubles beyond it.

SINGLE-PHASE RAILWAY IN ENGLAND.

The single-phase railroad has made very creditable progress both in this country and on the continent of Europe. A number of different systems have been installed, the differences generally consisting of the method adopted for compensating for armature reactions and improving commutation. So far the reports of the operation have been encouraging, but it is yet too soon to say whether any one type of motor is better than all the others or whether some further modification may be found desirable. One thing is evident, the system is to be given a thorough trial and will stand or fall on its own merits.

For these reasons it is interesting to notice the putting into service of the first single-phase railway system in England. This was described briefly in the ELECTRICAL REVIEW for June 27, the Siemens system being employed there, utilizing Westinghouse motors.

The selection of a single-phase system for this important railroad work is somewhat significant, since the polyphase system was introduced into London many years ago in what was at that time one of the most important electric railway undertakings, and this system has not lacked supporters in England. What it will do in city work should be pretty well known by this time, and the performance of the new equipment will enable British engineers to compare the two systems. Moreover, since the direct-current system is used in England for a good deal of heavy work, the outcome of the contest for supremacy will be watched with interest.

A HOME FOR THE INSTITUTION OF ELECTRICAL ENGINEERS.

We extend our sincere congratulations to our British brethren of the Institution of Electrical Engineers upon securing a suitable society home. A building, in many ways well adapted to the needs of the institution, has been obtained, and before many days have passed there will, we hope, no longer be need to trespass upon the hospitality of a sister society. The building is one owned by the Royal College of Physicians and Surgeons. It is excellently situated on the Victoria Embankment, and with some remodeling will meet every requirement. We trust that the impetus given to the institution by this step will make the financial burden thus assumed lighter than anticipated and that it may move with quickened strides to an even stronger and more influential position than the enviable one it now holds.

OHIO ELECTRIC LIGHT ASSOCIATION.

FOURTEENTH ANNUAL CONVENTION, HOTEL VICTORY, PUT-IN-BAY, LAKE ERIE, AUGUST 25, 26, 27.

The following programme has been announced for the fourteenth annual convention of the Ohio Electric Light Association, which will be held at the Hotel Victory, Put-in-Bay, Lake Erie.

Tuesday, August 25, 10 A. M.—Meeting of all committees for organization and work.

TUESDAY AFTERNOON.

First session, 1.30 o'clock.

President's address.

Announcements.

Paper, "Gas Engines in Central Station Work." William M. Adams, Citizens' Gas and Electric Company, Elyria, Ohio.

Paper, "Report on Gas-Producer and Oil-Engine Plants." B. H. Smith, Lexington Electric Plant, Lexington, Ohio; B. H. Gardner, Dayton Lighting Company, Dayton, Ohio.

Question Box.

ENTERTAINMENT FOR TUESDAY.

For the ladies—Afternoon, card party. For all—4 P. M., Bathing Beach; evening, ball, reception, singing.

WEDNESDAY, AUGUST 26, 9 A. M.

Appointment of committees.

Paper, "How Can We Best Increase Our Business?" F. H. Plaice, Hastings, Mich.

Paper, "Best Ways and Means of Getting Out and Keeping Out Private Plants in Central Station Territory." B. H. Gardner, Dayton Lighting Company, Dayton, Ohio.

Paper, "Electric Signs, Outlining and Other Special Uses of Electricity, as an Adjunct to Profitable Central Station Work." J. C. Rothery, East Liverpool Traction and Light Company, East Liverpool, Ohio; C. A. Elliott, Dayton Lighting Company, Dayton, Ohio; Mr. Engle, Youngstown Consolidated Gas and Electric Company, Youngstown, Ohio.

Question Box.

12.30 P. M.—Serving of light luncheon in convention hall, programme to be taken up immediately after.

Paper, "Should Central Stations do Wiring?" Edward F. Gwynn, Delaware Electric Light and Power Company, Delaware, Ohio; C. C. Custer, Miami Light, Heat and Power Company, Piqua, Ohio.

Paper, "Illuminating Engineering." J. S. Codman, Boston, Mass.

Paper, "Report on Experience of Central Stations with Tungsten Lamps."

Question Box.

Entertainment for Wednesday, for the ladies, 10 A. M., visit to the caves and other points of interest. 12.30 P. M., special luncheon for the ladies in the main dining room. Afternoon, for all, Bathing Beach, 3 o'clock. Evening, medley of fun, bridge whist, music, impromptu vaudeville.

THURSDAY, AUGUST 27, 9 A. M.

Reports of committees.

Election of officers.

Paper, "Some of the Causes of Failure in Municipal Lighting Stations." D. L. Gaskill, Greenville Electric Light and Power Company, Greenville, Ohio.

Paper, "Grounding Alternating-Current Secondaries." L. Clifford Anderson, Franklin Electric Light Company, Franklin, Ohio.

Question Box.

AFTERNOON SESSION, 2 O'CLOCK.

Paper, "Gas and Gasolene Competition, and Best Ways to Meet It." Fred Leslie, Muncie Electric Light Company, Muncie, Ind.

Paper, "Experience with Luminous Arc Lamps." C. H. McKay, Toledo Railway and Light Company, Toledo, Ohio.

Question Box.

Entertainment for Thursday, for ladies, morning, band concert; afternoon, euchre party, bowling. Evening, grand banquet for all as the guests of the Association with electric vaudeville between courses.

Demands Return of Fees.

The Indiana & Michigan Electric Company has filed a suit against the state of Indiana for the recovery of $5,760 collected from the plaintiff company as organization fees. The suit is to be a friendly one to test part of the corporation law. The plaintiff company was incorporated May 11, 1907, with a capital stock of $1,915,500. On June 21 and 22 of that year it was merged with the Elkhart Electric Company, capitalized at $150,000; the South Bend Electric Company, capitalized at $150,000, and the St. Joseph & Elkhart Power Company, capitalized at $250,000. F. A. Sims, secretary of state, refused to file the merger agreements until the company paid separate fees for each merger. The company contended that only one merger fee could be collected, as the mergers were made at the same time. It is to be alleged by the plaintiff in the suit that the action of the secretary was not legal. The fees were paid by the company under protest. The case will probably come up for hearing in September.

Side-Door Cars to Be Tried Out in New York Subway.

A final order providing for side doors in New York city subway cars was issued July 10 by the Public Service Commission for the First District. As a beginning, it was ordered that sixteen cars be so equipped. These will make up two express trains, and afford an opportunity to study the advisability of the change, which was recommended by Bion J. Arnold.

The terms of the order provide that the cars shall have four doors on each side. Two of the doors shall be in the position of the doors now in use, and two additional doors on each side shall be placed not less than one nor more than two doors' width from the doors now in use. The company, says the order, shall equip these cars with pneumatic or other mechanical or electrical devices, so arranged as to open and close the doors quickly and automatically to signal the motorman when the doors are closed.

Continuing, the order says that the sixteen cars shall be completed and ready for operation not later than October 15. The reconstructed cars are to have conspicuous signs, informing passengers that the doors near the end of each car are entrance doors, and the doors near the middle are exit doors.

In closing, the order states that the cars shall be operated daily on the express service during the morning and evening rush hours.

Mr. Arnold has estimated the cost of transforming the present cars at $1,500 for each of the 500 composite cars, or $750,000; and $2,000 for each of the 350 steel cars, or $700,000, a total of $1,450,000. General manager Hedley of the Interborough Rapid Transit Company put the cost at not less than $1,800,000.

The order was adopted on the report of Commissioner Eustis, who had indicated its nature at the argument before the commissioner on June 29.

Independent Telephone Merger.

According to the Cleveland *Plain Dealer* a merger of independent telephone properties extending from the Mississippi River to the Atlantic seaboard and embracing properties worth over $100,000,000 is again under way. Options have been secured, it is claimed, on the Frontier Telephone Company of Buffalo and on several eastern companies, forming a through chain of long-distance lines and local exchanges to New Jersey. Agents of the promoters have been endeavoring to secure an option on the independent plant at Detroit. St. Louis capitalists, it is thought, are represented in the new merger and will contribute the Kinloch system of that city.

Regulations for Street Cars in Washington, D. C.

Widespread interest will doubtless attach to the regulations for the street railways of Washington, D. C., which were issued on July 10 by the Interstate Commerce Commission. By act of the last session of Congress these railways were put under the control of the commission, which has had a special committee engaged lately in making inquiry into what regulations were necessary. The regulations issued will, in all likelihood, be given close attention in all municipalities in the country where street-railway regulation is a problem. The principal features of the commission's order are:

1. Every street-railway car operated in the District of Columbia shall be fully equipped with front pick-up fenders of the Blackistone, Claude, Tobe, Preusser or Parmenter pattern, and with wheel-guard fenders of the Brightwood automatic, the Blackistone, the Eldridge Smith, the Tobe or the Parmenter improved pattern; provided, that any street-railway company may substitute for the above any other fender or wheel guard which may hereafter be approved by the Interstate Commerce Commission.

2. Every street-railway car operated in the District of Columbia must be so constructed or altered that a clear space of fifteen inches in height above the rails is provided between the wheel guard and the adjacent end of the car, in order to allow the effective action of the wheel guard.

3. Platforms of street cars shall be guarded by gates of a construction and operation approved by the Interstate Commerce Commission.

4. The fenders must be kept in thorough working order and in good repair when in use.

No street car shall move at a greater rate of speed than fifteen miles an hour in the city of Washington, nor at a greater rate of speed than twenty miles an hour in the suburbs of the city. Street cars shall not exceed a rate of speed greater than six miles an hour at street crossings. No motorman or conductor shall refuse to stop to take up a passenger unless all the seats in the car or train are occupied.

6. Whenever street railroads cross each other all cars or trains bound north or south shall have the right of way over trains or cars bound east or west, and all motormen shall, on approaching intersecting crossings, stop their cars or trains and see that the way is clear before crossing; provided, that the provisions as to the right of way shall not apply where branches of the same street railway cross each other.

7. Flagmen shall be stationed at the crossings of all street-car lines when in the judgment of the Interstate Commerce Commission the public safety requires the same. And from and after the direction of the commission to any street-railway company to station a flagman at any such crossing it shall be unlawful for any motorman to run or operate any motor-car over such crossing in the absence of a flagman. No street car shall stand upon a street or avenue for a longer period than five minutes unless the way be obstructed, nor stop so as to obstruct a street crossing or intersecting street; and no street car shall follow a preceding car moving in the same direction at a less interval than 100 feet, unless coupled thereto. Every street car in motion after sundown shall have two lights, one displayed at each end thereof.

Public Service Commission Directs Rehabilitation of Plant.

The Public Service Commission of the Second District of New York has just issued a decision which is of great interest as indicating its attitude with regard to the protection of properties of existing companies and the conditions upon which competing companies will be permitted to operate in small communities.

Complaint had been made at hearings of alleged poor service given by the Albion Power Company in that village, and only recently a receiver was appointed for the company. The Swett Electric Light and Power Company, of Medina, has asked the commission for permission to furnish electric lights in Albion, as a result of the troubles of the local concern.

After investigation and upon the earnest request of the receiver and bondholders of the existing company, the commission has given the receiver of the Albion Power Company an opportunity to begin at once and complete, within thirty days, certain improvements which must be installed within sixty days. The application of the competitive company is held open for thirty days. If at the expiration of that time the improvements required have not been undertaken to the satisfaction of the commission, the application of the Swett company will again be taken up.

The Albion company is required to rehabilitate its water power plant, make necessary repairs to boilers and purchase and install a 900-kilowatt belt-driven generator, with other necessary appliances, and to purchase and put up the additional distribution copper necessary to furnish proper service in Albion. The company is also required to install the following apparatus: Three fifty-kilowatt 6,600-13,200-volt transformers with necessary connections; new arc light system, proper switchboard devices on its entire system, exciter regulators, single-phase feeder regulators, to conserve its water power and increase its availability so that the maximum water power will be available during the evening hours of greatest consumption.

If this work is completed within sixty days and the commission is satisfied that the village is receiving proper service, the application of the petitioner will be denied. Otherwise the pending application will be brought up for further action.

Bombay Electrical Development.

In September, 1905, the Bombay Electric Supply and Tramway Company started business in Bombay, India, with about seven miles of mains in the European section of the city. The advantages of electricity were speedily appreciated, and by the end of the year, installations amounting to the equivalent of nearly 20,000 eight-candle-power lamps had been coupled to the mains, including over 1,000 electric fans. During the past two years, although very busy with the electrification of the horse tramway system, the company has developed its general electrical supply at a rapid rate, as may be seen in the following table:

Date.	Mileage of Streets Served by Mains.	Equivalent Number 8 Candle-Power Lamps.	Number of Electric Punkahs.	Brake Horse-Power of Electric Motors.
January 1, 1906..	7½	19,778	1,050	69
January 1, 1907..	8	58,849	2,110	219
April 1, 1908.....	11¾	[1]100,000	4,000	474

[1]Approximate.

The increase in the consumption of energy is also shown by the fact that in 1907 there were sold 1,233,671 electrical units, as against 488,477 in 1906. Arrangements have been made for providing supply in other districts of the city. The following retail rates are now in force:

(*a*) For general purposes, eight annas (anna = two cents) per unit for the number of units equivalent to one hour's use per day throughout the month of the maximum demand as shown by indicator, and two annas per unit for all units in excess of this quantity as shown by difference between meter and indicator readings for the month.

(*b*) For elevators, four annas per unit flat rate.

(*c*) For bona fide industrial motive power installations of five brake horsepower and upward, two annas per unit flat rate.

PRIMARY STANDARD OF LIGHT.[1]

BY CHARLES P. STEINMETZ.

Light is not a physical quantity, but a physiological effect, that of certain wave-lengths of radiation, and therefore can not be expressed in absolute physical units; it must be measured by comparison with an arbitrarily chosen standard of physiological effect. As a result thereof even with the best existing primary standard of light, the amylacetate lamp, the difficulties of reproduction, and maintenance of its constancy, are such as to involve errors very far beyond those considered permissible in physical measurements. A radical increase in the accuracy of reproduction and maintenance of a primary standard of light appears possible only by relating the standard of light in such manner to physical quantities, that it can be determined by energy measurements.

This led to the recommendation of defining the primary standard of light by the energy of radiation. It requires, however, a definition of the quality of radiation, since the physiological effect of radiation has no direct relation to the energy of radiation: One watt of radiation of a wave-length from the centre of the visible range gives a far higher physiological effect, that is, more light, than one watt of a wave-length near the ends of the visible spectrum. This is not merely a function of the quality or color of the light, as light of the same intensity and same color, identical physiologically, may be entirely different physically, and therefore represent a different amount of power. For instance, the physiological effect of white light is produced by the combination of all colors of the spectrum, but also by an infinite number of combinations of two, three, or more spectrum colors; and these physically different forms of white light, while indistinguishable on the photometer screen, and thus physiologically identical, represent different amounts of radiation power per unit of physiological effect, or per candle-power. The same reasoning applies to colored light. The power of the visible radiation is, therefore, not a measure of light.

The definition of the absolute unit of light as the physiological effect of one watt of power of visible radiation, requires, therefore, an arbitrary definition of the distribution of power throughout the visible range. As such distribution of power through the visible range, may be chosen that of the black-body radiation at a definite temperature, and the temperature measurement may be eliminated by specifying the energy-ratio between two definite regions of the spectrum. For instance, such a definition would be:

The unit of light is that given by a black body radiating one watt of power between the wave-lengths of thirty-nine and seventy-two, under the condition (that is, at the temperature) where the power of radiation from wave-length thirty-nine to fifty-five bears to that from fifty-five to seventy-two the ratio a.

It does not appear to me that such a standard would be very satisfactory, and for the following reasons:

1. Though the intensity of radiation at the red end of the spectrum is very high, the physiological effect is very small, and an inaccuracy at this limit would therefore seriously affect the result.

2. The absorption constant of glass or any other envelope is different for different wave-lengths.

3. Any deviation of the radiator from the black-body radiation vitiates the result.

4. The color of the light would not be white, but yellow, due to the temperature limitation imposed by the radiator.

A more satisfactory primary standard of light, based on measurement of radiation power can, as I believe, be produced by selecting three primary colors of the visible spectrum. Let these colors be of definite wave-length, about equidistant from each other and of such character that they can be absolutely reproduced at high intensity, as the spectrum lines of a luminous gas or vapor. Then define the unit of light as that given by one watt of power radiated at these three wave-lengths, in definite proportions, chosen so as to give white, or yellowish-white, light. That is, the primary unit of light is the physiological effect, as observed on the white photometer screen, of one watt of power, radiated in the three definite wave-lengths A, B, C, in the proportion $a \div b \div c$.

The adoption of this standard of light would eliminate the sources of error which now affect the primary flame-standard. The radiation density or light flux intensity of the three primary colors is measured separately before they are combined on the same photometer screen, and the accuracy of determination would be limited only by that of physical measurement of radiation energy, by bolometer or otherwise.

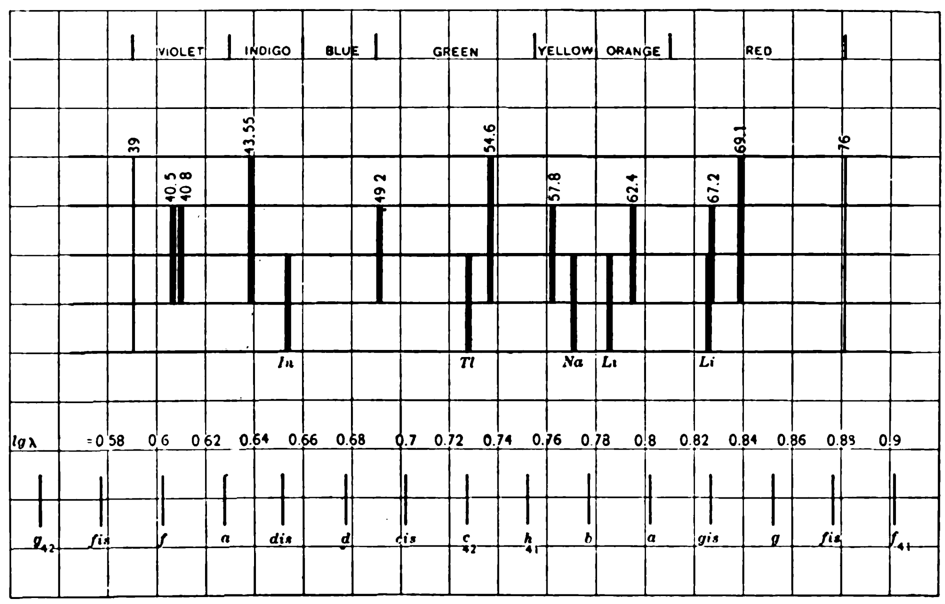


FIG. 1.—CERTAIN OF THE BRIGHTER LINES OF THE SPECTRUM SHOWN IN GEOMETRIC SCALE.

This standard of light requires three sources of monochromatic radiation, which can be maintained constant with any desired exactness. This requirement seems fulfilled by the mercury lamp. When reasonably protected from air drafts, changes of surrounding temperatures, etc., the intensity of radiation of a mercury lamp remains extremely constant at constant current, and, for minor variations of current, varies directly as the current, while that of the incandescent lamp varies as a high power of the current. It must be considered that a reproduction of the same intensity in the lamp is not required, as is the case with standard lamps,

[1] A paper presented at the twenty-fifth annual convention of the American Institute of Electrical Engineers, at Atlantic City, N. J., July 2.

since the mercury lamp is merely the source of monochromatic light, and its intensity is measured and adjusted.

I should therefore recommend mercury lamps as the sources of the three monochromatic radiations, which combined give the primary standard of light.

Approximately, some of the brighter lines of the mercury spectrum are shown in Fig. 1 in geometric scale; that is, with the logarithm of wave-length as abscissas. When investigating the combination of different frequencies to a resultant effect, this rational scale, which is the scale of acoustics, is preferable.[1]

In Fig. 2 the mercury spectrum is given in polar co-ordinates with the octave, or the ratio of wave-lengths two divided by one, represented by 360 degrees. For illustration, the frequency denotations of acoustics are recorded in Figs. 1 and 2; that is, one tone represents thirty degrees.

For comparison the spectrum lines of Li, Na, Tl and In are also shown.

[1] The usual way of recording spectra, with the wave-length, or the frequency as abscissas, is irrational; one wave-length in the ultraviolet represents a far greater range than in the ultrared. The infinite number of radiations of shorter wave-length, or higher frequency than the visible, are crowded into a finite space, when using wave-length as abscissas, while the lower frequencies or longer waves cover the whole range from the ultrared to infinity. The reverse is the case with the frequency as abscissas. The intensity curve of radiation, measured and recorded with the wave-length as abscissas, is different, and its maximum at a different point, than the intensity of the same radiation plotted with the frequency as abscissas. The rational scale of any periodic quantity is the geometric scale, where equal intervals represent equal percentual increase or decrease; that is, the logarithmic scale. This was realized long before science existed: it is the scale used in music, with the octave; that is log. 2, as abscissas.

Of the spectrum lines of mercury, of approximate wave-lengths:

40.5; 40.8; violet.	43.55; blue.	49.2; 54.6; green.	57.8; yellow.	62.4; orange.	67.2; 69.1; red.[1]

the lines:

Blue	43.55
Green	54.6
Yellow	57.8

are the most prominent. The three red lines, and many more red lines, appear only at higher temperature, as in the Heraeus quartz lamp.

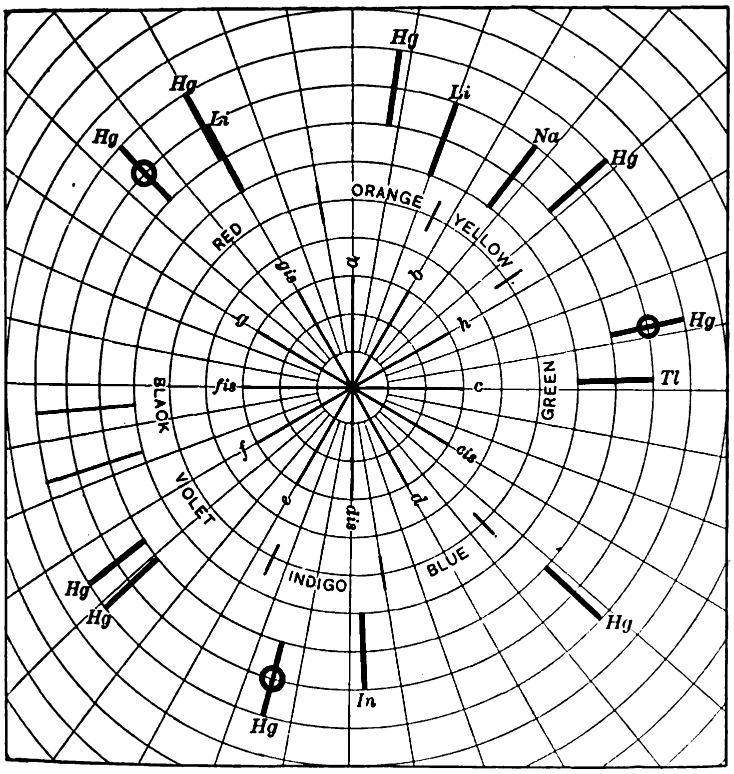


FIG. 2.—THE MERCURY SPECTRUM SHOWN IN POLAR COORDINATES.

The three spectrum lines of mercury:

Blue	43.55
Green	54.6
Red	69.1

which are about equidistant and therefore appear the most suitable as primary colors for a standard of light.

Two low-temperature mercury lamps would be required for the blue and the green, and one high-temperature quartz lamp for the red. These would be maintained at constant radiation by maintaining the current constant, and also the condition of ventilation and surrounding temperature.

Resolved by a prism, the blue line of the first, the green of the second, and the red of the third lamp are thrown on the same white screen, and their radiation energy measured separately. What energy proportion to select for the three colors, to give a color suitable for a primary standard, remains to be investigated. Probably a yellowish-white would industrially be most convenient.

[1] The wave-lengths of these red lines require redetermination. Some of the other lines are twins.

It is interesting to note that such a selection of three primary colors as components of a standard of light would also allow an exact numerical expression of the physiological color of any light, by the ratio of the three intensities, $a \div b \div c$; that is, the color of light could be measured by varying the intensities of the three standard wave-lengths until their combination, on the white screen, becomes identical in color with the observed light.

The State's Water-Power Right.

A very interesting and important suit has been brought by the Fulton Light, Heat and Power Company, of Fulton, N. Y., against the state of New York, and action is being taken in the Court of Claims. The power company alleges that $3,200,000 damages is due it for the appropriation by the state for the barge canal of private property in the bed and waters of the Oswego River.

The power company is one of sixteen users of water power at Fulton, and there are a number of water-power users at other points affected in the same way. Upon the result of this action depends the ability of the state to complete the building of the barge canal. George F. Decker, deputy attorney-general, has made the following statement:

"It is doubtful if the interests of the state were ever more boldly challenged. The state claims that the Oswego River was by nature and immemorial usage a public highway before the river was canalized, that its bed and waters were never bartered away, or, if they were, that the grant was subject to navigation uses. The state also claims that if this river ever became private property, it was reappropriated by the state when it was canalized in 1826.

"If the state's position is unsound, it will probably result in preventing the completion of the present canal enlargement as well as the undertaking of any state improvement of navigation hereafter, because of the increasing value of water power with wood gone and coal going. This case is the first in a very long time which has arisen directly against the state and wherein this question has been involved. It will determine whether the water power of our larger rivers and of the canals is held as an irrevocable monopoly in private hands."

THE RELATION OF THE MANUFACTURING COMPANY TO THE TECHNICAL GRADUATE.[1]

BY B. A. BEHREND.

Even though in times of business depression it may seem to us as if there were more applicants than positions, yet no thoughtful man denies that, while the number of positions in such times may have greatly decreased, the importance of filling them by thoroughly capable and competent people has correspondingly increased. For example, a position which, in times of exceptional prosperity may be filled fairly well by an average man, will be sorely in need of a man of exceptional ability when business prosperity is on the wane. If there is any one fact more patent than another it is the fact that there is always room at the top of the ladder for men of integrity, of moral courage, and of intellect. There are plenty of men who possess any one of these qualities; there are few who possess all three, and these the manufacturing companies, or the world at large, most require. In their anxiety to secure the raw recruits for officers thus endowed, the manufacturers turn of necessity to the universities and their graduates.

It must be granted that the colleges possess an almost unlimited potentiality for improving the human material turned over to them to shape and polish, and, it seems to me, considering the results obtained, they are doing very well in this shaping and polishing process. But they are not always supported in the right direction by the manufacturing companies. To allude to one instance only, I refer to the manner in which the manufacturing company seeks the young graduate, instead of letting him do the seeking. He thus gains, at the outset, an exaggerated idea of his importance, and an independence which is not conducive to the development of those qualities which make thoughtful and painstaking men. Our graduates are chiefly deficient in these qualities, and this is due, not so much to an innate deficiency in this direction, as to the fact that the incipient faculty has never been properly awakened and cultivated. There is abroad among our colleges and their graduates a most ominous disdain for painstaking accuracy and devotion to laborious detail, so essential to all really great work in engineering. The wish to take someone else's thought and work and make it a commercial success, which is so prominent a feature of our business life, is easily explainable, though not so easily excusable. Men of ability realize that the same effort turned into the channels of commercial work will be productive of better returns than they would obtain by painstaking working out, for instance, the design and construction of electrical machines. In this case, even though their work may have met with eminent commercial success, our business methods are not much concerned with a debt of gratitude or obligation to the men that did the building up. Here lies a menace to the stability and continued prosperity of our manufacturing industries which must, in time, be remedied, lest it produce a far-reaching result in discouraging graduates of our colleges from the pursuit of new and important creative engineering work, with the result that we will have to draw on other countries for a supply of well-trained engineering brains.

The managers of our manufacturing plants can do as much toward the development of right views and proper education as can the teachers and organizers of the colleges. The former need to study more sympathetically the condition of the latter, and *vice versa*. There are very poor pretenses of both managers and teachers in this world, and it is obvious that "the highest gifts are not always brought to the highest place." Education is a very good thing, but it can not give the qualities which it should develop. Those who, like the writer, have been instrumental in the building up of large manufacturing organizations, recognize that the absence of moral qualities frequently mars a successful career, as frequently, perhaps, as the absence of purely intellectual qualities. Success often accompanies the work of men possessing ability, untempered by scrupulous restraint. Examples of this kind, so plentiful, have left a detrimental impression on the minds of aspiring young men. The thoughtful words of James Bryce, that this country " . . . has the glorious privilege of youth, the privilege of committing errors without suffering from their consequences," remind us that many of our faults are not visited upon us with the unerring justice they deserve, because of the actual and potential wealth of this country in its present state of youthful and vigorous development. But let us not be deceived permanently into believing that, with our population increasing in geometric progression and thickening in our cities and manufacturing centres, many of the crude and lavish methods, despite which our industry is the most flourishing in the world, can be permanently retained without doing infinite harm. Space does not permit me to do more than to indicate the line of thought I wish to suggest. We need both character and intellect in our graduates, which should be cultivated by close co-operation between the manufacturing companies and the colleges, but for creating which no panacea has yet been devised.

[1] A paper presented at the twenty-fifth annual convention of the American Institute of Electrical Engineers, Atlantic City, N. J., July 2, 1908.

Theodore N. Vail on Business Conditions in the West.

Theodore N. Vail, president of the American Telephone and Telegraph Company, has returned from an extensive trip throughout the West, having visited from Mississippi to the Coast and from Texas to the extreme Northwest. In speaking of the business conditions, says the New York *Journal of Commerce,* in that part of the country, Mr. Vail said:

"So far as basic conditions go in that section, there is absolutely no reason for a depression. I have been taking a broad view of the West for the last thirty years, and never in that time has the outlook been better than it is now.

"Crops are promising, indeed; in fact, the original producers, as the farmer and the cattle and sheep raiser, are in better shape than I have ever known them. Developments in every phase during the last five to eight years are beyond comprehension and belief. Cities as widely apart geographically as Dallas, Tex., and Spokane, Wash., have expanded in every direction.

"The floods have not done any great harm on the whole. It is true that the railroad losses can not be offset, but the sections needing moisture have profited more than other sections not needing it have suffered. Dry farming places—the semi-arid lands—were never in such luxuriant growth, and the grazing areas are likewise in the fullest flush of growth.

"The public utility and the public service corporations have been the central factor in the business situation, and they continue to remain the dominating element, and many of their problems have not yet been solved. This is the disquieting feature. What brought this about and how it was brought about everyone now knows."

Taking up the companies whose interests he serves, President Vail says: "Our business shows relatively no falling off. The business of the associated Bell companies is better this year than last year. There is a good demand for the better class of telephones; in fact, we have all the business of that kind we can do. As for new construction, the associated companies will do twenty-five to thirty per cent less than last year. The figures will fall even below our estimates made at the beginning of 1908."

FINANCIAL REPORTS OF ELECTRIC COMPANIES.

LEXINGTON & INTERURBAN RAILWAY COMPANY.

The report of the Lexington & Interurban Railway Company, of Lexington, Ky., for the month of May and five months ended May 31 shows May gross of $50,271; expenses, $35,180; May net, $15,091. Five months' gross, $225,340; expenses, $154,458; five months' net, $70,882, an increase for the five months of $5,226.

NORFOLK & PORTSMOUTH TRACTION COMPANY.

The report of the Norfolk & Portsmouth Traction Company, Norfolk, Va., for the month of May and five months ended May 31 shows May gross of $152,175; expenses, $90,262; May net, $61,913. Five months' gross, $711,092; expenses, $448,912; five months' net, $262,180.

TWIN CITY RAPID TRANSIT COMPANY.

The report of the Twin City Rapid Transit Company, Minneapolis, Minn., for the month of May and five months ended May 31 shows May gross of $527,393; expenses, $254,577; May net, $272,816; charges, taxes and preferred dividend, $126,972; May surplus, $145,844. Five months' gross, $2,429,348; expenses, $1,265,571; five months' net, $1,163,777; charges, taxes and preferred dividends, $621,178; five months' surplus, $542,599.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

For the five months ended May 31 the American Telephone and Telegraph Company reports an increase of 0.32 per cent in net earnings for dividends on the augmented capital stock. The net earnings available for dividends were equal to 5.57 per cent on the outstanding stock, against 5.25 per cent on nearly $21,000,000 less stock in the first five months of 1907. The current year will be one of greatly decreased figures on the score of new construction and extensions. In the last eight years nearly $352,000,000 was devoted to this purpose. The tendency to let up in expansion began early last year, when expenditures for new construction on the part of the Bell system were $30,000,000 less than in 1906. Financial requirements have been satisfied until January, 1909, and it is stated no new funding operations will be needed until 1910, when the company's note issue of $25,000,000 will come due.

PHILADELPHIA RAPID TRANSIT COMPANY.

The gross earnings of the Philadelphia Rapid Transit Company for the fiscal year ended June 30 were $18,228,000. This is an increase of $132,500 over the previous year. Although the official figures for the net earnings have not been made up, it is understood that operating expenses increased about ten per cent over last year, in which case they amounted to approximately $11,000,000. On this basis net earnings were about $7,228,000, compared with $8,049,016 in the previous year, a decrease of 11.3 per cent.

TOLEDO RAILWAYS AND LIGHT COMPANY.

As a part of the plan of the protective committee of the bondholders of the Toledo Railways and Light Company, Toledo, Ohio, the July 1 interest on the $4,866,000 consolidated first-mortgage four per cent bonds of the company will not be paid. The July 1 interest on the $1,066,000 Toledo Consolidated Street Railway first mortgage five per cent bonds and that on the $4,234,000 Toledo Traction Company first consolidated mortgage five per cent bonds will be paid. These two latter companies are underlying companies of the Toledo Railways and Light Company. All of these bonds fall due July 1, 1909. Accordingly, the bondholders' committee is anticipating the future by a year. On February 1, 1912, there is an issue of $700,000 Toledo Electric Street Railway Company first-mortgage five per cent bonds that come due.

The earnings of the Toledo Railways and Light Company are showing some slight improvement over those for last year, the increase in the surplus for the five months ended May 31 being $4,570. Now that no dividend is being paid it is believed it will be possible for the company to take care of its floating debt with its earnings. Some of the company's street railway franchises expire in 1909, and others expire from year to year until 1914, by which time all the franchises will have expired unless renewed. Lighting franchises do not expire for several years. It does not seem likely that satisfactory arrangements can be made to refund the outstanding bonds until the city and the company are able to come to terms as to the renewal of the street-railway franchises.

Wireless System on the Amazon.

Wireless telegraphic communication between Lima, Peru, and Iquitos, on the Amazon River, has been successfully established, according to a cablegram received by Eduardo Higginson, Peruvian consul-general at New York.

The National Electrical Contractors' Association Convention.

The eighth annual convention of the National Electrical Contractors' Association was held during the week at the Auditorium, Chicago, Ill. The programme included two open sessions, one on Wednesday morning and one on Thursday morning. Business sessions were held each day, both in the morning and afternoon. At the open sessions papers were presented by George Loring, on "The Electrical Contractor's Opportunities in the Illuminating Field"; by W. H. Merrill, Jr., on "The Relations Between the Underwriter and the Contractor"; by J. R. Cravath, on "Illuminating Engineering"; by Alex Dow, on "The Relations Between the Lighting Company and the Contractor," and by Seth B. Wetherbee, on "The National Electrical Contractors' Association." The extra feature of the convention included a rejuvenation of the Sons of Jove, a ladies' banquet, a men's banquet and an all-day outing to Michigan City.

June Copper Output.

Reports from the various producing mines in the United States, Canada and Mexico would indicate a decrease of 95,961,979 pounds in the production of copper for the first six months of 1908, and a decrease of 118,557,000 pounds as compared with the first half of 1906.

Every month of the year has shown a substantial decline. May approached nearest to last year's figures.

The Boston News Bureau figures the production of copper in the United States, Mexico and Canada for June at 79,431,725 pounds, compared with 96,123,030 pounds in June last year, and 101,666,900 pounds in June, 1906.

The total production, by months, for the first six months of this fiscal year, is estimated as follows:

	1908	1907	1906
January ..	65,900,000	84,935,143	97,296,400
February ..	65,036,750	85,278,160	89,205,800
March	79,105,704	102,495,230	96,480,081
April	87,582,805	96,567,700	98,044,400
May	90,880,300	98,500,000	103,800,000
June	79,431,725	96,123,030	101,666,900
Total ...	467,937,284	563,899,263	586,494,581

For the first time this year the production in Arizona (in June) exceeded last year's figures, amounting to 24,909,000 pounds, as compared with 23,096,000 pounds last year.

Utah also comes forward with new high figures of 8,600,000 pounds, as against about 6,000,000 pounds for June a year ago, and California and Canada both show a slight increase over last year.—*Wall Street Journal.*

Annual Convention of the American Institute of Electrical Engineers—II.

Report of the Fifth and Sixth Sessions, Wednesday, July 1.

THE fifth session of the twenty-fifth annual convention of the American Institute of Electrical Engineers, which was held at Atlantic City, N. J., June 28 to July 2, inclusive, was called to order Wednesday morning, July 1, with Vice-President Armstrong in the chair. The reports of the two preceding days were given in the issues of the ELECTRICAL REVIEW for July 4 and 11. At the Wednesday morning session a number of papers dealing with the construction and operation of electrical machines and the equipment of generating stations were taken up. Two papers were first read dealing with the split-pole converter.

C. A. Adams presented a paper on "Voltage Ratio in Synchronous Converters with Special Reference to the Split-Pole Converter." This is a purely theoretical analysis showing how the field distortion of a split-pole converter does not necessarily involve electromotive-force distortion. Incidentally the author develops a method of analysis by which the direct electromotive force or any one of the alternating electromotive forces is determined analytically from the harmonic analysis of the flux distribution curve, thus establishing a simple and direct connection between the shape of the flux distribution curve and the shapes and magnitudes of the resulting electromotive forces. The author concludes that with the tap connections 180 degrees apart and a large number of slots, an mth harmonic in the flux distribution appears in the alternating electromotive force, but reduced to one mth of its value. The higher harmonics are of little value in changing the voltage ratio. With 120-degree connections, the third, ninth, fifteenth, etc., harmonics do not appear in the alternating electromotive force. With three-part poles and symmetrical distortion there is a definite minimum per cent of electromotive-force harmonics for a given range of voltage ratio, and the fifth harmonic is usually the most prominent. With two-part poles the total per cent of electromotive-force harmonics for a given range of voltage ratio may be made considerably less than for the symmetrical distortion, and as the third harmonic is naturally predominant in this case the employment of the 120-degree connection or of the 180-degree connection with star-connected transformer primaries may result in the practical elimination of electromotive-force or current harmonics. The conditions in this respect may be still further improved by the use of mid-slot connections and a fractional pitch winding.

A paper on "Application of Storage Batteries to Regulation of Alternating-Current Systems" was presented by J. L. Woodbridge. This points out that in many cases where alternating-current generation is employed a regulating storage battery is even more valuable than for direct-current service. This is because alternating-current generation is particularly applicable for long-distance interurban railway work, as in many cases it is developed in water-power plants and transmitted for long distances. Moreover, in many cases of water-power development power is sold on the maximum-demand basis, so that the saving effected by removing peaks and smoothing out the load is particularly valuable. The auxiliary apparatus required in connection with the storage battery adapted for regulating an alternating-current system may also be used for changing the frequency or controlling the power-factor; and, further, the increasing use of gas engines in steel plants offers a large field for the application of storage batteries, since in most cases the large areas served by the plant make it advisable to adopt an alternating-current distributing system. The author then discusses the various alternating-current systems in which storage batteries may be used with advantage and describes suitable means of adapting the battery to regulating the load on the generating station.

The discussion was opened by P. M. Lincoln, who said, with reference to Mr. Adams's paper, that the wave-form of the electromotive force, which was given the most attention, is not the only important feature in a machine of this type. In this type of design there is considerable lost space and the efficiency is decreased. Analytical discussions, such as have been made, do not demonstrate the practical value of this apparatus, as the test of time only will prove its weaknesses and virtues. Mr. Lincoln then discussed the effect of the number of taps in the converter on the harmonics of this wave-form, and said that those 120 degrees apart have less influence than those 180 degrees apart. He does not think that the efficiency of the split-pole converter is any better than that of a machine combined with a booster. Moreover, it is probable that the design will give rise to considerable noise, which it will be hard to prevent. The voltage changes of the machine are slow, and it, itself, is large. While a rotary is desirable, other conditions being the same, the disadvantages of the split-pole converter outweigh its advantages.

A. S. Hubbard said that the system described in Mr. Woodbridge's paper can hardly be taken as accepted practice, as there are only five plants of this general type in the country. One of these, which is not now in operation, was installed primarily to tie together two generators of different voltage and a transmission line. The regulation of the system was erratic. The plant described in the paper is included in the five, but as the conditions existing there are peculiar, it can hardly be taken as a fair example of the use of storage batteries for alternating-current regulation. In a third plant a two-coil regulator of the dynamometer type is employed, which causes the battery to charge and discharge in response to variations of the true energy on the system. The regulation on this system is not good, there being variations of twenty-five per cent above and below the average. In a fourth plant, utilizing water power and developing 13,000-volt, three-phase, twenty-five-cycle current, another type of regulator is employed. There are three current transformers on the incoming high-tension lines with their secondaries connected to a second set of three current transformers back of the switchboard, and provided with sectional secondaries connected to a compensator head. From the compensator head the current is led to the collector rings of a rectifier consisting of an armature with a two-pole winding. This is driven at synchronous speed by a synchronous motor, so that the rotating field set up by the current is fixed in space. Two brushes placed upon the commutator of the rectifier thus deliver a direct current varying directly with the true load on the system, and thus control the charging and discharging of the battery. A second pair of brushes ninety degrees from the former, and connected to an inductive circuit with characteristics corresponding to those of the main circuit, delivers a current which varies with the power-factor of the system, and thus enables the regulator to correct the power-factor of the system by changing the excitation of a synchronous motor or rotary. With this arrangement the load in kilowatts on the generators varies only three and one-half per cent above and below the average. An important feature of the arrangement is that the output of the rectifier does not affect the load on the driving motor at all, nor has the rectifier any motor action. The fifth plant referred to employs a regulator of the same kind, designed, however, for sixty cycles. Mr. Hubbard believes that this method of regulation is particularly suitable for plants driven by water power, gas engines or steam turbines.

W. L. Waters said that the question regarding the installation of storage batteries in a direct-current plant is one of cost. In a mixed plant, however, the chance of breakdown is considerably increased, and this is a serious consideration. Regarding the split-pole converter, he thought one point had been overlooked, and that was the probable difficulty of maintaining satisfactory commutation, and he asked what advantages this machine had over the ordinary arrangement employing a booster.

C. P. Steinmetz said that some surprise had been expressed at the use of what was treated as a newly recognized property of the synchronous converter. However, the reactions depended upon for regulating the split-pole converter have long been known. In the ordinary rotary with fixed brushes, the ratio between the alternating and direct potentials is constant, since the latter is merely the maximum value of the former. If, however, the brushes be shifted from the neutral plane, the direct potential will be lowered, since a part of the armature winding is thus rendered ineffective, while the alternating potential is not changed. The ratio of the two potentials may in this way be changed, but the method is not practicable, since commutation becomes impossible. Another way would be to hold the brushes in a fixed position and shift the poles mechanically, the result of which is identical with the first method described. But there is still another way—that is, to shift the field electrically. If the field poles be divided into two parts and each provided with a separate winding, by varying the relative excitations of the two parts, the position of the magnetic field may be shifted with respect to the brushes and the voltage ratio varied continuously. This is all that is done in the split-pole converter. There is another method of varying the potential ratio, which consists in adding harmonics to the alternating-current wave. The third harmonic is the most useful, and on three-phase converters this harmonic does not get out of the machine, though it causes some additional loss. On six-phase rotaries the harmonic flows through the transformers, but does not get beyond them and transfers additional loss to them. Regarding the criticism made by Mr. Lincoln that the split-pole converter is large, Dr. Steinmetz said that this is a characteristic of all machines designed to have a range of working. They must be constructed so as to carry the maximum current and develop the maximum potential, and hence the size is determined by the product of these two values.

In closing the discussion, Mr. Woodbridge did not agree with all the points made by Mr. Lincoln, and said that the use of a damper to prevent surging of the flux did not interfere with the quickness with which the machine responded to changes of excitation.

Three papers were then read dealing with the construction of alternating-current generators.

B. A. Behrend presented a paper entitled "A New Large Generator for Niagara Falls." This describes the new 6,500-kilowatt generator recently installed by the Niagara Falls Hydraulic Power and Manufacturing Company in the new station at the foot of the falls on the American side, just below the old power-house of the same company. The new machine is interesting because of its high speed, which is 300 revolutions a minute and is greater than that of any other generator at the falls. It is wound for 12,000 volts, three-phase, twenty-five cycles, and will carry a continuous load of 7,320 kilowatts. The generator has been designed for a safe speed of 506 revolutions a minute, which is the runaway speed of the water-wheel. The construction of rotor and stator is described somewhat in detail and some very interesting results of an investigation of the mechanical stress produced in the different parts of the machine by the high speed are given. The guaranteed efficiency of the generator at full load is 96.5 per cent with a power-factor of ninety-five, and 95.9 per cent with a power-factor of eighty-five. Under test the efficiency was found to be 97.83 per cent at full load and ninety-five per cent power-factor, and 97.5 per cent with a power-factor of eighty-five. Temperature tests showed that the temperature will remain within thirty-five degrees of the normal at the rated load and within forty degrees with an output of 7,500 kilowatts.

A paper entitled "Modern Developments in Single-Phase Generators" was read by W. L. Waters. Although single-phase generators have been used for twenty years or more, they have generally been of small size only, and used for lighting work. The recent development of the single-phase alternating-current railway motor has given rise to a new demand for large high-speed, low-frequency, single-phase generators, and in the design and construction of these there are some serious difficulties. These are all due to the low frequency of the machine, which necessitates a large pole-pitch and a high armature reaction. In polyphase generators the armature reaction is practically constant, while in single-phase machines it pulsates. The large pole-pitch, moreover, makes the stress on the end connections of the armature coils more troublesome than is the case of polyphase machines. The pulsating magnetic flux, due to the armature current, gives rise to hysteresis and eddy-current losses throughout the entire magnetic system. It is rather difficult to determine just what these will be, but several methods are suggested which, from experience, have been found to give a good indication of the magnitude of the loss. A satisfactory way is to send current of a normal frequency through the armature and measure the losses by a wattmeter. The exact measurements of the loss are, however, difficult to make. The eddy-current losses, due to the pulsations, may be practically eliminated by laminating the entire magnetic field, but, on the other hand, the use of solid poles gives rise to eddy current which tend to choke back the pulsations and thus reduce the hysteresis loss. If a laminated structure be used, with damping grids of low resistance inserted in the pole-faces, the eddy-current losses in the iron are avoided, while the reaction of the grids reduces the hysteresis loss. The resistance of the grids is small, so that the eddy-current losses taking place in them are not large. In this way the pulsations due to a simple laminated field may be reduced to one-thirtieth of the original value. The use of solid poles would reduce them to half value only. Actual figures for this loss for three machines are given. Without dampers the average loss was three and one-half per cent, but with dampers it was reduced to one-half per cent and the temperature rise reduced from 125 degrees centigrade to thirty degrees. The importance of providing mechanical support for the end turns of sufficient strength is evident when it is considered that a short-circuit on a generator will cause current of fifteen or twenty times normal full-load value to flow. This brings a stress on the coils in proportion to the square of the current, or from 200 to 400 times the normal value. In actual figures these stresses may be from two to ten tons on one end of one armature coil. A satisfactory form of support is shown, this consisting of a heavy girder of bronze.

A paper by Jens Bache-Wiig, entitled "Application of Fractional-Pitch Windings to Alternating-Current Generators," was read, the object of which was to deal briefly with the points leading to the use of a chorded winding for alternating-current generators from the standpoint of manufacture and design and to determine what influence this winding has on the performance of the machine. In general, chorded windings have been adopted to facilitate the manufacture of armature windings, as this enables a standard frame to be used for a number of different ratings at different speeds and voltages. Group windings with a number of slots per pole per phase equal to an integer are generally preferred, and the number of conductors is fixed within a limited range for a given voltage. This often necessitates the use of a chorded winding to get the proper number of effective conductors. An advantage resulting from the chorded winding is the reduced space occupied by the end turns. Moreover, as form-wound coils may be used and space gained, the result is equivalent to taking copper off the end turns and laying it in the slots. This type of winding also reduces the strain on the end turns, making it unnecessary to provide extra insulations there. The demagnetizing effect of the chord winding is practically the same as that of the full pitch winding, and there is also a reduction in magnetic leakage. There is a possibility, however, of currents flowing around the delta of the machine if the electromotive forces of the coils are not pure sine waves. The author concludes that no general rules may be formulated governing the proper arrangement of the chord windings for all cases. Where this is not determined from mechanical reasons, the most efficient chord will depend upon the number of poles, the ratio of pole-pitch to pole-length, the voltage and size of the machine. These must be worked out in each individual case.

The discussion was opened by D. B. Rushmore, who said the greatest difficulty in the construction of large generators is to secure the desired regulation. The mechanical design must always be sufficient to withstand the runaway speed of the turbine, which is a little less than twice the normal. The General Electric Company designs its generators to withstand speeds 100 per cent above the normal. He emphasized the necessity for installing protective apparatus on all large machines.

W. J. Foster pointed out some of the interesting features of the machine described by Mr. Behrend. The armature reaction adapted is unprecedented, which is a good feature. The efficiency is also unusually high. In this machine, nickel steel has been employed, and it is interesting to point out that steel of this class having a high permeability is now available.

A communication from L. Schuler was read by P. H. Thomas, which dealt briefly with the losses in single-phase alternators due to the pulsating armature reaction. He described a method of measuring these losses in which a damper of variable resistance was employed. The use of a low-resistance damper reduces the total loss due to this effect. F. H. Clough criticized the method employed by Mr. Waters of supporting the end coils of his single-phase generator.

Dr. Steinmetz described a method of carrying a single-phase load on a polyphase machine without unbalancing the latter. This consists in placing a reactance coil across one phase and the single-phase load across another. In this way the power loop of the reactive circuit falls behind the two power loops of the load circuit. In other words, power is stored up in the reactance coil during those periods when the external load is not drawing on the generator. In this way it is possible to get a perfectly balanced, uniform load. The arrangement is particularly good for low frequencies.

In closing the discussion, Mr. Waters criticized rather sharply the generator described by Mr. Behrend, saying that in the design it appeared to him mechanically weak. In regard to Dr. Steinmetz's suggested method of balancing the load, he said it was all a question of cost, and the single-phase generator might be the cheaper.

The two remaining papers on the schedule for the morning session were then presented.

J. R. Bibbins, in a paper entitled "Double-Deck Steam Turbine Power Plants," described in some detail the equipment of the West Point station. This is one of the new double-deck stations in which the generating machinery is placed above the boilers on the second floor of the station. Some of the important features of this design are the supporting of the generating apparatus entirely by the steel building skeleton and the carrying of a water-cooled floor column through the middle of a boiler setting to reduce weight and cost of the beams spanning the battery. This arrangement simplifies all the piping and produces a compact, accessible and efficient plant. It is estimated that the total cost of the station, excluding property and siding, was $563,520. As the station has an output of 8,500 kilowatts, this gives a cost of $66.25 per kilowatt.

In concluding his abstract, Mr. Bibbins said that credit for the success of this type of plant must be given to the two engineers, Dr. Louis Duncan and Thomas Elliott, who had designed and built the Fort Wayne station.

J. R. Bibbins, in a paper entitled "Working Results from Gas-Electric Power Plant," gave a report of a thirty-day test on the service plant of the Richmond works of the American Locomotive Boiler Company, of Richmond, Va. This plant contains a horizontal gas engine driving a generator rated at 325 kilowatts. The test showed that the pounds of coal per kilowatt-hour at full load were 1.65. The thermal efficiency, from coal to electricity, at the same load was 14.35 per cent. From the figure obtained at the plant an estimate is given of the cost of installation and operation of a 700-kilowatt gas-engine plant as compared with an equivalent steam-turbine plant. The equipment cost of the first was found to be $96,600, while the fixed charges would be $12,220. This should produce one kilowatt-hour, at full load, for 1.62 pounds of coal. The steam-turbine plant would cost $70,000 to install, the fixed charges would be $8,050 and the coal consumption at full load would be 2.96 pounds per kilowatt-hour. The cost per kilowatt at the gas plant would, therefore, be a little less than one cent, with coal at $1 a ton, and about one and one-half cents with coal at $6. With coal at $1 a ton the steam-turbine plant would save eight and one-half cents over the gas-engine plant; at $2 a ton the two would be about equal; and at $6 a ton the gas-engine plant would save nineteen per cent.

The discussion was opened by C. W. Ricker, who has been associated with the West Point plant and who gave some interesting figures showing the distribution of cost. Assuming as a basis a rating of 3,000 kilowatts, the following cost table was submitted, the figures being the cost per kilowatt:

Building and all cement work........	$21.40
Boiler plant, settings, pump, pipe and pipe covering..........	14.24
Barometric condensers............... ...	6.41
Generating plant.......................	37.59
General supervision of erection..........	2.42
Making a total of..........	$82.06

J. P. Jackson discussed briefly the interesting features of Mr. Bibbins's two papers, and laid much stress upon the necessity for entire reliability.

The session was then adjourned.

WEDNESDAY AFTERNOON SESSION.

The sixth session of the convention was called to order Wednesday afternoon, July 1, about 2.30 o'clock, by Vice-President Armstrong, and four papers pertaining to electric railways were read and discussed.

Dr. J. B. Whitehead, Jr., in a paper entitled "From Steam to Electricity on a Single-Track Road," gave a somewhat detailed analysis of the equipment which has been decided upon for electrifying a single-track steam railroad known as the Annapolis Short Line, connecting Annapolis with Baltimore, Md. This is a single-track road of standard gauge, twenty-five and one-quarter miles in length, with a four-mile extension beyond Annapolis to Bay Ridge, a summer resort on Chesapeake Bay. The Baltimore terminal is in Camden station, the main terminal of the Baltimore & Ohio Railroad. The maximum gradient on this road is one and one-half per cent, of which there is one stretch a mile and one-half long. The severest curves are one of eight degrees and one of six degrees. The present normal service is seven trains a day, making an approximate monthly car mileage of 30,000. The reasons for the change from steam to electricity are to increase the traffic by providing a better train schedule and in this way build up the local traffic and the excursion business. Through traffic between the two cities is not likely to change much, but the section through which the road runs offers many opportunities for suburban homes which are much more likely to be built if served by an electric road. It is not thought that the change will reduce the cost of operation, but profit is expected as a result of other changes. Power will probably be purchased from one of the large modern plants in Baltimore, of which there are two, both having power arrangements with the Susquehanna development. The car selected has seats for sixty-two passengers and is fifty-five feet long. The body weighs about sixteen tons. By using the multiple-unit control trains may be built up of these cars. The system decided upon is one of twenty-five-cycle, single-phase, alternating-current, which has been selected after a comparison with the 600-volt direct-current system. The author goes into considerable detail over the predetermination of the voltage drop in conductors and rails, and in the considerations which led to the selection of the motor equipment. One-hundred-horse-power motors were chosen, four of each being placed on each car. The form of this equipment is compared with that of a similar equipment of ninety-horse-power direct-current motors, and it is shown that in spite of the greater weight of the alternating-current equipment, the average energy consumption of the latter is only 3.2 kilowatt-hours per car-mile, as compared with 3.32 kilowatt-hours per car-mile for the direct-current system. The saving is due to the reduction of rheostatic losses through the use of a transformer in starting. Dr. Whitehead computes that the cost of the alternating-current equipment will be $344,300, including the overhead system, nine cars, power-house and substation apparatus. An equivalent direct-current system would cost $397,300. The cost of operating the electric system is estimated to be 28.47 cents per car-mile, an increase of 5.37 cents over the present figure for steam operation. The author concludes that from a general consideration of all the factors entering into the problem, the electrification will prove profitable.

The discussion was opened by W. I. Slichter, who pointed out the advantages of the high-potential, direct-current railway system for such conditions as those described by Mr. Whitehead. This system is being developed by the General Electric Company.

William McClellan said that in choosing a system to be adopted on any section of road, the engineer should look far enough ahead and select that system which is not merely the most suitable for the particular conditions obtaining on the first section to be electrified, but which will be the most suitable for the electrification of the entire road. We are apt to-day to overestimate the influence of local conditions and to select an equipment to meet them only, without taking into account those conditions which must be met as the electrical zone is extended further and further.

A. H. Babcock referred briefly to the conditions existing on the section of the Southern Pacific Road, the electrification of which is now being contemplated. He said that the first estimates of the cost of equipment with a direct-current system and a single-phase system agreed with one another within the liability of error, hence the selection of the system will turn upon the cost of operation and not that of equipment. He wanted to know what the engineers should recommend under such conditions if they could not obtain entirely reliable information on the costs of operating the two systems. He asked Mr. Whitehead whether the observed drop of potential in the overhead line and track agreed with those which had been calculated.

A communication from A. W. Copley was read, which gave the results of measurements of the impedance of the track return of the New Haven system. Current measurements have shown that the percentage of current returning through the rail varied from twenty-five to forty and that returning through the earth from seventy-five to sixty per cent. The rail impedance at twenty-five cycles is from two and a half to three times the rail resistance. These figures show that the track furnishes a better return for the alternating current than had been assumed when the system was laid out.

Replying to Mr. Babcock's question, Dr. Whitehead said that there had been no opportunity to check the voltage drop on the road which he had described so as to compare it with that calculated, but it had been found that the starting conditions of the cars were very good.

A paper on "Induction Motors for Multi-Speed Service, with Particular Reference to Cascade Operation" was presented by H. C. Specht. This discusses the various methods employed for varying the speed of induction motors. Each of these involves certain disadvantages which have precluded the general adoption of any one of them for all purposes. The most generally employed method is that of inserting resistance in the secondary circuit. This is open to the objection that the speed of the motor then varies with the load. For small motors this method is satisfactory, but for large motors intended to be used at two or three different speeds and giving good efficiency and good regulation it is not suitable. To meet the requirements of such cases independent motors may be used having different numbers of poles, the rotaries of which are mounted on the same shaft; or a single motor with separate windings, each of which gives a different number of poles; or a single winding may be employed, but split up so that it will give a different number of poles; or the secondary of an induction motor may be connected to a synchronous motor; or, finally, two induction motors may be connected either in direct or differential concatenation. This last arrangement gives, in general, four speeds—that of each motor used singly and that produced by each method of combining them. Equations for these combinations are then deduced and discussed and the curves illustrating them are plotted. The practical advantages of the combination are set forth, these being the fairly good efficiency and power-factor procurable, the latitude in design of the motor, the flexibility and simplicity of the speed control and the safety of operation. To illustrate the method, consider two motors, one running at 720 revolutions a minute and the other at 1,200 revolutions a minute; these two speeds are available. Direct concatenation will give 450 revolutions a minute, and differential concatenation 1,800 revolutions a minute; and, if desirable, intermediate speeds may be secured by connecting resistance across the circuit connecting the motors.

Mr. Slichter asked what is the effect upon the performance of the motor of varying the number of poles.

A. E. Averett said that when a change of speed is made by changing the number of poles, the efficiency of the motor is held up, but the power-factor goes down. One-half the problem is in the mechanical design of the motors. If a close range to the normal speed of operation is desired, concatenation works well, but for variations from the normal speeds the arrangement is not good.

A. E. Sperry asked whether the concatenated system as described made practicable the return of energy to the line.

In closing, Mr. Specht said that two motors would develop less torque than a single motor because of the double losses taking place. He then described briefly certain combinations of induction motors which had been proposed by Heyland and others, which he said were good when it was desired to start up a small input.

G. B. Werner read a paper on "The Determination of the Economic Location of Substations in Electric Railways." Of the considerations that govern the layout of the secondary distribution of electric railways, the question of economy is generally preponderant, but the theoretical economic solution may be difficult or impossible of attainment on account of certain operating considerations which may dictate a cross-section of secondary copper other than that indicated by Kelvin's law. For instance, it is necessary that the cars be able to move under the most unfavorable conditions irrespective of the question of economical drop. There may also be important commercial considerations which influence the location of a substation. The author develops an equation involving the number of substations, or the distance between substations, which will render the total annual charges on the installation a minimum. This equation is in terms of the various constants fixed by the length of line, the time-table, weight of the cars, motor characteristics, cost of energy, and equipment charges. There are a number of annual charges which are independent of the number of substations, such as those due to the trolley suspension and to the high-tension distributing system when a separate line is not run to each substation. Algebraic expressions are developed for the annual charges on substations, the annual charges on overhead copper influenced by the station location, the annual cost of substation losses and the annual cost of secondary conductor losses. The author points out that the track losses may generally be neglected because they are relatively small and, when brought in, result in an equation of the third degree. His final equation shows that for a minimum value of the annual charges the cost of copper is equal to that part of the cost of the substations which is independent of the output. The method of applying this solution is demonstrated by an example and the author concludes that his method obviates the usual necessity of solution by trial. By substituting in his equation constants already available from previous technical and commercial study of the service requirements of any road, the economical distance between adjacent substations is at once determined.

S. B. Fortenbaugh read a paper entitled "Conductor Rail Measurements," which consisted of a discussion of measurements of rail insulation which have been made on the Metropolitan District Railway and the Baker Street & Waterloo Railway, both of London. There are fifty-six miles of main-line double track and three deep level "tube" railways, aggregating about twenty-eight miles of double track. Third and fourth conductor rails were installed on the above lines, supported on brown stoneware insulators. In 1905 considerable trouble was experienced in maintaining the insulation resistance of the negative conductor rail, so that an extended investigation was undertaken to account for the trouble. The results obtained were rather erratic. While the voltage between the positive rail and the ground remained approximately 500, that between the negative and the ground was seldom as high as 100, and at times was as low as forty or fifty. Reversing the polarity of the two rails reversed the phenomenon after forty-eight hours; bringing the negative conductor again nearly to the potential of the earth brought back the original condition. The following conclusions are drawn: The difference of potential between the positive conductor and earth is normally considerably greater than the potential existing between the negative conductor and earth. This difference is the more marked the longer the conductors are subjected continuously to a difference of potential in the same direction, and reversal of the polarity is instantly accompanied by a considerable increase in the normal leakage current between the positive and negative conductors. The insulation of the negative conductor to earth can not be proportionately maintained. It is suggested that these results depend upon the phenomena long known in connection with static charges; that is to say, that a negative charge leaks away much more quickly than does a positive charge. A negatively electrified conductor appears to be discharging negative ions, which have the effect of conferring conductivity on the surrounding gas and causing deposition of moisture from air more or less saturated. It seems probable that this same action might render the insulators of the negative rail more or less conductive, due possibly to a film of liquid which gradually spreads out from the conductor over the surface of the insulator. It is possible, also, that the reducing chemical action of the ions may result in the formation of compounds which actually lower the resistance of the negative insulator.

C. J. Hopkins, in opening the discussion, questioned the usefulness of Mr. Werner's formula for the location of substations. He said that too many assumptions must be made when applying it, and, after all, local conditions which can not be allowed for are most likely to settle the question. The problem is thus a practical one, and can hardly be helped by such analytical studies.

Mr. Werner said that he realized fully the difficulties of applying analytical solutions to such problems, but the ordinary method of trial and failure is so laborious that any means of lightening it should be acceptable. Of course, in the actual application of his method, local considerations are very likely to shift the location somewhat.

P. M. Lincoln said that when such a solution as proposed by Mr. Werner was employed, the final location must be adjusted afterward so as to fit all conditions.

P. H. Thomas said that although the method might not give the final solution for all conditions, it is a good plan to make some such general analysis of these complex problems.

(To be concluded.)

Electricity in Churches.

The use of electricity in churches is not large, it is not continuous, so that it would not be feasible to install an isolated plant. To take advantage of the convenience of electricity, however, many churches have been wired for electric current. The main consumption of electricity in churches takes place on Sundays and holidays only. Since they have no plant of their own they are obliged to draw on the local plants for supply. The greater bulk is used for lighting purposes, the remaining portion being used to operate fans, ventilating systems, chime mechanism and for supplying the organ with air.

The accompanying illustrations show what has been done in the harmonious design of candelabra, clusters and brackets. Although not originally designed for electricity, the old-style gas fixtures can be modified for the use of the electric current. It will be noticed in Fig. 1, showing the interior of Cross Church, Dresden, that all the candelabra were originally designed for gas, but have been fitted with electric fixtures. In Fig. 2 is shown the interior of St. Juergens Church, in Kiel, demonstrating the application of tantalum lamps. Owing to the characteristics of this lamp, the individual lamps have been placed farther apart; little use is made of larger clusters. The application of group lighting, such as candelabra, is shown in Fig. 3.

FIG. 1.—INTERIOR OF CROSS CHURCH, DRESDEN, GERMANY.

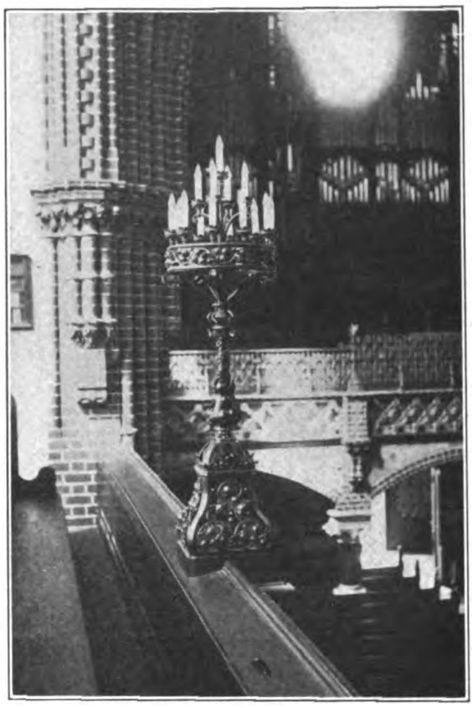


FIG. 3.—INCANDESCENT LIGHTING ADAPTED TO CANDELABRA.

In connection with the lighting of a church it is essential that the wires be concealed and run in approved duct. In the above-mentioned churches the Peschel system of conduit, as used by the Siemen-Schuckert Company, is installed.

FIG. 2.—INTERIOR OF ST. JUERGENS CHURCH, KIEL, GERMANY.

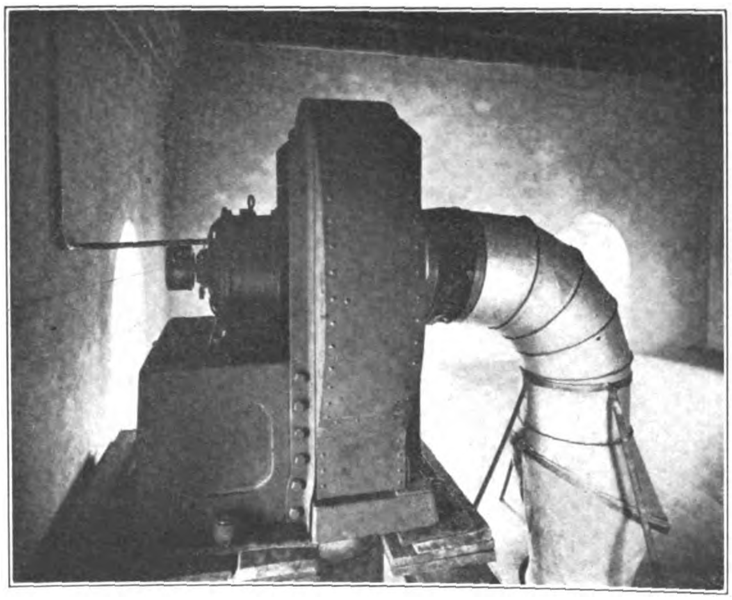


FIG. 4.—MOTOR-DRIVEN FAN FOR SUPPLYING AIR TO ORGAN IN CHURCH AT POTSDAM, GERMANY.

In Figs. 4 and 5 is illustrated the application of the electric current to an organ. Fig. 4 shows the motor-operated fan. The motor is of five horse-power, making 1,400 revolutions per minute. It will readily be noticed that the fan can be placed in any available space. The rheostat for operating the motor is placed conveniently near the organist's stool.

FIG. 5.—RHEOSTAT AT SIDE OF KEYBOARD OF ORGAN IN A CHURCH AT KIEL, GERMANY.

In Fig. 6 is given an excellent illustration of the application of an electric motor. As shown, a six-horse-power motor drives the chime-ringing device of a church in Potsdam, Germany.

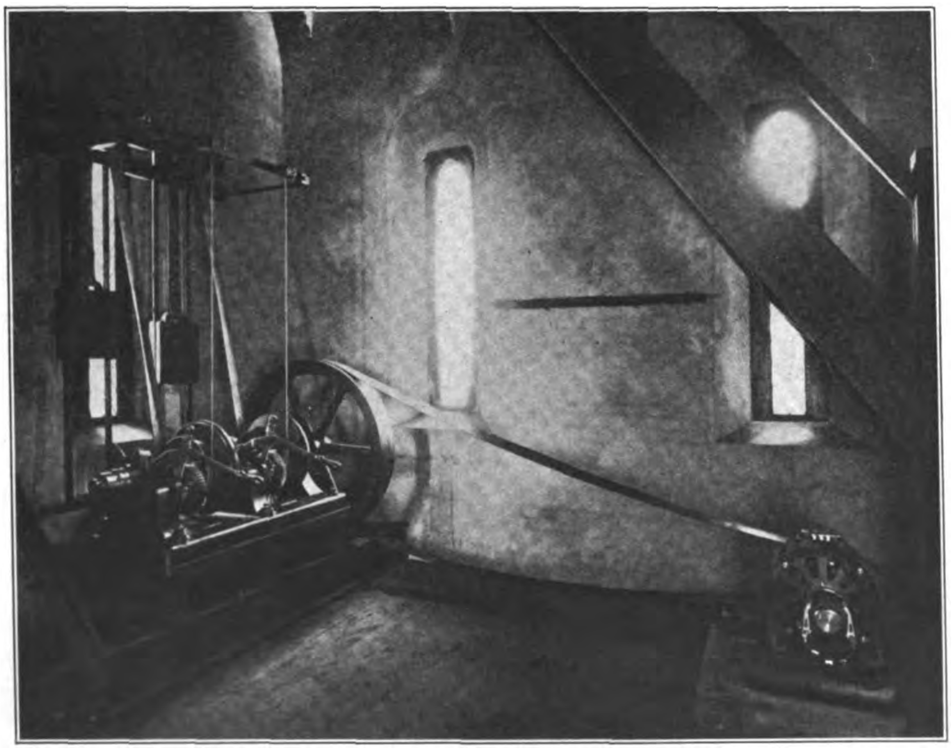


FIG 6.—MOTOR-DRIVEN CHIME-RINGING DEVICE IN A CHURCH AT POTSDAM, GERMANY.

Another very ingenious application of electric motors is their use in winding up the weights of tower clocks; motors of one-tenth horse-power being of sufficient size for the purpose.

The Faraday Society.

The thirty-seventh ordinary meeting of the Faraday Society was held on Tuesday, June 9, at the Institution of Electrical Engineers, 92 Victoria street, London, England, Dr. F. Mollwo Perkin, treasurer, in the chair.

Dr. Albert Frank read a paper, "On the Utilization of Atmospheric Nitrogen in the Production of Calcium Cyanamide, and Its Use in Agriculture and Chemistry."

The practical manufacture of calcium carbide in the electric furnace in 1894 by Willson and Moissan furnished Professor Frank and Dr. Caro with the ideal base required for fixing atmospheric nitrogen in the place of the metallic base which they had previously used (barium) in their experimental search for a commercial method of producing cyanide of potassium for the recovery of gold in mining. As a result of these researches the Cyanid Gesellschaft was founded, which has supplied such a large proportion of the cyanides used in gold extraction in South Africa, Australia and the United States. They also led to the production of calcium cyanamide (nitrolim), a genuine substitute for sulphate of ammonia and nitrate of soda for all agricultural purposes, and which can be produced in unlimited quantities wherever limestone, coal and air are available, containing up to twenty-eight per cent of nitrogen.

The only other practical method of fixing atmospheric nitrogen which has been perfected of recent years for similar uses to calcium cyanamide, is known as lime saltpetre, and has been invented by Professor Birkeland, of Christiania, but this process, though successful from the scientific point of view, requires considerably more expenditure of power than the Frank-Caro process, and the product possesses, for agricultural purposes, several drawbacks which calcium cyanamide does not. The latter has been so long and extensively tried by agricultural experts all over the world that its behavior is no longer doubtful. It can replace for all purposes sulphate of ammonia and for most purposes nitrate of soda, with the added advantage which neither of the others possesses of being alkaline instead of acid. It does not require any greater precautions in application than the other nitrogenous manures, and can with certain precautions become a useful constituent of mixed or complete manures, as has been determined by Dr. Hall's Rothamstead investigations. It is not so subject to being washed out of the upper soil by heavy rains as either of its predecessors and its effect is more persistent. The lecturer illustrated this part of his lecture with lantern slides of the relative results of the nitrogenous manures, including cyanamide, on a variety of crops—wheat, barley, oats, mangels, beets, etc., all showing at least equality with the older and better known manures.

Calcium cyanamide by melting with certain fluxes yields pure cyanide of potassium or sodium, and in the form of "surrogate," which can readily be produced near most gold mines, is an efficient substitute for cyanide in the recovery of the precious metals. Ammonia can also be readily and inexpensively obtained from it. Concentrated into dicyandiamide, it is in increasing demand for the manufacture of organic dyes, and its future as a "deterrent" in the form of salts of guanadine to reduce the temperature of explosion in high explosives and prolong commensurately the life of the inner tube of big guns, is assured; it also does away with the flash accompanying explosion as well as with smoke. Mixed as a powder with other ingredients, calcium cyanamide tempers, hardens and cements steel in the most efficient way.

The author then proceeded to describe the practical features of the manufacture of nitrolim. The carbide is first ground to powder in air-tight mills, filled into furnaces which are kept full of nitrogen, and raised to and maintained at a temperature of 800 degrees to 1,000 degrees centigrade for several hours, then allowed to cool slowly, and finally reground into a fine slate-black powder, which is sent out to the farmer in paper-lined bags, containing from fifty-seven to sixty-three per cent of pure cyanamide, or twenty to twenty-two per cent of nitrogen, with about twenty per cent quicklime, fourteen per cent of carbon, and seven to eight per cent of silex iron oxide and alumina. To replace the present consumption of Chili nitrate by calcium cyanamide would require something like 800,000 horse-power, and works are springing up all over the world to produce it wherever water power is abundant and cheap. The first works established for producing and selling 3,000 to 4,000 tons a year, working for the last three years, were in Italy, at Piano d'Orte (Abruzzi), and are now being enlarged for an output of 10,000 tons. Another works is just being erected at San Marcel (Val d'Aosta) for another 4,000 tons, and the great Terni Carbide Works are laying themselves out for the production of some 10,000 tons in the near future. Dalmatia has followed the Italian example at Sebenico, at Fiume (each for an initial 4,000 tons), and at Almissa, where 50,000 horse-power is available, and a further 10,000 tons output is being planned, all the product being required in the Balkans, Hungary and the Mediterranean coast of Africa, and Egypt.

France already possesses two works for an initial output of 4,000 tons; Switzerland, one for 3,750 tons; Germany, three works with an initial output of 12,500 tons, and one in prospect in the Bavarian Alps for 15,000 tons. The United States Cyanamide Company is erecting a 5,000 to 6,000-ton works at Ontario, in Canada, to begin with, and another to follow in Tennessee of much larger proportions. The central provinces of India are to be supplied from works on the Nerbuddah River, while the Japanese are erecting a works at the southern end of Kuiskzu Island for an initial 4,000 tons. The largest works, however, are due to British enterprise and have just been completed at Odda, in Norway, for an initial output of 12,500 tons, with facilities for a prospective increase to 50,000. At the Odda works the largest Linde plant for obtaining nitrogen from the air ever designed has been erected. These works are supplied with carbide from the adjacent works of the well-known Alby United Carbide Factories Company, with an initial capacity of 34,000 tons, which can be readily expanded to four times that amount by calling further on the available water power at command, up to 80,000 horse-power. Slides illustrating the features of the several works mentioned were thrown on to the screen.

The author concluded by stating that by the end of the present year works for the production of 45,000 tons of nitrolim would be in full swing, but this would not sensibly affect the market for sulphate ammonia and nitrate of soda as the demand for nitrogenous manures and products was increasing so rapidly, by over 15,000 tons of nitrogen a year in Germany alone. Both agriculture and the arts and industries seemed capable of absorbing untold quantities of nitrogen in ever-increasing amounts and there were no signs of surfeit.

Henry Cottrell pointed out that a great advantage of these artificial nitrogenous manures is that they are all alkaline, whereas the native nitrates are acid and produce in time sickness in the soil. It was difficult to persuade the farmer, however, to use new manures.

Walter Reid, referring to some tests he had made on calcium cyanamide, drew attention to the moisture in the soil as having considerable effect on the results of such tests. With regard to the use of calcium cyanamide in smokeless powder, he had found it rather too efficient in slowing the explosion.

Dr. H. Borns hoped the author would furnish some fuller details regarding the efficiency and construction of the electric furnaces in which combination of nitrogen with carbide took place.

Dr. J. H. Voelcker said farmers could not be expected to use new manures until they were perfectly satisfied as to their cost and effect. There were, for example, at present certain disadvantages connected with the use of nitrolim which would have to be eliminated before it could become entirely satisfactory. Beyond that the situation was determined entirely by price.

W. Murray Morrison asked whether the cyanamide could not be made direct from limestone and coal in one operation.

J. L. F. Vogel asked what fear there was of a charge of carbide not being completely nitrated.

The chairman drew attention to the use of cyanamide in synthesis, and hoped that some of the very interesting and important compounds that could be made from it would be manufactured in this country.

Dr. Frank replied to the points raised by the various speakers. Cyanamide was ten per cent cheaper than ammonium sulphate. Its stability was good; although the lime absorbed moisture, there was no loss of nitrogen. Up to the present its manufacture in one operation had not proved successful.

At the meeting of the society held on June 23 a paper was read by J. Härdén entitled "Recent Developments of the Kjellin and Röchling-Rodenhauser Electric Induction Furnaces." Adolphe Jouve communicated a paper entitled "New Applications of Electrometallurgical Alloys."

The following officers were elected to serve for the ensuing year:

President, Sir Oliver Lodge.

Vice-presidents, G. T. Beilby, R. A. Hadfield, Professor W. Hittorf, Professor A. K. Huntington, Lord Rayleigh, Professor A. Schuster, Professor J. J. Thomson.

Treasurer, F. Mollwo Perkin.

Council, Bertram Blount, A. C. Claudet, S. Z. de Ferranti, F. W. Harbord, R. S. Hutton, T. M. Lowry, H. F. K. Picard, James Swinburne, J. F. L. Vogel, N. T. M. Wilsmore.

New British Patent Law.

The representations made by the United States and Germany asking an extension of the time limit beyond August 28, when the new British patent law is to go into effect, have proved unavailing. This law provides that foreigners who obtain British patents must manufacture the patented goods on British soil. President of the Board of Trade Churchill definitely informed the House of Commons on July 2 in this connection that the government had no intention of proposing fresh legislation to modify the sections of this law to which foreign patentees have taken objection.

The Use of Automobile Trucks by the Pennsylvania Railroad Company.

The Pennsylvania Railroad Company, as an experiment, has introduced the use of automobiles to expedite the handling of freight between stations in large cities. Such a service has been started between Kensington and Shackamaxon stations in Philedalphia, Pa., and if it is a success it is planned to try the same experiment in other large terminal cities, such as Pittsburg and Baltimore.

The automobile truck which the Pennsylvania Railroad is using in Philadelphia has saved between six and twelve hours in the handling of package freight between the stations named. This freight automobile has a capacity of five tons and is driven by a six-horse-power electric motor. It averages about seven and one-half trips a day, carrying 2.2 tons per trip; its daily mileage averaging about eight miles.

Previous to the introduction of the automobile in the Kensington district, small lots of freight were sent from station to station in cars. With the automobile service congestions are relieved and the movement of freight by a direct route instead of a circuitous one saves both time in delivery and the use of freight cars.

The Pennsylvania Railroad is also bringing the automobile into use in its passenger service. In Jersey City an innovation is the introduction of large automobile trucks in the baggage service. These trucks are about the size of a three-horse wagon and are so built that, when loaded, the floor of a truck is on a level with and flush against that of a baggage car.

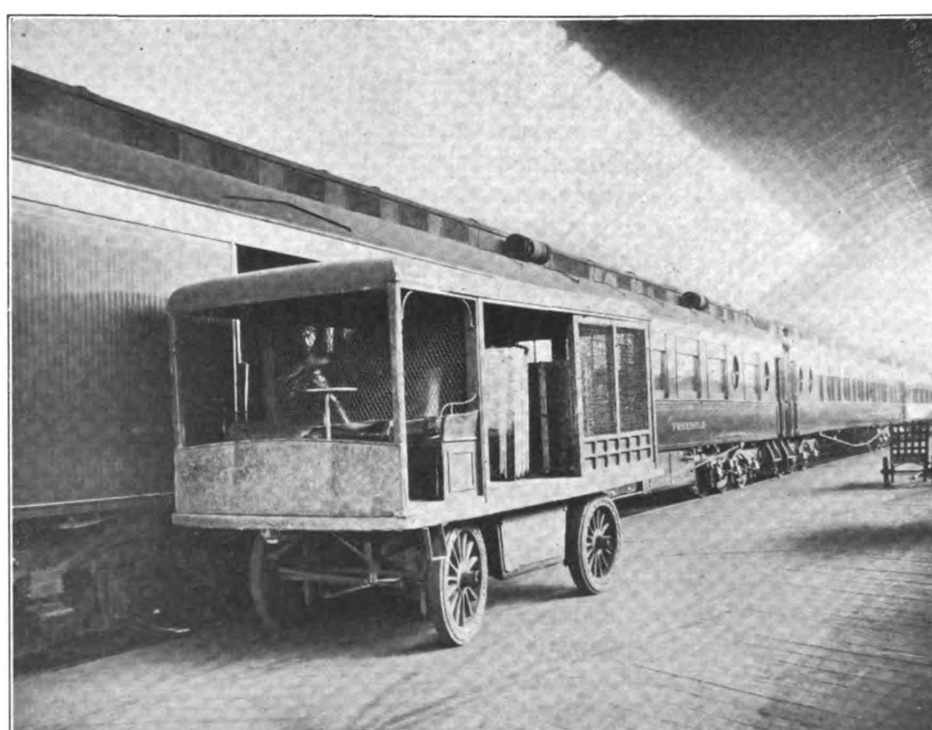
Many hard knocks are in this way saved to every trunk handled through the Jersey City station. In moving a trunk from the car to the truck it receives about the same handling it would get in being shifted about inside the same car. This is but one of the trunk-protective features of the trucks. Another is that they are enclosed entirely with a wire grating and leather top, preventing any scraping or falling in the trip across the river.

The service to which the new trucks are being put entails through trips between the baggage cars and the Twenty-third street station, in New York. They are loaded to their full capacity and are raised and lowered between the ferry level on elevators. The electric power does away with the manual labor formerly necessary to push loaded trucks up the heavy grades at the approach to the ferries, at certain stages of the tide.

The truck is about fifteen feet long and five feet wide, with a seat in front for the driver. Its height of about nine feet is necessary that the floor of the truck may meet the baggage-car floor on a level.

So satisfactory have these automobiles proved in the baggage and mail service that there are now being built a number of small electric trucks for use in the new terminal station in Washington, D. C. These will be similar to the trucks now used in Broad street station, though they will embody improvements which are expected to overcome the slight difficulties experienced with the first automobile trucks that were placed in service.

Automobile Freight Truck Used for Hauling Freight Between Local Freight Stations of the Pennsylvania Railroad in Philadelphia, Pa.



Large Automobile Truck Used by the Pennsylvania Railroad in Transferring Baggage from Cars in the Jersey City Terminal to New York City.

A DIRECTIVE SYSTEM OF WIRELESS TELEGRAPHY.

To the Editor of the Electrical Review:

In your issue of May 9, Mr. O. C. Roos reviews the two articles describing the system of directive wireless telegraphy published by us in *Electrical Engineering* (November 14, 1907 and March 5, 1908).

Mr. Roos characterizes our account as being "interesting, but in some respects indefinite"; that is to say, that our explanation lacked clearness in certain parts, as would also appear from the observations made by Mr. Roos.

We intend now to clear up certain obscure points. The diagrams of the energy emitted or received by an aerial of our system were obtained by the employment of the thermogalvanometer, which responds to the whole of the energy received and not to the maximum amplitude of the oscillations; and only in applying the detectors generally employed (electrolytic, magnetic, coherer, etc.) to our system were we obliged to make reservations as to the diagrams to be considered in the different cases in relation to the special manner in which these detectors operate.

In the description of the transmitting radiogoniometer we said that the primary winding induces in the two aerial circuits currents whose intensity and phase vary with the orientation of the said winding.

To make this point more clear, which we evidently did not sufficiently explain previously, let us consider the case of a single secondary winding connected to a single *closed oscillatory circuit* forming the aerial. When the plane of the primary winding coincides with that of the secondary, the current induced has its maximum value. On turning the primary bobbin through 180 degrees, the current in the aerial will have the same value as before, that is to say, will be a maximum, but its phase will be altered by half a period with reference to the phase of the former current. In other words, when one causes the movable coil to pass from one side to the other of the axis of the fixed winding, the phase of the current changes by a half period while at the same time its intensity passes through zero.

For the radiogoniometer with two secondary windings the phenomena are the same. No special relation exists between the length of wave used and the dimensions of the aerials, for obtaining the phase difference. The radiation from a closed oscillatory circuit is due to the electric field of dispersion, the lines of force from which extend from the armatures of the condenser to the earth's surface; and since at the same instant these lines of force are on the one side of the opposite sign to those on the other side, it follows that the phase of the magnetic field in the one sense differs by one half period from the field in the opposite sense.

When the aerial is formed of two vertical closed oscillatory circuits mutually perpendicular, the space can be regarded as being divided up into four quadrants. The partial fields set up by the two circuits will be in phase in two opposite quadrants and in consequence they add themselves; in the two remaining quadrants they will be opposite in phase and hence they are to be subtracted. If one varies the phase in one of the aerial circuits by one half period, by suitably turning the movable winding, in the two quadrants where previously the fields were in phase they will now be in opposition of phase, and *vice versa;* the direction of the maximum radiation will have passed from one pair to the other pair of quadrants.

Mr. Roos asks with what exactitude the determination of azimuths can be effected with our system when the station is encircled by disturbing influences such as adjacent buildings, ships and other stations, and what accuracy we obtained in our determinations of the bearings of the Channel stations.

To this we can reply that every time it was possible to take a sufficient number of observations of the bearing of known transmitter stations the approximation was always close to about one degree; and in the most unfavorable case, where the signals lasted only a few seconds, it was easy to get within five degrees. In the extreme case, where a station might be so surrounded by buildings that the waves arrived distorted or deviated, it would be possible to find empirically the relation connecting the true bearing with the apparent bearing as given by the radiogoniometer.

As regards the disturbing effects of other transmissions, the only station which affected the directive reception at Havre was the station at Dieppe belonging to the Western Railway of France, which is situated in the same plane with reference to Havre as our own station at Dieppe; and the wave-length employed at this station is nearly the same as at our station, while the energy employed and the damping are both very much greater. Other disturbances arose from the signals from ships inside the harbor at Havre at a distance of only a few hundred metres from our station.

The coupling between the aerials and the exciting circuits has always been loose, which is an inherent condition with closed oscillatory circuits having too great a self-inductance to permit of close coupling being employed.

E. Bellini and A. Tosi.

[The foregoing letter from Messrs. Bellini and Tosi was translated by L. H. Walter, who translated for *Electrical Engineering* the two articles above referred to, and upon which the criticism from Mr. Roos was based.]

Electricity in the Mines and Reduction Works of the Anaconda Copper Mining Company.

In the issue of the *Mining and Scientific Press* of June 27, a very interesting report of the operation of the mines and reduction works of the Anaconda Copper Mining Company is given. Electric locomotives have been installed on several important levels of the Anaconda group and are giving satisfactory results in efficiency and cost of haulage. The new compressor building erected at the Diamond mine contains four electrically driven compressors with a total capacity of 16,000 cubic feet. These are all fitted with steam cylinders for use in case of failure of the electric current. Four new 600-horsepower, alternating-current electric motors and two circulating pumps and four five-ton traveling cranes have been installed.

The Never Sweat compressor plant now consists of five compressors with a capacity of 32,000 cubic feet of air per minute, two of the largest being electrically driven.

Since February, 1907, electric power has been used at the concentrator and in other departments of the works. This power has been found efficient and the cost much below that of steam for the same work. A large part of the electric power furnished at the works is brought from the Missouri River, but during the year the Flint Creek water power and electric light plant has been furnishing a considerable amount of current.

The Washoe company installed in its substation at the works three 400-kilowatt transformers, one voltage regulator for the city lighting system, and additional switchboard capacity for the new blast-furnace blower-house. In the smelter power-house there have been installed one 600-horse-power motor, one 750-horse-power motor for blowing engines, and one 600-horse-power motor for an air compressor. An entirely new blower building has been erected, with a fifteen-ton crane for handling machinery, four 600-horse-power motors, and four blowers, each of 36,000 cubic feet of air per minute capacity.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Influence of Humidity Upon the Electrical Discharge from Points in Air.

An investigation of the effect of moisture upon the electrical discharge points in air has been made by John Zeleny. It is of some importance to establish the magnitude of this effect so that the results of experiments performed on different days in the open air may be directly compared, and so that laboratory results for dry air may be applied to such cases as the discharge from points of lightning conductors or the discharge from high-potential wires. The experiments were designed to determine the influence of humidity upon both the voltage required to start a discharge and the magnitude of the potentials required to produce different currents. The apparatus consisted of a brass wire about a quarter of a millimetre in diameter and four centimetres long. The end was rounded and placed at a distance of one and one-half centimetres from a brass disc seven and one-half centimetres in diameter. The two were enclosed in a brass cylindrical vessel fifteen centimetres high and thirteen centimetres in diameter. The disc was connected to earth through a galvanometer and a telephone, and the point could be maintained at any desired potential by means of a small Wimshurst machine. Air was passed through the apparatus and then through a gas meter. The amount of water contained was determined by measuring the absorption in calcium chloride tubes. The experiments were conducted at various temperatures, and the first important fact noticed was that the effect of water vapor depends upon the absolute water content of the air, and not on its relative humidity. Evidence on this point was obtained by observing the discharge with dry air and then air saturated with water vapor at three degrees centigrade. It was found that the ratio of potential required to obtain a given current in air at this low temperature was smaller than when the air was at the ordinary room temperature, and this ratio for the cold air corresponded in both discharges to that obtained for warm air having equal water content. Two sets of curves are given, the first showing the influence of humidity upon the positive discharge in air. The curve showing the point at which the positive discharge begins is nearly horizontal, the amount of water vapor having but little effect, though apparently with a tendency to diminish the critical potential. The other curves, which show the potential required to maintain different values of current, show that this increases with the humidity of the air, and the increase is somewhat more rapid for the dryer air. From these curves it is possible to plot a second set showing how the current produced by a given potential changes with the amount of water vapor present. The curves showing the effect of humidity upon the negative discharge in air are somewhat more erratic than those for the positive discharge. That showing the potential at which the discharge begins lies below that for the positive critical value, as do all the curves for corresponding currents. The form of these curves corresponds, however, to those for the positive discharge, and the potential required to produce a given current increases with the amount of water vapor in the air, the change being more rapid when the amount of water present is small. The total increase from dry air to saturated air is about sixteen per cent.—*Abstracted from the Physical Review (Lancaster), June.*

The Design of a Continuously Adjustable Resistance.

A certain investigation making necessary a resistance which would vary continuously the current through a coil from a maximum value in one direction to a corresponding value in the other, a study of the problem thus presented was made by J. T. Morris, R. M. Ellis and F. Strude. The results of their investigation are given here. A liquid resistance was first tried, and the type first experimented with consisted of a cast-iron tank containing a soda solution, into which an electrode could be gradually lowered, finally short-circuiting the whole of the resistance. As the short-circuiting occasioned an abrupt change in the current, it became necessary to work with a lower resistance of the electrolyte. This could not be accomplished sufficiently well by the use of soda nor by copper sulphate; consequently, dilute sulphuric acid was tried. A direct consequence of the decrease of resistance now became apparent in an abrupt change of the current immediately the electrode entered the liquid. This effect might have been diminished by using an electrode with a finer point, but the method was abandoned because it permitted a variation in current from the maximum value to zero only, and it was desired to obtain a complete reversal in one operation. For this purpose a liquid resistance was tried. This was in the form of a trough with current passing continuously through it. By means of two movable lead electrodes attached to a shifting belt, so that they would travel simultaneously, a continuous variation in current from the maximum positive to the maximum negative value was obtained; but there was difficulty in obtaining sufficiently large final values with a soda solution, so that sulphuric acid was substituted. The latter, however, gave rise to polarization, causing an abrupt reversal of the current as the electrodes passed one another. A better arrangement was obtained by using two large water resistances, but the device was neither portable nor efficient. An attempt was then made to substitute resistances built up of carbon plates, which could be pressed together more or less firmly. Two such resistances were used, each divided into two portions by insulating plates connected in a way similar to the arms of a Wheatstone bridge. This method was inefficient, and the resistance of the arrangement was uncertain, unless the plates were pressed firmly together. Next a similar arrangement built up of wire was tried, the wire in the first design being wound on a piece of slate. Contact was made by means of two sliders to reverse the screws rotated by a common hand wheel. This arrangement was satisfactory for currents not greater than one ampere, but when larger currents were employed, the adjustment, as the sliders approached one another, became less and less continuous. The arrangement was rather bulky and noisy in operation. It was therefore discarded for a resistance consisting of a single strip of metal folded up in zigzag form, the alternate portions being insulated from one another by mica. The strip was one and one-quarter inches wide and 0.005 inch thick. The total number of folds was

2,000, and two sliders were provided, which are traversed over the same side of the resistance by means of screws. This arrangement answered the purpose admirably. The only objection to it is the time required to shift the sliders so as to produce considerable variations in the current. There is one defect of little importance, which is the slight break in the continuity of changes produced by the short-circuiting of adjacent layers of the resistance by the two brushes as they pass. —*Abstracted from the Electrician (London), June* 26.

Converting Hand-Blown Organs.

Several simple methods of adapting an electric motor to driving hand-blown organs are here described by J. W. Barr. All of these methods have been actually applied by the author. Where a rocking lever is still retained the problem is somewhat troublesome and generally necessitates the installation of a crank-shaft. In one case an organ which required the services of three men was converted to the electric drive by connecting three rocking shafts to a crank-shaft having three cranks, and on which was a thirty-six-inch pulley which was belted to the motor pulley. To control the motor a liquid resistance was placed in the armature circuit, and the electrode suspended from a cord attached to the wind chest. As the latter rises as it is filled with air, the electrode is gradually lifted out, decreasing the speed of the motor. At first there was some difficulty due to pulsations of the motor as the circuit was made and broken when the amount of air drawn from the wind chest was small. In this organ there were two wind chests for furnishing air at different pressures. By connecting the regulator to both chests the operation became smooth. The crank-shaft was driven at thirty-two revolutions a minute. The motor required five amperes at eighty volts. About 350 watts were dissipated in the liquid resistance. The motor pulley was about six inches in diameter, and the speed, when reduced by the resistance, was 200 revolutions a minute. This motor runs within four feet of the organist's seat, and the regulator is placed just back of the organ. The operation is entirely noiseless, and all that is required to maintain the system in good condition is an addition of soda solution once a week to make up for evaporation. Blowing this organ by hand cost $50 a year. To drive it electrically costs about $1.10 a month, with energy at four cents a kilowatt-hour. A second organ which the author transformed to the electric drive had but a single wind chest. The hand-blowing arrangement was a thirty-inch wheel fitted with a handle rotating a three-throw crank-shaft. A leather belt was placed over this wheel and over a motor pulley, and a liquid resistance installed, as in the first case, although here the electrode was counterbalanced so that in case the controlling string should break, the motor circuit would be opened. The author does not think that the induction motor can be used as satisfactorily for organ blowing on account of the disagreeable magnetic hum. He, however, installed a single-phase, five-horse-power induction motor for operating a large organ, belting the motor to the crank-shaft as in the cases just described. In this case it is necessary to install a belt-shifting device for throwing the load off and on the motor, and a damper in the feeder to the wind chest which controls the amount of air supplied to the latter. The running performance was not altogether satisfactory.—*Abstracted from the Electrical Review (London), June* 26.

The Electric Train-Lighting System of the Gesellschaft für Zugbeleuchtung.

The system of train lighting here described is being introduced in Germany, and makes use of the Rosenberg dynamo. This machine, it will be remembered, delivers a fairly constant current independently of the speed at which it is driven. The regulation is secured by short-circuiting the usual brushes and by placing a pair of secondary brushes midway under the poles. The latter brushes furnish the series exciting current, and the charging current for the batteries. The armature reaction produced by the currents flowing through the short-circuited connection not only maintains the output current constant, but maintains unchanged its direction when the direction of rotation is changed. When this system is employed a number of auxiliary devices are necessary, and these are described here in some detail. Two types of generator are constructed, one intended to be placed in the baggage car, where it is more or less under control of the train attendants, and the other for suspension under the cars. The dynamos are completely encased, as is also the driving belt, which is provided with a stretcher. Roller bearings are used, which require but slight attention. There are two methods of applying the system, one employing two batteries which are alternately charged and used, and the other, which is less expensive, uses but a single battery. In the latter case automatic means must be provided for preventing the battery when charged from discharging through the generator. On the Prussian State Railways movable switches are prohibited. In their place an electrolytic valve cell is used. There are two electrodes, consisting, respectively, of aluminum and iron, placed in a solution of ammonium borate. In operation the solution liberates ammonia, which is undesirable, but sodium and potassium can not be used. It is necessary to have the aluminum electrode completely covered by the electrolyte. A rubber-covered lead is attached to it, the lug itself being covered with rubber and vulcanized on the plate. These plates must be formed before assembling, which is done by thoroughly cleaning them and then maintaining them subjected to a potential for several days while in the borate solution. The cells are intended to resist potentials of forty volts. Some of them have been in use for six years without giving trouble. To regulate the potential at the lamps fine iron wire resistances similar to the Potter ballast employed in the Nernst lamp are used. The company has also developed automatic switches, which are installed when preferred to the electrolytic valve. When the latter is used it is necessary to replenish the electrolyte every four days or so in summer, and in winter about every ten days. A fifty-ampere cell weighs complete about eighty-eight pounds.—*Abstracted from Engineering (London), June* 26.

Municipal Lighting at Manchester, England.

The report of the Electricity Committee of Manchester, England, for the year ended March 31 states that on the year's working there was a net surplus of $97,715, of which $9,965 has been appropriated for extension of works (for which borrowing powers can not be obtained), $50,000 has been paid to the city fund in aid of rates, and the balance, $37,725, has been carried to the reserve fund. The total income was $1,923,010. The working expenditure absorbed $1,096,790, and the balance was $826,220. The reserve fund now stands at $69,270. The capital outlay up to the end of the year amounted to $12,212,995. At the end of December prices of current for lighting purposes were reduced from nine cents to 7.25 cents per unit to consumers on the flat rate. To long-hour consumers the reduction was from $35 per kilowatt of maximum demand and 3.5 cents per unit to $35 per kilowatt of maximum demand and three cents per unit.

The total output of electricity from the three generating stations during the twelve months amounted to 82,752,989 units, as compared with 63,056,914 units of the previous year, an increase of 31.24 per cent. The total mileage of main conductors laid on March 1, 1908, equals 338 miles 1,084 yards, being sixteen miles 1,001 yards more than on March 31, 1907.

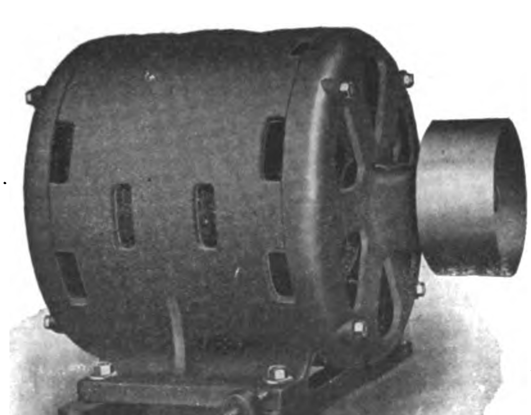
INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

IN the last issue of the ELECTRICAL REVIEW considerable space was given to descriptions and illustrations of electrical apparatus which entered largely into the work of the electrical contractor. The apparatus described and illustrated in the following pages is also of especial interest to the contractor and in many instances is shown for the first time.

The Richmond Electric Company's Polyphase Induction Motor.

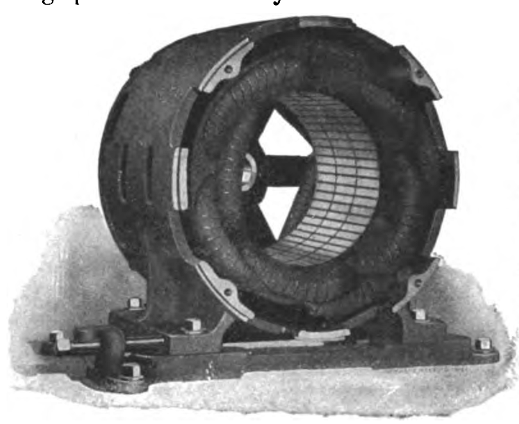
The Richmond Electric Company, Richmond, Va., has placed on the market a polyphase induction motor, illustrations of which are shown herewith. Great care has been taken to make these motors compact, light, free from vibration, and at the same time having the highest possible efficiency and power-factor. The company is now manufacturing these machines of the squirrel-cage type in sizes from one-quarter to fifty horse-power. The stator frames are of cast iron in one piece. The feet are broad, and the entire frame construction is such that there can be no possible springing, and a rigid support for the laminations is secured.



RICHMOND POLYPHASE INDUCTION MOTOR.

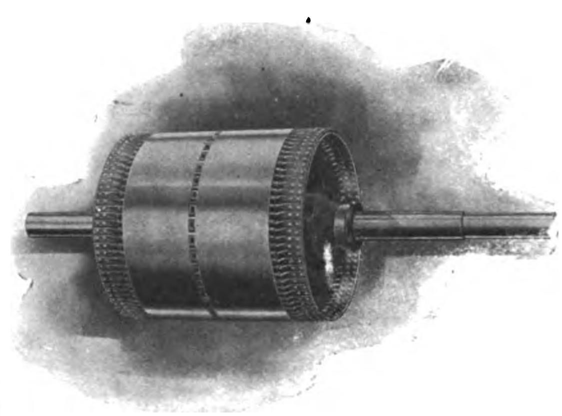
The stator windings are liberally designed for carrying capacity, and sufficient insulation has been used to withstand severe service and avoid breakdowns.

The rotor is built up of thin discs of sheet steel, clamped under hydraulic pressure. These rotors are of the squirrel-cage type, the heavy insulated copper bars being placed in entirely closed slots and



STATOR OF RICHMOND POLYPHASE INDUCTON MOTOR.

riveted to resistance rings at each end. Before winding, the outside diameter of



ROTOR OF THE RICHMOND POLYPHASE INDUCTION MOTOR.

the rotor and the inside diameter of the stator are ground to exact diameters, presenting a bright, smooth surface and insuring an absolutely accurate air-gap.

A special starting winding is placed in the stator slots of these machines. This winding, at the time of starting, is thrown in series with the running coils, and after the machine has been brought up to speed these coils are cut out of circuit with a double-throw switch provided by the company.

Machines smaller than seven and one-half horse-power are not usually furnished with starting coils, but are thrown directly upon the line with an ordinary single-throw switch.

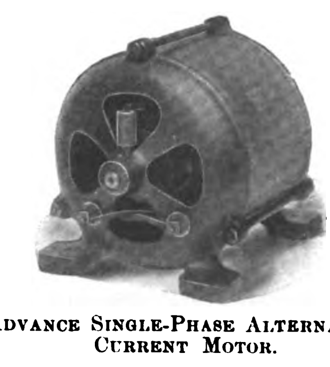
The Advance Electric Company's Single-Phase, Alternating-Current Motor.

The accompanying illustration shows the one-quarter-horse-power, single-phase, alternating-current motor placed on the market by the Advance Electric Company, St. Louis, Mo. This is an induction motor with the field of the usual construction, slotted, laminated and coil-wound, and connected directly to the supply circuit. The induced currents in the armature are carried by two sets of conductors. One set, near the surface of the core, is an insulated winding connected to a commutator which is short-circuited through a set of brushes; and the other set is deep down in the core and consists of copper bars extending through a circle of holes and securely connected to the conducting flanges connecting the armature discs.

The mechanical construction follows the best modern practice, with large steel shafts and ample bronze bearings. The lubrication on the smaller sizes is by grease cups, and on the larger sizes by oil chambers and oil rings.

The motors may be arranged for wall or ceiling suspension, and can be supplied at extra cost with enclosing covers, special shafts, back gears or idler pulleys. The motor is started by simply closing the switch, and may be stopped or started from any distance.

The motor is reversed from the outside without changing connections, by loosen-

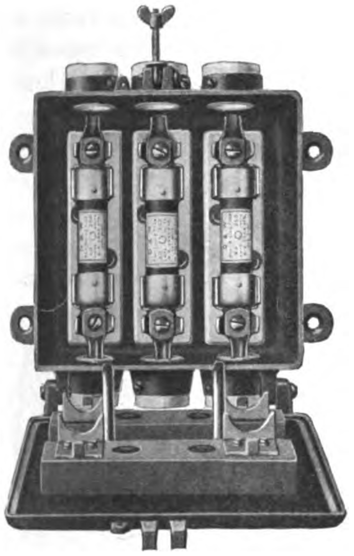


ADVANCE SINGLE-PHASE ALTERNATING-CURRENT MOTOR.

ing a clamp stud and turning the field to an index mark for the opposite direction of rotation. The motor may be operated at any speed below normal by reducing the voltage by either a rheostat or transformer.

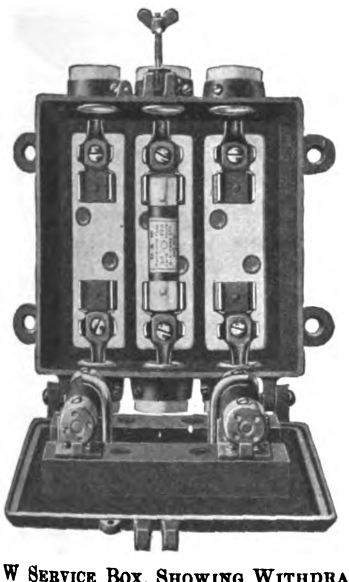
Recent Improvements In Weatherproof Service Switches and Branch Boxes.

There has developed, within the last few years, a large demand for weatherproof service switches, and they have been



New D & W Weatherproof Service Box.

extensively used with the result that severe conditions have indicated ways in which they could be improved. One of the weaknesses of the old-style switch was that the neutral fuse was removed when the switch was opened, which sometimes resulted in accidents owing to the fact that the removal of the fuse opened the



D & W Service Box, Showing Withdrawal Hooks on Positive and Negative Only.

ground connection of the neutral wire. Another point was that while the old-style box was intended as a weatherproof box, not being provided with gaskets, it frequently fell far short of meeting this requirement.

A new line of D & W switches and boxes has been developed in which these defects have been corrected. They are constructed for use both as cutout and switch, and are intended to be placed on the outside of buildings where overhead wires enter, or in cellars where the wires enter from the subway. The accompanying illustrations show how the service switches are so designed that the neutral fuse remains permanently in the box, thus avoiding any possibility of accidents due to the fuse being improperly withdrawn. Withdrawal hooks are provided on the positive and negative only. This avoids any possibility of tampering with the box through ignorance or otherwise, and in case of fire the neutral fuse is drawn, leaving the other fuses in the box.

Fuse guides are mounted in the covers to accurately align the fuses, so that positive contact is made when the cover is again closed, throwing the fuses into circuit. There are also mounted in the covers withdrawal hooks, which, by a one-quarter turn of the levers on the outside of the cover, remove the positive or negative fuse at will, and, when desired, the cover can also be opened without removing any of the fuses. The fuses are of the well-known D & W National Electrical Code standard, and the boxes are provided with rubber gaskets and removable porcelain bushings, thus making them thoroughly moisture-proof when the cables are taped in. The outlets of the box are amply large, so that after the bushing is removed the cable terminals may be passed through the box and sweated on to the cable, which is highly desirable during installation.

To insure a uniform product, the castings are made in the factory's own foundry and are of much finer grade than are ordinarily purchasd in the open market, being lighter in weight as well as having a smoother, finer finish.

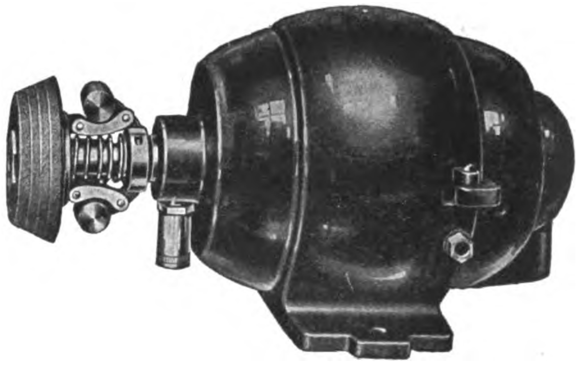
Branch boxes and main-line boxes are manufactured in the types and capacities given below: Type I-7, 0-60 amperes, double-pole; type I, 0-60 amperes, triple-pole; type I-8, 61-100 amperes, double-pole; type I-2, 61-100 amperes, triple-pole; type I-9, 101-200 amperes, double-pole; type I-3, 101-200 amperes, triple-pole; type I-10, 201-400 amperes, double-pole; type I-4, 201-400 amperes, triple-pole; JB-1, thirty amperes, triple-pole, single-branch, 250-volt cutout boxes; JB-2, fifty amperes, triple-pole, single-branch, 250-volt cutout boxes; JB-3, 100 amperes, triple-pole, single-branch, 250-volt cutout boxes.

Branch boxes have split bushings mounted in the covers and boxes, which permit of the necessary connections without any break in the wiring, thereby reducing the cost of installation.

This improved line of cutout boxes is being placed on the market by the Central Electric Company, Chicago, Ill.

Apple Ignition Apparatus.

Although not strictly to be considered as part of an electrical installation, as these terms are generally understood, contractors are finding a very profitable



Apple Dynamo.

field in applying ignition apparatus and in selling ignition supplies for use with gas engines and in the automoble industry.

The Dayton Electrical Manufacturing Company, Dayton, Ohio, has developed an ignition apparatus consisting of an Apple

Apple Snap Switch and Ampere Meter.

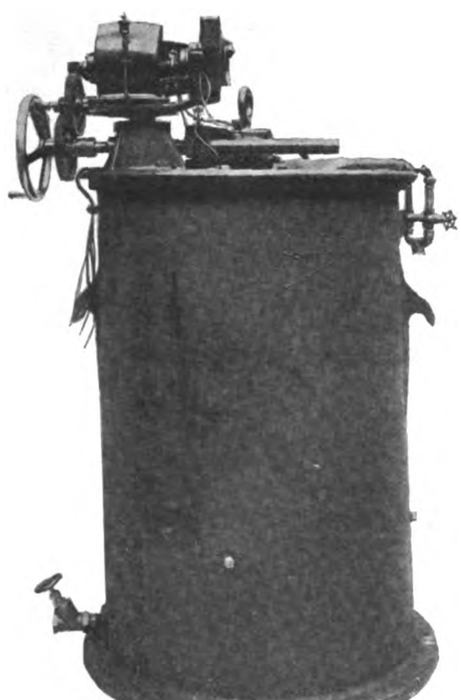
dynamo, a switchboard and a six-volt, sixty-ampere-hour storage battery.

The plan of wiring this outfit provides for taking the ignition current from the storage battery at all times, while the dynamo is used simply to keep the battery recharged. The switchboard acts as a terminal for all wires between the dynamo and the battery, and by means of the meter on the switchboard the operator can ascertain at all times just how much current he has available.

The outfit has two reliable sources of current—the battery and the dynamo. The current should be taken regularly from the battery while the dynamo keeps the battery recharged, but in an emergency the dynamo can be used without the battery.

Westinghouse Potential Regulators.

In order to secure good regulation throughout a central station distribution system means must be provided for regulating the voltage on each feeder. The voltage drop in any feeder depends upon its arrangement, sectional area and length, and upon the amount and power-factor of the load it carries. The time-load curve of each feeder must also be considered in comparing the voltage drops on several feeders, as it is evident that these curves may vary widely, even when the average loads on the feeders are approximately the



WESTINGHOUSE POLYPHASE MOTOR-OPERATED INDUCTION REGULATOR.

same. By compensating for the voltage drop on each feeder independently of all the others, good regulation can be established with widely varying conditions of load. It is for this purpose that the potential regulators described herewith were primarily designed.

The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., makes regulators of different kinds for varying the potentials on feeder circuits. The two principal types employed are the induction type potential regulator and the step-by-step type potential regulator. The first type effects the regulation of a single-phase circuit by altering the position of a coil in a magnetic field, thereby changing the magnetic flux passing through the coil; the second type by cutting in or out, by means of different taps, sections of the winding of a regulating transformer. Both of these types of regulators are made for either single-phase or polyphase circuits. The single-phase regulators are generally used on feeder circuits supplying electric lights, and the polyphase regulators are used in connection with rotary converters on feeder circuits supplying power either with or without lights.

The design of the Westinghouse potential regulators is such that a minimum amount of material enters into their construction, leading to light weight and compactness, and requiring minimum floor space. Leads from two similar coils are brought out through the case. These can be connected in parallel outside the case, so that double the rate of current can be regulated through half the standard range. A further advantage of the induction type regulator is that it lends itself readily to automatic operation, so that a constant potential may be maintained on the feeder circuit without attention on the part of the station operator.

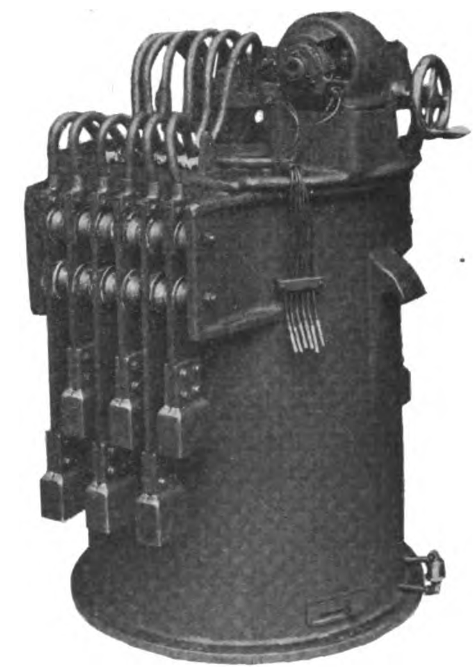
The capacity of the regulator for any given service depends on the range of regulation required and the total load on the feeder. The standard regulators are designed to raise the voltage ten per cent or lower the voltage ten per cent, thus giving ten per cent regulation; and the capacity, therefore, would be ten per cent of the full load of the feeder. For example, a 100-kilowatt circuit with ten per cent regulation would require a ten-kilowatt regulator. If five per cent regulation were required a five-kilowatt regulator would be necessary.

The essential parts of a single-phase induction regulator are a rotatable primary core and windings assembled on a shaft, and a stationary core with windings which is mounted in the regulator case. The rotor is operated by means of a worm wheel and worm, the shaft of the latter being driven either by a hand wheel or by a motor through spur gearing. The cases of both the manually operated and the motor-driven induction regulators are the same, and are made of cast iron well ribbed so as to provide ample cooling surface. The top of the case, which forms the cover, is a separate casting held in place on an accurately machined surface by means of four poles. A hole is bored in the centre of the cover, forming the upper bearing of the primary or rotor shaft.

The rotor shaft is revolved by means of a bronze worm wheel which engages a forged steel worm, the latter being provided with a ball bearing end thrust. The housing for the worm gear is a separate casting which is bolted to the cover. This casting is made separate instead of being an integral part of the cover, in order to permit close adjustment between the worm wheel and the worm.

On the automatic regulators the worm shaft is connected to the motor through a spur gear and pinion. This makes a compact driving device. A handle is also provided on the automatic regulator so that in case of emergency the regulators may be operated manually. When hand-operated regulators are furnished the spur gear is replaced by a hand wheel, and the regulator is driven directly from the worm shaft.

In motor-driven induction regulators the operation of the motors is controlled



SIX-PHASE AIR-BLAST INDUCTION REGULATOR, MOTOR-OPERATED, FOR USE WITH SIX-PHASE ROTARY CONVERTER.

by means of relays. As the current-carrying capacity of the contacts or switches for starting, stopping and reversing the motor must be ample, entailing substantial construction, and as the accuracy of regulation must be approximately from one-half to one per cent under all conditions, it has been found desirable to divide these functions between two relays, one the voltage-regulating relay and the second the auxiliary relay.

The voltage-regulating relay is in effect a contact-making voltmeter which is connected to the circuit to be regulated. Its functions are to close one contact when the voltage of the circuit is below the desired value, and to close another contact when the voltage exceeds the desired value. The relay is mounted in a circular case of the same general appearance as those of the Westinghouse indicating switchboard meters. The total energy required for this coil is about ten watts at normal voltage.

The secondary or auxiliary relay is connected between the voltage relay and the motor circuit, and is designed to relieve the contacts of the primary relay from carrying the whole current required to operate the motor. The auxiliary relay is in effect an electrically operated, double-pole, double-throw switch with carbon contacts. It is so connected as to start the motor in either direction and at the same time release the motor brake. These relays vary slightly in design according to the character of the service and the ampere capacity required. They may be wound to suit the voltage and the frequency of the auxiliary circuit used.

The principle of the operation of the step-by-step potential regulator is practically the same as that of the induction regulator. In the step-by-step type the series coil is divided into a number of sections which may be successively cut in or out of the circuit to be regulated instead of varying the flux through the entire coil as in the induction type. The step-by-step type regulator has been developed in two general mechanical forms—the drum type and the dial type. The former comprises a drum and finger type switch similar to a railway controller, and the latter a face plate with a dial switch for switchboard mounting. The drum type regulator can be placed on the station floor in front of the switchboard or it can be placed behind the switchboard and operated by means of a hand wheel through chains or shaft and gears. It may be mounted in a horizontal, vertical or inverted position as required.

Effective Lighting.

The lighting fixture business in the West has for years been considered a commercial proposition of selling so much metal for its equivalent in money. Most wonderful forms have been created and placed in various buildings without regard to whether such pieces harmonized with the surroundings. The architect, contractor and the consumer have for years visited fixture showrooms contemplating the purchase of lighting effects for their building, whether such building be for public use or for the home, and have been greeted by a maze of metal so dense that it has always caused confusion to the purchaser. After purchasing the desired amount of metal for the building, there still remained a doubt as to whether such pieces as were selected were really appropriate. This condition has caused many disappointments.

For years the Central Electric Company, 264-270 Fifth avenue, Chicago, Ill., has studied the shortcomings of the fixture-supply business in the West, and after looking carefully at all sides of the situation decided that a fixture house which was sufficiently progressive to take a stride forward out of the rut of the past would be appreciated and patronized in a manner which would be profitable. The first step was to acquire a factory equipped for the production of correct and unusual effects in metal. To secure the craftsmen for such an organization it was obliged to locate its factory in Boston, where it now has a designing department, and a factory organization which is second to none in the United States. Each man in this organization has been selected with great care, bearing in mind that to give the public what it desires from the designer of the various effects through to the modeler, the foundryman, the toolmaker and the chaser, there must be in their temperament the necessary feeling for art in its true meaning, and on all of the work produced by this company will be seen in the lines of the model, in the marks of the hammer and the dainty lines forced by the chaser's tools, the characteristics of each individual craftsman.

The following quotation will give some idea of this company's interpretation of the true meaning of the lighting fixture business:

"A lighting fixture must have two inceptions: First, in the designer's thought, made apparent by the use of the pencil, and, second, by craftsmen of sterling worth. It is the service of such an organization that they offer."

In building its studios, the company has given great care to the arrangement of the various rooms so that each fixture is seen individually, and under conditions which enables the purchaser to make intelligent selections. Crowding of the rooms has been avoided, each piece shown being lighted, thus enabling one to see the effect as it will be when the fixture is permanently placed.

The sales organization is composed of representatives having a thorough knowledge of interior architectural detail so that when a prospective client makes known the conditions existing in his building, correct suggestions can be offered. The studios are, undoubtedly, the most complete and beautifully decorated rooms for the display of lighting effects in the West, and every courtesy and convenience is shown prospective clients.

The Central Electric Company cordially extends an invitation to those interested to visit these studios.

A New Strand or Messenger Wire Grip.

As requirements necessitate, the inventive mind is called into play to devise means of supplying something to fill the want. In this particular instance, the requirements were in the nature of a device to handle strand or messenger wire safely, securely and without injury to the wire. For this purpose the grip shown in the illustration herewith has been designed. The grip consists of a body or retaining piece in which two steel wedge-shaped jaws move longitudinally. These jaws are

THE KLEIN "QUICK SAMPSON" WAVE GRIP

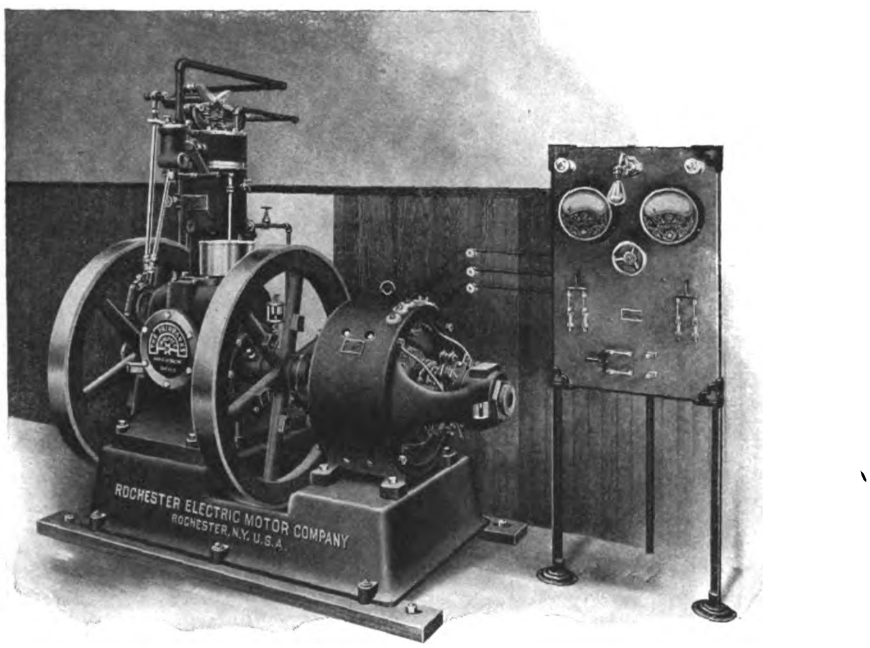
arranged so as to move in either direction simultaneously, thus opening or closing them in unison. The gripping surface of the jaws is concave, and is provided with a series of milled teeth, spread over their entire length. These teeth grip into the spirals of the strand, and being uniformly distributed over the entire length of the jaw, grip the wire at very many points, thus taking a secure hold with the pressure distributed along the entire length of the gripping surface, so that no amount of strain falls sufficiently at one point to crush or injure the wire. The tackle is attached to the two oblong rings in the body piece; these rings, being arranged central, insure a straight pull. The proportions of the various parts are calculated to carry any strain that is necessary to tighten the wire, and the jaws are self-adjusting to accommodate sizes from one-quarter inch to five-eighth inch. This grip is called the "Quick Sampson," and was designed and is manufactured by Mathias Klein & Sons, 87-89 West Van Buren street, Chicago, Ill.

Electric Controller and Supply Company Change of Name.

The Electric Controller and Supply Company, of Cleveland, Ohio, has changed its name to "The Electric Controller and Manufacturing Company." The latter name more truly indicates the nature and scope of its business, as evidenced by the following list of apparatus it manufactures: Controllers, both manual and magnetic switch types for all purposes; lifting magnets, electric brakes, magnetic switches, solenoids, limit stops, arc welders, crane fittings, knife switches, flexible couplings and the electric fault-finder.

The Rochester Motor Company's Gas-Engine-Driven Unit.

The Rochester Electric Motor Company, Rochester, N. Y., is meeting the demands of contractors all over the country for a direct-connected unit of medium size for residence and hotel lighting and for the power equipments of small factories. The accompanying illustration shows a 5.5-kilowatt Rochester type C dynamo direct-connected to a ten-horse-power Fairbanks gas engine.



TEN-HORSE-POWER FAIRBANKS GAS ENGINE DIRECT-CONNECTED TO 5.5 KILOWATT ROCHESTER TYPE C DYNAMO.

For use with ordinary engines the company manufactures a line of generators with a balance or flywheel mounted upon an extension of the shaft. This wheel is of web pattern, turned all over, fitted to a taper bearing, and held in place by both lock nut and key. The bearings are amply heavy to support the balance wheel outboard, and can be easily replaced if necessary. The frame of the dynamo is of a special mixture of cast iron having a high magnetic permeability. In all but the smaller sizes the pole-pieces are built up of punchings of annealed sheet steel. The armature core is built up of carefully annealed discs insulated from each other and mounted directly upon and firmly keyed to the shaft. One-half of the spherical seat is milled from the end plate, the other being an adjustable cone held in place by a lock nut. The commutator is built up of bars of hard-drawn copper insulated with prepared mica, wearing uniformly with the copper. The brushes are of carbon, and no adjustment is needed to compensate for wear or change of load.

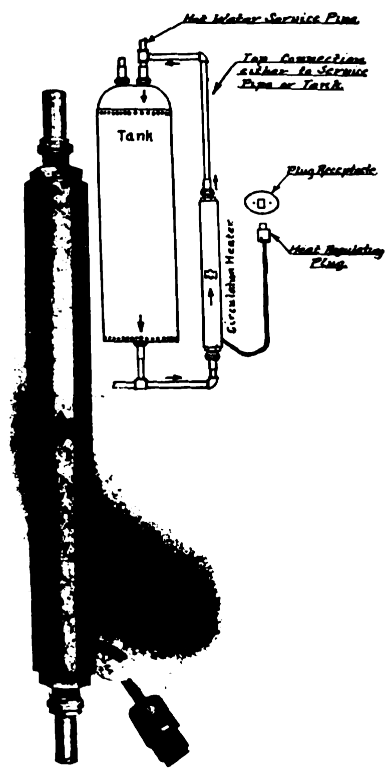
The Simplex Electric Water-Heater.

The Simplex Electric Heating Company, Cambridge, Mass., has recently put on the market a circulation heater for attachment to range boilers which seems to overcome many of the objections and difficulties of taking care of the hot-water problem electrically. As shown in the illustration, the heater is placed along the side of the boiler, connected at the bottom through the pipe that also connects to the range, and at the top with the pipe that supplies hot water to the house. This heater is so constructed that when the current is turned on it will, in a few minutes, begin to discharge water at about 180 degrees into the top of the boiler, drawing its supply from the bottom of the boiler. The maximum power demand for this heater is two kilowatts, and when applied to the boiler in this manner makes the boiler more efficient in the case of quick delivery of warm water than when the range is in operation. The current demand on the station is within reasonable limits, and for all practical purposes meets the average household demands.

The heater is arranged with three heat divisions, so that 500, 1,000 or 2,000 watts may be used as desired. Where considerable hot water is required the maximum heat may be turned on for a limited time and then the temperature of the boiler kept up with the low heat. Where a large quantity is not desired, merely what is needed about the kitchen for ordinary requirements, a short period of the use of the maximum heat enables the supply to be provided at low cost. The efficiency is very high. The heater consists of an enameled tube through which the water passes. Surrounding the tube is an outer brass shell or jacket lined with asbestos, which provides a closed air space between the tube and the jacket.

A peculiar feature of its construction is the control of the circulation, which insures the delivery of high temperature water, thereby permitting hot water to be drawn in a short period after turning on the current while utilizing all present house plumbing in the normal way and yet without having to heat up the entire contents of the boiler.

The use of this device with reasonable control is entirely practicable and commercial in all communities where power rates are made for electric cooking and in many other cases where the convenience and simplicity of the method are allowed to offset the difference in cost over the usual methods. In practice in the ordinary home, even at lighting rates, where care is used the total cost for the use of this heater during such occasional intervals as it may be required in the summer time need never be large, or reach a point which would make its use prohibitive.



SIMPLEX ELECTRIC WATER HEATER.

The installation of the heater involves little work for the plumber and electrician, so that the total cost of the equipment is quite moderate. The device is three inches in diameter, thirty-three inches long, with three-quarters-inch couplings on each end, and when it is connected stands close to the boiler, taking up little room. All of the outer portions are nickel-plated brass. For connecting to the circuit it is provided with a plug switch and flexible conductor.

Automatic Voltage Regulators.

The maintenance of a constant voltage at the lamp not only determines the economy with which a lighting system is operated, but is also essentially the measure by which the customer judges the excel-

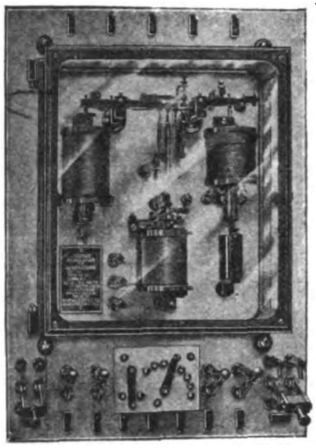


Fig. 1.—Form "A" Voltage Regulator Mounted on Marble Base.

lence of the illumination supplied. The life and candle-power of an incandescent lamp changes rapidly with comparatively small variations from normal voltage and the automatic regulation of voltage at the station so as to give a constant voltage at the lamp is therefore of vital importance and while apparently of benefit

Fig. 2.—Type BR Automatic Regulator.

chiefly to the consumer is in fact of far greater value to the producer.

In order that a practically constant voltage be maintained at the lamp, the generator should be controlled by a potential regulator so as to maintain a constant voltage at the bus or substation independent of load changes. The various feeders branching out from the station should also be controlled by feeder regulators arranged so as to automatically compensate for the drop in that particular feeder due to varying loads.

It is possible to dispense with the regulator controlling the generator by supplying the individual feeders with regulators having a sufficient capacity not only to compensate for line drop, but also to compensate for the voltage variations in the generator. It is, however, advisable both on account of economy and operating conditions to control the generators by a Tirrill regulator. This regulator, shown in Fig. 1, is a relay device mounted on the switchboard and is so adjusted that it controls the generator voltage by rapidly opening and closing a shunt circuit across the field rheostat of the exciter. The action of this regulator is very rapid and there is practically no fluctuation in the voltage. By its use the kilowatt capacity of each regulator for the individual feeders is reduced as well as the number and amount of their adjustments.

Two types of regulators designated as the BR and IR are manufactured by the General Electric Company for automatically controlling the voltage of individual feeders. The feeder regulators of the above types are variable ratio transformers or rather compensators having two separate and distinct windings, primary and secondary, connected respectively across and in series with the feeder to be controlled.

The BR regulator, shown in Fig. 2, consists essentially of a transformer, the secondary of which is divided into a number of equal sections, and a dial switch, the points of which are connected to the sections of the secondary winding. In this type of regulator the moving element is exceedingly light and having but little inertia is particularly adapted for very rapid adjustments. The total time required for obtaining the complete range from maximum boost to maximum lower is about six seconds.

The BR regulator is built only for single-phase circuits and in comparatively small units, since the capacity is limited by the current and voltage which can be conveniently handled by the switch. The capacity of the standard switch is 200 amperes and 220 volts boost and lower.

The induction or IR regulator, shown in Fig. 3, is more rigid, and substantial in construction, and has a less number of moving parts than the switch type and no moving contacts. The efficiency is somewhat higher, but it is slower in operation than the BR regulator as the armature or movable core on which the primary is wound has not only considerable inertia but also a torque depending on the kilowatt capacity, both of which must be overcome by the operating motor.

The three curves shown in Fig. 4 were taken simultaneously and show the com-

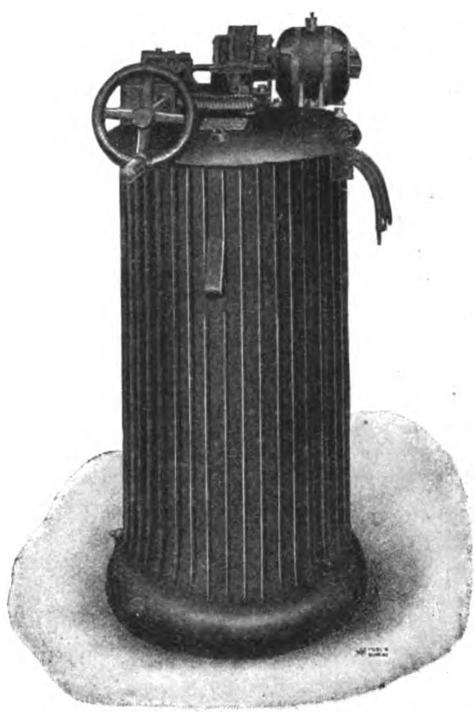


Fig. 3.—Type IR Automatic Regulator.

parative regulation of voltage by General Electric type BR and IR feeder regulators. The middle curve represents the generator voltage, while the upper curve

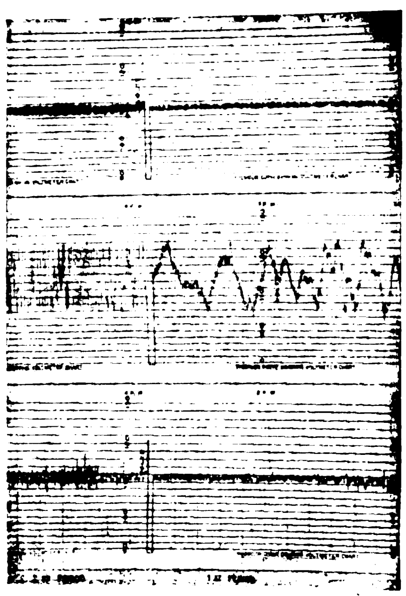


Fig. 4.—Thomson Curve-Drawing Voltmeter Charts, Showing Regulation of Feeder Voltage.

was taken from a feeder controlled by a BR regulator, and the lower curve represents the voltage on a feeder controlled by a regulator of the IR type.

A New Line of High-Efficiency Incandescent Lamps.

The new line of high-efficiency incandescent lamps just brought out by the General Electric Company fills a long-felt want for high-efficiency units of low candle-power. Among the new lamps may be mentioned the twenty-five-watt tantalum, miniature and battery types of tungsten lamps and a complete line of tantalum lamps for train-lighting service in both round and pear-shaped bulbs, made in thirty-fifty-volt and sixty-sixty-five-volt sizes.

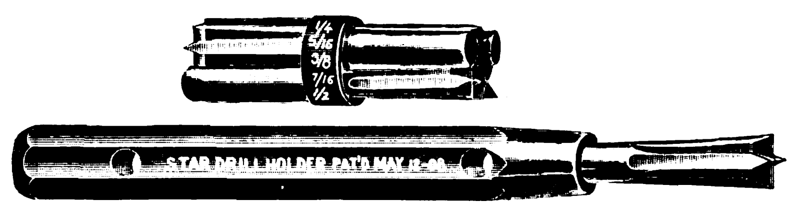
The twenty-five-watt tantalum lamp gives twelve and one-half mean horizontal candle-power. It may be burned in any position and is serviceable on alternating-current circuits of sixty cycles or less. The twenty-five-watt lamp is made in the regular sixteen-candle-power carbon-lamp bulb and presents a more graceful appearance than the tantalum lamps of higher candle-power. This lamp should prove very popular as it consumes but half the current of the ordinary sixteen-candle-power carbon lamp and can be used in conjunction with the tungsten lamp for ordinary socket installations where it might not be desirable to install tungsten lamps on account of their size and higher cost.

The miniature and battery types of tungsten lamps are made in standard and miniature bulbs and can be supplied in any voltage from one and one-half to twenty volts and from fractional candle-powers up to twenty-four candle-power. These lamps are intended for use with electrical novelties, portable devices, pocket lamps, etc., and are particularly applicable for use in automobile service as a substitute for oil and acetylene lamps. The filaments are short, thus insuring good, stable filaments sufficiently strong to withstand the shocks of automobile service. They can be operated from the regular ignition storage batteries very satisfactorily. The efficiency of these lamps is one and one-quarter watts per candle with excellent life and superior quality of light. Tungsten, by reason of the high efficiency it secures, is peculiarly adapted to the battery type of lamps, where low-energy consumption is a prime requisite.

Aside from the miniature and low-voltage lamps the company has also brought out a 250-watt tungsten lamp which is designed for use where the outlets are limited and where a large unit is required to replace present illuminants. The mean horizontal candle-power of the 250-watt lamp is 200, or over 300 candle-power when used as an incandescent unit with a bowl Holophane reflector. The lamp is made in a pear-shaped bulb, five inches in diameter, and is the most powerful incandescent lamp made for lighting service. One of the 250-watt lamps will effectually replace a gas arc or the ordinary electric arc. Recent tests of these lamps in a large department store in Newark, N. J., have shown an average life of 900 hours.

Holder for Drills and Bits.

The Star Expansion Bolt Company, of Bayonne, N. J., has brought out recently an admirable device in the form of an improved holder for electrician's special drills. As will be seen, the holder, while comparatively light, is solid and substantial, enabling a firm hold to be taken and a heavy blow struck, with no danger of breaking even the smallest drill point. Any diameter bit may be had (one-quarter-inch, five-sixteenths-inch, three-eighths-inch, seven-sixteenths-inch one-half-inch) and one size fits in the holder just as readily as another.



Star Drill Holder.

Beyond a large saving in breakage, the Star drill holder possesses another great advantage which will appeal to the man who is in the habit of carrying around a big cumbersome kit with different diameters of drills—all in full twelve-inch lengths. The entire set of Star special drills and the holder itself can be slipped into the pocket, their weight and bulk being scarcely perceptible.

Crocker-Wheeler Company Election.

The following officers of the Crocker-Wheeler Company, manufacturers and electrical engineers, of Ampere, N. J., were elected July 10:

President, S. S. Wheeler.
Vice-president, Gano Dunn.
Second vice-president, A. L. Doremus.
Chief engineer, Gano Dunn.
Secretary, Rodman Gilder.
Treasurer, W. L. Brownell
Assistant secretary, J. B. Milliken.
Assistant treasurer, G. W. Bower.

Westinghouse Electric and Manufacturing Company.

The Merchandise Creditors' Committee of the Westinghouse Electric and Manufacturing Company has issued another circular to the creditors, repeating the figures given out last week relating to its reorganization plan. It reports that ninety-five per cent of all the merchandise creditors have assented to this plan, and that it expects to secure the assent of the major part of the remaining merchandise claims. Substantial progress has been made toward securing from stockholders, employés and others the $6,000,000 of stock subscriptions to assenting stock required by the plan.

With the beginning of July a decided advancement has manifested itself in the business of the Westinghouse companies. It is stated that the business for June was fifteen per cent above that of May, and twenty-three per cent higher than the business of the earlier months of the year. Within the last month it has almost reached its normal point. While the improvement in itself is very encouraging, the character of the orders is of such a diversified nature and the orders have come from so many different sources that they show conclusively the renewed confidence of business men and capitalists. That the revival is not spasmodic is also proved by letters being received from district managers throughout the country.

Long-Distance Telephone Reporting.

The Baltimore *Sun*, in connection with reporting the Democratic National Convention, at Denver, Col., used a 1,800-mile telephone circuit with complete success. A line was formed from Denver to Omaha, to Chicago, to Pittsburg, and then to the long-distance telephone exchange on Belvidere avenue, Baltimore.

Mica Production in 1907.

The total value of the mica produced in the United States in 1907 was $392,111. This is the largest production on record. The imports in 1907 were valued at $925,259.

Current Electrical News

DOMESTIC AND EXPORT.

MORTGAGE FOR $1,000,000 ON GREAT FALLS & OLD DOMINION PROPERTY—The Great Falls & Old Dominion Railroad placed on record on July 9 a mortgage on all its property rights and franchises to secure the payment of an issue of $1,000,000 bonds. The issue comprises 1,000 bonds of the par value of $1,000 each, maturing June 1, 1933, bearing five per cent interest. The mortgage is made to the American Security and Trust Company, of Washington, as trustee. It is understood that under the terms of the mortgage the proceeds from the sale of the bonds may be used to secure acquisitions to the railroad property and to buy other roads. This is the first bond issue of the company.

PHILADELPHIA RAPID TRANSIT $5,000,000 BOND ISSUE—Directors of the Philadelphia Rapid Transit Company have voted to submit the proposition to issue $5,000,000 bonds to stockholders for their approval at the annual meeting September 16. In the meantime no action for the sale of any of the bonds will be taken, as there is no present need of money in addition to that to be received from the assessment payable September 7. In compliance with the regulations of the New York Stock Exchange, where the company's stock is listed, the directors designated a transfer agent and a stock registrar, and arrangements were made for issuing new certificates of stock when the last payment is made in September next.

UNDERGROUND ROAD BETWEEN ST. PAUL AND MINNEAPOLIS—A company, known as the Twin City Underground and Elevated Electric Railway Company, has been organized to build an underground electric railway between Minneapolis and St. Paul. Offices have been established in the Guarantee Loan Building, Minneapolis. The company is capitalized at $50,000 and its officers are: George Norris, president and treasurer; W. E. Stewart, vice-president, and J. W. Crane, treasurer. The estimated cost of the road is $6,000,000. It will be fifteen miles long, and underground trains will make the trip, it is claimed, in twelve minutes. The company says it has opened negotiations with the United States Government for a bridge across the Mississippi River. Officers say they will build a half-way station in the midway district.

MOHAWK POWER COMPANY—The Mohawk Power Company, with principal offices in Glens Falls, N. Y., which is practically a reorganization of the Niskayuna Power Company, and which proposes to develop and sell electricity in several central and northern counties in New York, filed an application on July 1 with the Public Service Commission in the Second District for authority to issue 1,000 shares of its capital stock of the par value of $100. Doubt has arisen as to the right of the old company to transact business and issue bonds, consequently it is proposed to dissolve the old company. Interests in the new company are also connected with the Hudson River Electric Power Company. It is proposed to construct dams across the Mohawk River and its tributaries in the counties of Schenectady, Albany, Saratoga, Montgomery, Herkimer and elsewhere.

TWO-HUNDRED-MILE TROLLEY LINE—An electric railway project that will cover five counties of eastern Oregon has been mapped out by the Wasco County Electric and Power Company. Plans have been made to commence actual construction of a trolley system 200 miles in length during the fall. It is believed by the promoters of the concern that work will be begun not later than August 15. The company was incorporated on May 15, with a number of Portland (Ore.) men in the directorate. Since that time agents have been working to finance the company, and matters have now progressed so far, they say, that a favorable outcome of present negotiations is expected whereby one large syndicate will take the $15,000,000 bond issue authorized by the articles of incorporation. C. D. Charles, financial manager for the Oregon Gold Prospecting and Promoting Company, is promoting the Wasco County Electric and Power Company. His headquarters are at room 318 Marquam Building, Portland. The promotion work is being done under the name of the Oregon Gold Prospecting and Promoting Company, of which Dr. Homer I. Keeney is president and Mark G. Will is vice-president.

REORGANIZATION OF THE UNITED STATES INDEPENDENT TELEPHONE COMPANY PROPERTIES—The reorganization plan of the United States Independent Telephone properties outside of Rochester, as originated by the reorganization committee, is progressing satisfactorily. A large amount of work is being done in Syracuse, N. Y., where a new company, called the Onondaga Independent Telephone Company, is organized to conduct the business under the reorganization. Incorporation of this new company for $1,500,000 was filed with the secretary of state on July 2, with the following named as directors: George R. Fuller, W. Roy McCanne, Joseph W. Taylor and Edward H. Peck, of Rochester, and Alexander H. Cowie, John B. Pierce and Hendrik S. Holden, of Syracuse. The Onondaga company will form an important link in the long-distance chain of the Rochester, Syracuse and Utica systems, which in turn are connected with other long-distance lines. Henry W. Conklin, referee in the foreclosure action of the Security Trust Company, as trustee, against the United States Independent Telephone Company, has filed his report on the distribution of the remaining funds to the non-assenting bondholders. The report shows that the non-assenting bonds amounted to $4,647,000, of which $3,772,000 were proved and $875,000 were not proven. There remained in the hands of the referee, before any deductions were made, $70,527.71, payable to holders of non-assenting bonds. One deduction of $78.50 was made and the remaining amount was increased to $71,198.50 by the interest account. To the holders of the bonds that were proved $58,098.44 was paid, and $13,100.06 is due those not proved. From this amount due bonds of proved ownership $747.27 was deducted for referee's expenses, leaving $57,351.17 as the net balance due the proved bonds, or $15.12 on each such bond.

DATES AHEAD.

Michigan Electric Association. Annual meeting, Grand Rapids, Mich., August 18-21.

International Association of Municipal Electricians. Annual convention, Detroit, Mich., August 19-21.

Ohio Electric Light Association. Annual convention, Put-in-Bay, Ohio, August 25-27.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 6-7.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

OBITUARY NOTES.

CAPTAIN THOMAS F. ATTIX, head of the Attix Electrical Engineering Company, of Brooklyn, N. Y., died at his home, 34 St. Mark's avenue, Brooklyn, on July 6, in his seventy-eighth year. He is survived by two sons. Captain Attix fought through the Civil War and in some of the Indian campaigns. He was a member of the Fremont Old Guard and the Montauk Club.

MR. JAMES ROBISON BURNET, a lawyer and president of the Investment Securities Company, died Saturday, July 11, in Roosevelt Hospital, New York city, where he had been operated upon for appendicitis. Mr. Burnet was president of the City Club Realty Company, a director in the Commonwealth Trust Company of Buffalo, vice-president of both the Empire Investment Company and the International Car Wheel Company, president of the Ottawa Water Works and Light Company, vice-president of the United States Land Company and secretary and treasurer of the Publishers' Paper Company.

ELECTRIC RAILWAYS.

BRIDGEPORT, CT. — The Cole's Electric Express Company, which has been doing business in this section for a number of years, has been acquired by the Connecticut Company.

YONKERS, N. Y.—The up-state Public Service Commission has approved of the issuance of $65,000 receiver's certificates by Leslie Sutherland, receiver of the Yonkers Railway Company. The proceeds are for the purchase of fifteen double-truck cars.

NATCHEZ, MISS.—The Southern Railway and Light Company has been incorporated with a capital of $456,700. It is to be the successor to the Southern Light and Traction Company recently purchased at receivers' sale by Lynn H. Dinkins, of New Orleans.

PORTLAND, ORE.—By unanimous vote of the city council on June 24 an ordinance was passed granting to the Mount Hood Railway and Power Company right of way for an electric line across property on the Bull Run Reserve, controlled by the municipality.

YORK, PA.—The York Railway Company on July 1 decided to make four important changes in the road between York and Windsor, which will cost $120,000. They will take out all of the bad grades and curves and establish a solid roadbed with seventy-five-pound steel rails.

FORT WAYNE, IND.—Judge Heaton, of the Superior Court, has authorized J. D. Mortimer, receiver of the Toledo & Chicago interurban road, to purchase new four-motor cars for the line between here and Waterloo. The new rolling stock was much needed. It is to cost not to exceed $22,680.

CHICAGO, ILL.—The Chicago, Lake Shore & South Bend Railway Company, the project of Cleveland capitalists which will gain entrance over the Illinois Central at Kensington, has filed an equipment trust agreement, the Cleveland Trust Company as trustee, to secure an issue of $350,000 equipment bonds.

NEENAH, WIS.—On August 6 the Winnebago Traction Company, operating an interurban line between Neenah, Oshkosh and Omro, will be sold to the highest bidder at auction. The sale is made by virtue of judgment of foreclosure and sale made in the case of the Trust Company of America *vs.* Winnebago Traction Company.

LEXINGTON, KY.—The directors of the Central Kentucky Traction Company, at a meeting on July 2, authorized the building of an interurban line from Lexington to Nicholasville, a distance of twelve miles. The present interurban system extends to Paris, Georgetown, Versailles and Frankfort. The new line will hardly be completed before next spring.

PENDLETON, ORE.—All doubt concerning the Walla Walla Valley Electric Company's intention to extend its interurban line from Milton to Athena has been set at rest with the filing of sixteen right-of-way deeds in the office of the county recorder. The deeds are all across land lying between Milton and Athena, and extend to the heart of the wheat belt. The deeds are all given to two Walla Walla men, E. S. Isaacs and S. M. Drumpeller, and provide that an electric road must be in operation within two years.

ROCHESTER, N. Y.—The Rochester, Corning & Elmira Traction Company applied on July 7 to the Up-State Public Service Commission to modify its order that the entire capital stock must be taken at par before any bonds were issued. The company stated that it has made diligent efforts to comply, but found that by reason of the fact that no part of its road is yet complete or in operation, it is impossible to obtain subscriptions to its entire capital stock at par. The company asks leave to build and put in operation a portion of its line from Rochester and Lakeville to Conesus Lake, twenty-five miles, the cost of which will be $1,277,000, and later to build from Lakeville to Dansville, an additional twenty-five miles, at a cost of $1,705,610. The company asserts that it will be able to construct and put in operation its road from Rochester and Lakeville to Conesus Lake from the proceeds of $1,000,000 and $500,000 stock, and requests authorization for such an issue. The request is made to build a road from Lakeville to Dansville for an issue of $1,250,000 bonds and $750,000 stock at par. It is the intention of the company to operate the first section by purchased power and for the second section it will build a power-house to operate the entire fifty miles proposed. The commission promised to decide the matter at the earliest possible date.

NEW INCORPORATIONS.

HARRISBURG, PA.—Landes Telephone Company, Landesville, $5,000.

CAIRO, ILL.—Home Telephone Company. Capital increased from $5,000 to $10,000.

SPRINGFIELD, ILL.—Industry Telephone Company. Capital increased from $3,000 to $4,000.

MINNEAPOLIS, MINN.—Mesaba Telephone Company. Capital increased from $100,000 to $300,000.

COLUMBUS, OHIO—Delaware Telephone Company, Delaware. Capital increased from $10,000 to $20,000.

GUTHRIE, OKLA.—Starlight Telephone Company, Calumet. $300. Incorporators: George Kennedy, Thomas Jarville and Jeff Pritner.

BOSTON, MASS.—Barnes-Pope Electric Company, Boston. $10,000. President and treasurer, Frank L. Barnes, Waltham; clerk, Herbert A. Pope, Boston.

JEFFERSON CITY, MO.—Lathrop Light, Heat and Power Company, of Lathrop. $5,500. Incorporators: W. C. Young, H. C. Shepherd, S. L. Stuckey and others.

DENVER, COL.—The La Garita Telephone Company, Center, Col. $3,000. Incorporators: C. D. Wadsworth, Michael White, W. E. Gardner, W. F. Bomers and A. W. Dawson.

ALBANY, N. Y.—The Copake Telephone Company, of Copake, Columbia County. $5,000. Directors: Fred Holsapple, of Copake Iron Works; John D. Ackley and Willard Holsapple, of Copake.

NASHVILLE, TENN.—Farmers' Union Telephone Company, of Warren County. $5,000. Incorporators: Robert M. Horton, Aaron B. Moffitt, Alvadore Golloday, Abner D. Womack and Ed Sparkman.

RALEIGH, N. C.—The Little River Power Company. $100,000. To operate a telegraph and telephone line, as well as water, gas and electric plants. Incorporators: M. B. McRae, W. D. McNeill and J. F. Gilmore.

INDIANAPOLIS, IND.—Brookville-Oldenburg Telephone Company, of Brookville. $10,000. Incorporators: I. D. Garrigues, Fred Stumpf, Jr., M. Hubbard, R. S. Taylor, Casper Ritzi, M. Senefeld, F. A. Wright and Herman Trichle.

ST. PAUL, MINN.—Deer River Telephone Company, Deer River. $5,000. Incorporators: Archie McCallum, Deer River; B. L. Freedy, St. Paul; C. D. Rutherford, Floodwood; John E. O'Connell, Deer River; W. Reithner, Deer River.

LAKE CHARLES, LA.—Texas Power Company, Limited, of Houston, Tex. To manufacture, sell and supply gaslight, heat and electric power. $500,000. Directors: Charles A. Cleaver, Charles S. Cleaver, J. A. Reed and Rufus Cage.

RICHMOND, VA.—Mount Olive & Saint Luke Telephone Company, Mount Olive. $6,000. George A. Copp, president, Strasburg, Va.; J. G. Sager, vice-president, Woodstock, Va.; Josiah Wisman, secretary and treasurer, Woodstock, Va.

DUBUQUE, IOWA—Dubuque & Delaware County Telephone Company, Dyersville. $100,000. Officers: President, G. E. McFarland; vice-president, W. J. Van Allen; secretary and treasurer, J. D. Mason; board of directors, C. F. Hall, W. J. Van Allen, G. E. McFarland, J. D. Mason and Charles Hutchinson.

JEFFERSON CITY, MO.—Kansas City, Ozarks & Southern Railway Company, of Ava. $300,000. To build and operate a standard gauge electric railway between Mansfield, Wright County, and Ava, Douglas County, a distance of fifteen miles. Incorporators: J. H. Murray, H. E. Bush, J. M. Adams, A. P. Miller and J. S. Clark, all of Ava.

TILLAMOOK, ORE.—Tillamook Public Service Company. $500,000. Incorporators: John K. Kollock, M. A. Zollinger and Frank E. Smith. To build electric railroads, telephone and telegraph systems, wharves and docks, flumes, boats, steamships, power and electric light plants, etc., and to carry on a public service system. Principal office and place of business, Bay City, Ore.

TELEPHONE AND TELEGRAPH.

JAMESTOWN, N. D.—The Mutual Electric Construction Company has completed a telephone line from this city to Spiritwood Lake and to Courtenay.

READING, PA.—The Pennsylvania Telephone Company has let a contract to R. J. Gordon, of Philadelphia, for underground work in various parts of the town.

LOUISVILLE, NEB.—Farmers west of Louisville have incorporated the Farmers' Co-operative Telephone Association, and will complete a telephone system as soon as possible.

CHICAGO, ILL.—The Chicago Telephone Company announces general reductions in rates around Chicago, in a few cases as high as fifty per cent, as a result of a change in the measurement to the block system, following the introduction of shorter toll lines.

POTTSVILLE, PA.—The American Union Telephone Company has secured possession of the telephone lines of the United Telephone and Telegraph Company. In connection with this deal the company also leased the lines of the Friedensburg, McKeansburg and Ringtown companies.

CHARLESTON, S. C.—The Bell Telephone Company has made a contract to establish a long-distance line connecting Manning with the main line at Pinewood. The line will be operated in connection with the Manning telephone exchange, but it will be strictly a toll line. The service is to be established in sixty days.

LACONIA, N. H.—At the annual meeting of the stockholders of the Citizen Telephone Company the report of the treasurer, S. B. Cole, showed the company as being in a most excellent financial condition with a large increase in subscribers. The officers elected were: President, Dr. A. W. Abbott; treasurer, S. B. Cole; clerk, E. H. Shannon; manager, William D. Johnson. Directors: Dr. A. W. Abbott, John H. Dow, H. Beckford, True E. Prescott, V. C. Haserick, John W. Ashman, of Laconia; C. H. Odell, Sanbornton, and Judge W. B. Fellows, of Tilton.

NASHVILLE, TENN.—A charter has been granted to the Citizens' Telephone Company, of McMinnville, Warren County, which proposes to construct a telephone line from that place to Nashville and various other places in Tennessee. The incorporators are: James Walling, Butler Smith, J. M. Lively, A. H. Faulkner and J. J. Morford. The company has an authorized capital stock of $5,000. It proposes to construct a telephone system and lines from McMinnville, in the county of Warren, to the following cities and towns: Tracy City, Beersheba, Spencer, Sparta, Smithville, Woodbury, Nashville and Manchester, such lines beginning at McMinnville as a common centre and radiating to the several cities and towns specified.

LEESBURG, VA.—At a meeting of the Leesburg Telephone Company Charles P. Janney was elected president; W. S. Jenkins, vice-president, and C. H. Shipman, secretary and treasurer. The officers were elected members of the board of directors, together with W. E. Garrett and M. E. Church. A charter has been applied for from the state corporation commission. The new company will be known as the Leesburg Telephone Company. Incorporated. The stock is nearly all taken by local men. Arrangements are being made to rebuild the old plant as soon as possible, installing a new up-to-date switchboard and central office equipment. All subscribers will be given local and long-distance connections, which will enable subscribers in the town of Leesburg to get direct connection with Washington and other outside points. M. E. Church will have charge of the rebuilding and installing of the new plant.

ELECTRICAL SECURITIES.

While there were several reactions in the stock market last week, prices, as a rule, closed higher, with more interest manifested than for some time. This increased speculation is thought to be due to the analysis that is being made of the future value of many of the stocks now held at rather low figures. There are many signs of betterment in trade conditions. Large orders for copper and for iron and steel, and the re-employment of large numbers of laborers indicate a revival in the metal industry. The American Railway Association reports a large decrease in the number of idle cars, and with the movement of the tonnage indicated by the expanding volume of orders for new material and the promise of bounteous crops bids fair to bring on a day of new profits for the railroad companies. It must be remembered, too, that there have been put into effect many radical savings in operating expenses. These retrenchments, in view of the great increase in business soon to become a fact, should mean largely increased dividends next year.

Dividends have been declared upon the following electrical securities: Guaranteed dividend of 2½ per cent on the stock of the Brooklyn City Railroad Company, payable July 15. Electric Company of America; regular semiannual dividend of 3½ per cent to stock of record July 10. New Hampshire Electric Railways; semiannual dividend of 1 per cent on the preferred stock, payable July 31. Havana Electric Railway Company; a dividend of $1.50 a share on preferred stock, payable August 15. Electric Bond and Share Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable August 1. American Light and Traction Company; quarterly dividend of 1¾ per cent on the common stock, placing the stock on a 7 per cent basis. The stock was placed on a 6 per cent basis one year ago, and two years ago the dividend was increased from 4 per cent to 5 per cent per annum. The regular quarterly dividend of 1½ per cent on the preferred stock has also been declared. Both dividends are payable August 1. New Orleans City Railway Company; dividend of 1 per cent on the common and the semiannual dividend of 2½ per cent on the preferred stock, payable July 10. East St. Louis & Suburban Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable August 1. United Traction Company; regular dividend of 2½ per cent on the preferred stock, payable July 20. Omaha Electric Light and Power Company; a semiannual dividend of $2.50 per share, payable August 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED JULY 11.

New York:	*Closing.*
Allis-Chalmers common	11¼
Allis-Chalmers preferred	34
Brooklyn Rapid Transit	48⅝
Consolidated Gas	126¾
General Electric	136¼
Interborough-Metropolitan common	11
Interborough-Metropolitan preferred	30⅛
Kings County Electric	112
Mackay Companies (Postal Telegraph and Cables) common	64⅛
Mackay Companies (Postal Telegraph and Cables) preferred	65¾
Manhattan Elevated	137
Metropolitan Street Railway	23
New York & New Jersey Telephone	105
Western Union	55⅛
Westinghouse Manufacturing Company	55¾

Boston:	*Closing.*
American Telephone and Telegraph	116
Edison Electric Illuminating	211½
Massachusetts Electric	46½
New England Telephone	112
Western Telephone and Telegraph preferred	65

Philadelphia:	*Closing.*
Electric Company of America	10¼
Electric Storage Battery common	30
Electric Storage Battery preferred	31½
Philadelphia Electric	9⅝
Philadelphia Rapid Transit	15⅛
United Gas Improvement	85½

So far more than one-third of the Electric Company of America stock to be transferred into American Gas and Electric Company bonds, under the proposition made by the Electric Company of America shareholders to the Gas & Electric Company, has been deposited.

Chicago:	*Closing.*
Chicago Telephone	139½
Commonwealth Edison	105
Metropolitan Elevated preferred	49¾
National Carbon common	69½
National Carbon preferred	111

The net gain by Chicago Telephone in the number of telephones installed last month was 3,322, as against 1,858 the previous month and 3,340 a year ago. Total gain this year, 16,632, as against 18,835 a year ago. Telephones in service, 219,396, as against 189,794 a year ago. Unfilled orders, 5,000.

PERSONAL MENTION.

MR. WILLIAM E. EVANS, who has been superintendent of the Butler (Mo.) city electric light plant for the past year, has resigned. He will go into the electrical supply business in Butler.

MR. C. L. REEDER, of Baltimore, Md., has been appointed engineer in charge of the work on the electric plant which will be built at Laurel, Md., in the next few months. Mr. Reeder's appointment has been confirmed by the council.

MR. J. D. WELSH, general superintendent of the Colorado & Southern Railway, has been made superintendent of the Denver & Interurban Railroad Company, an electric line, which has been taken over by the Colorado & Southern Railway.

MR. GEORGE A. McKINLOCK, president of the Central Electric Company of Chicago, with his son Alexander, has been catching bluefish off the shores of Long Island during the past week. They were guests on board Commodore W. L. Candee's yacht.

MR. C. S. HAMMATT, vice-president and organizer of the Florida Electric Company, of Jacksonville, Fla., has disposed of his stock in the company and resigned as vice-president to engage in the precious stone business as the Hammatt-Dickey Company, which is now being organized.

MR. CLARENCE J. McQUAIG, of McQuaig Brothers, Montreal, Canada, has been elected a member of the board of directors of the Tri-City Railway and Light Company, which controls all the street railway, gas and electric light business in the cities of Davenport, Iowa; Rock Island, Moline and East Moline, Ill.

MR. ADOLPH A. THOMAS has become associated as an assistant in the office of Brown & Williams, attorneys and counsellors, making a specialty of patent law. Mr. Thomas, after completing the course in chemical engineering at the Case School of Applied Science, graduated from the law school of Georgetown University. For four years he was an assistant examiner in the electrical division of the United States Patent Office.

MR. CHARLES S. DAVIS, of Somerville, Mass., has assumed charge of the Marlboro Electric Company, Marlboro, Mass., *vice* Eugene W. Godfrey, resigned. Mr. Davis is a graduate of Tufts College, and was also a student in electricity at the Massachusetts Institute of Technology. He was assistant electrician for the Boston & Maine Railroad, and consulting engineer for Concord, Mass., when it was putting in its electric lighting plant. He was the first manager of this plant, and for five years was master electrician in the construction and repair department of the Charleston Navy Yard.

MR. ALBERT J. MARSHALL has severed his connection with the engineering department of the Holophane Company, New York city, and has associated himself in the capacity of chief consulting and designing illuminating engineer with the Bureau of Illuminating Engineering, 437 Fifth avenue, New York city. He was associated with the engineering department of the Holophane Company for about three years, and during the last year of his connection with that company had charge of the engineering department. Previous to his work with the Holophane Company he was associated with the Baltimore branch of the Welsbach Company for a short time. Mr. Marshall has been a prominent figure in spreading the gospel of illuminating engineering in every part of the country. He completed a short time ago a series of illustrated lectures on the subjects of "The Fundamental Principles of Illuminating Engineering" and "The Proper Use of Artificial Light." This lecture trip covered a period of about nine months and a distance of approximately 26,000 miles. About fifty-five or sixty of these lectures were given in various parts of the United States. Mr. Marshall's work with the engineering department of the Holophane Company, the exceptional opportunity which he had to meet practical problems in all classes of service and all existing conditions throughout the country, and his natural adaptability for this work, have fitted him to take up his work as an independent engineer in the science and art of illuminating engineering. The Bureau of Illuminating Engineering has been in existence for about two years, and during that time has engineered the illumination of several notable buildings. On a number of occasions the bureau has been retained by the government for working out the illuminating problems in several of the federal buildings.

MR. ALBERT J. MARSHALL.

ELECTRIC LIGHTING.

ELDORADO SPRINGS, MO.—It is stated that the plant of the Eldorado Springs Electric Company, which was recently destroyed by fire, will be rebuilt if the owners can make satisfactory terms with the city. C. A. Ross, of Wilmette, Ill., is president of the company.

PALESTINE, TEX.—At the annual meeting of the Palestine Light, Heat and Power Company the following officers were elected: E. C. Beach, of Little Rock, president; Volney Foster, of Chicago, vice-president; A. T. Knies, general manager. The affairs of the company were shown to be in good condition.

APPLETON, WIS.—The plant of the Appleton Paper and Pulp Company will be operated only about three months longer. When the present supply of pulpwood is exhausted the plant will be closed down and the company will begin the erection of a new electric power-house, the power to be used for commercial purposes.

RAYMOND, WASH.—The South Bend-Raymond Electric Company has elected the following officers: J. L. Meyers, of South Bend, president; P. H. Ridgway, of Seattle, vice-president and manager; R. L. Fisher, of Seattle, secretary and treasurer. Directors: F. F. Fisher, P. H. Ridgway, Martin Welsh, Mr. Raymond, W. S. Cram, R. L. Fisher, superintendent.

NATCHEZ, MISS.—Pursuant to a decree of the chancery court of Adams County, O. Pollock, as trustee, has sold the local property of the Southern Light and Traction Company, consisting of the electric railway and electric light and gas plants, the purchaser being Lynn H. Dinkins, president of the company and president of the Interstate Trust and Banking Company, of New Orleans, who offered $5,000 above the liabilities of the company. The property is assessed at $125,000 on a fifty per cent valuation.

RED BLUFF, CAL.—The organization of another electric power company in Tehama County is likely to be consummated in the near future. Valuable water rights on Mill Creek are controlled by Gorham King, T. H. Ramsey, S. P. Stice, E. D. Gardner estate, Smith Crowder, W. A. Fish and W. F. Luning, and negotiations are now under way for their sale to a party of capitalists who expect to expend over a million dollars in the construction of a plant to generate many thousand horse-power of electric energy. The completion of the Northern Electric to Red Bluff and Redding will create a demand for a large amount of power.

BALTIMORE, MD.—At the annual meeting of the stockholders of the Mount Washington Electric Light and Power Company, held at the company's offices in Mount Washington, the following officials were elected: President and general manager, Thomas W. Offcutt; vice-president, Alten S. Miller; secretary and treasurer, Harry J. McIntyre. Directors: Thomas W. Offcutt, Alten S. Miller, S. Davies Warfield, Walter R. Townsend and Richard A. Bevan. The Mount Washington Company supplies electric current for public and private lighting in the villages of Arlington, West Arlington, Pikesville, Melvale, Mount Washington, Ruxton, Sherwood, Govanstown, Towson and Lutherville.

SALT LAKE CITY, UTAH—The Davis County Light and Power Company, with a capital of $50,000, in shares of the par value of $1 each, has filed articles of incorporation with the secretary of state. The officers are: J. D. Wood, president; J. H. Wilcox, vice-president; N. B. Stadley, manager; E. F. Richards, secretary-treasurer, and they with O. C. Dixon, constitute the directorate. The company takes over for $6,359 five miles of poles and wire in Farmington, three miles of the line outside of the city limits, a franchise from Davis County, a year lease of water power, a filing on water in Farmington Cañon and the good will of the present holders. Of the capital stock $43,641 is for the present left in the treasury.

INDUSTRIAL ITEMS.

THE CENTURY ELECTRIC COMPANY, St. Louis, Mo., in bulletin No. 10 describes and illustrates its single-phase motors. Copies of this bulletin will be furnished to those interested upon request.

THE AMERICAN CONDUIT COMPANY, Marquette Building, Chicago, Ill., manufacturer of bituminized fibre conduit for underground construction, is mailing a postal-card illustrating a line entrance insulator for bringing high-tension lines through the wall of the central station.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 17 Park place, New York city, has ready for distribution its catalogue No. 24, entitled "Something Electrical for Everybody." This catalogue is supplemented by the confidential net price list, which is available to those interested in the distribution of electrical supplies.

THE CONDIT ELECTRICAL MANUFACTURING COMPANY, Boston, Mass., has moved to larger quarters at 76 and 78 Batterymarch street. The company owns its own building at this point, and is occupying five floors and a basement. There are complete facilities for large stockrooms and storerooms and for office departments.

THE RIDGWAY DYNAMO AND ENGINE COMPANY, Ridgway, Pa., announces that in order to take care of its southern territory it has concluded negotiations with the Machinery Sales Agency, at 1021 Prudential Building, Atlanta, Ga., to handle its complete line of side and centre-crank engines, as well as direct-current electrical machinery.

THE GENERAL COMPRESSED AIR AND VACUUM MACHINERY COMPANY, St. Louis, Mo., has prepared several very interesting booklets devoted to compressed-air and vacuum cleaning apparatus and tools. The compressed-air and vacuum system of dust removal is gaining great favor for factories, hotels, residences, central stations and car-cleaning departments. This apparatus is arranged to be driven by electric motors, engines or manually, according to the style of equipment desired. Full information and illustrated catalogues will be furnished upon request.

THE ARTHUR JONES COMPANY, Old Colony Building, Chicago, Ill., has issued a booklet giving special prices on motors and generators, new and second hand, for both alternating and direct current. These machines are of recent and modern design, built in modern shops to meet all conditions. Prices are figured very closely and on the basis of spot cash on delivery. The company has unexcelled facilities for executing orders, and will be pleased to give full information to those interested upon request. The list given in this book is very complete, and it should be in the hands of every one finding it necessary to make quick purchases of electrical apparatus of this character.

THE WESTERN ELECTRIC COMPANY, 463 West street, New York city, has issued a number of attractive booklets on intercommunicating telephone equipments. These equipments are manufactured both in key and jack types for residence, factory and office use. The booklets call attention to the time-saving features and convenience of the intercommunicating system, also to the elimination of telephone operating expenses and the availability of the system for use at all hours of the day and night, owing to a telephone operator not being required. Explicit instructions are given regarding the installation, wiring and operation of each of the different equipments listed.

THE STANDARD GAUGE MANUFACTURING COMPANY, Syracuse, N. Y., has ready for distribution bulletin No. 1, devoted to "Eclipse" oil filters. "Eclipse" continuous-oiling systems and exhaust heads. The filter department is an addition to its well-known line of standard indicating and recording gauges for all purposes. Besides the standard line of "Eclipse" oil filters, this bulletin illustrates special forms for particular conditions; also several arrangements of the component parts of the "Eclipse" oiling system, so that engineers will find the problem of the recovery and purification of lubricating oil worked out for plants of all sizes and types. Copies of this bulletin will be furnished to those interested upon request.

Record of Electrical Patents.

Week of July 7.

892,410. SWITCH MOUNTING. Arnold E. De France, Toledo, Ohio. The switch is mounted on a rectangular metal box.

892,411. INSULATED COUPLING FOR ELECTRIC CONDUCTORS. John J. Dossert, New York, N. Y., assignor to Dossert & Company. A two-part coupling joined by a third threaded member and enclosed in a two-part insulator.

892,419. SYSTEM OF ELECTRIC-MOTOR CONTROL. Fletcher D. Hallock, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Locking means are provided, preventing the closing of the controller if any part of the starting resistance is short-circuited.

892,421. SYSTEM OF ELECTRIC-MOTOR CONTROL. Ford W. Harris, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The starting circuit is automatically opened if the individual starting switches are closed out of the predetermined order.

892,429. SYSTEM OF ELECTRIC-MOTOR CONTROL. Henry D. James, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Means are provided for delaying the closing of the individual starting switches.

892,445. ELECTRIC LIGHTING SYSTEM FOR AUTOMOBILES. Frank L. Parrill, Vincennes, Ind. The lighting dynamo is mounted on a rocking shaft allowing its driving wheel to be brought into contact with the main driving wheel.

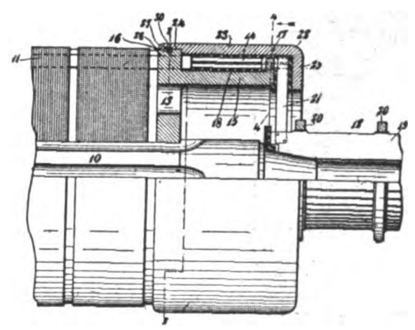
892,464. CONTROLLER. Emmett W. Stull, Norwood, Ohio, assignor to Allis-Chalmers Company. A magnetically operated switch is provided which opens the circuit when the controller reaches its first operative position as it is moved backward.

892,470. SYSTEM OF DISTRIBUTION. Hermon L. Van Valkenburg, Norwood, Ohio, assignor to Allis-Chalmers Company. A polyphase system utilizing a number of series transformers, enabling one instrument to be connected into any phase.

892,475. ARC-LAMP REGULATING MECHANISM. Ernest P. Warner and Carl Wiler, Chicago, Ill., assignors to Western Electric Company. A retarding device is attached to the feed clutch.

892,487. TURBO-GENERATOR CONSTRUCTION. Alfred H. Wouters, Norwood, Ohio, assignor to Allis-Chalmers Company. The commutator leads are carried on a ring and held by a second ring enclosing them.

892,500. BATTERY INDICATOR. Rufus N. Chamberlain, Depew, N. Y., assignor to Gould Storage Battery Company, New York, N. Y. A permanent magnet indicator.



892,487.—TURBO-GENERATOR CONSTRUCTION.

892,554. SHUNT. Frank W. Roller, Plainfield, N. J., assignor to Whitney Electrical Instrument Company. A convoluted conductor with its convolutions extending in planes at right angles to the terminals.

892,608. ELECTRIC BATTERY. William Morrison, Chicago, Ill., assignor to George Rumrill Coryell, Chicago, Ill. The negative element supports a deposit of bromin.

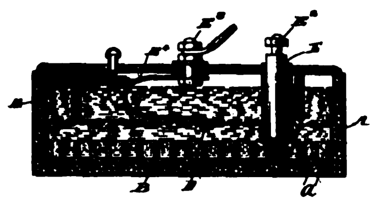
892,616. MEANS FOR CONTROLLING MACHINERY. Henry A. Peters and Charles W. Morgan, Paterson, N. J. The controllers are locked by an electrically actuated detent.

892,626. ELECTRICAL INSULATOR. Hugo F. Selinger, St. Louis, Mo., assignor to Wagner Electric Manufacturing Company, St. Louis, Mo. An insulator for transformer terminals or the like.

892,636. CONTROLLING APPARATUS FOR RAILWAY APPLIANCES. Hiram C. Williams, Utica, and Francis B. Harrington, Albany, N. Y., assignors to General Electric Company. A time-limiting circuit-closer actuated by the interlocking levers.

892,637. CONTROLLING MEANS FOR RAILWAY APPARATUS. Hiram C. Williams, Utica, and Francis B. Harrington, Albany, N. Y., assignors to General Electric Company. The magnet controlling the movement of the signaling lever is itself controlled by a switch requiring a predetermined interval for closing.

892,655. BATTERY-CHARGING APPARATUS. Frederick G. Duryee, Fort Wayne, Ind. A vibrating pole changer.



892,608.—Electric Battery.

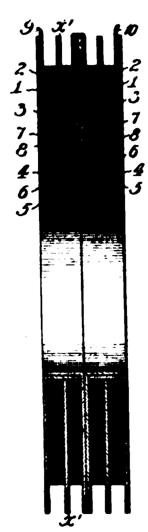
892,656. CONTROLLER FOR ALTERNATING-CURRENT MOTORS. George W. Euker, Boston, Mass., assignor to Diehl Manufacturing Company. A variable inductance is inserted in one of the leads.

892,670. ELECTRIC SNAP SWITCH. Walter S. Mayer, Philadelphia, Pa., assignor to the Machen & Mayer Electrical Manufacturing Company, Philadelphia, Pa. A pivotal snap switch.

892,677. SAFETY APPLIANCE FOR ELECTRIC RAILWAY TRAINS. Edwin T. Munger, Chicago, Ill. A device for rendering the motor controller inoperative whenever the brakes are out of order.

892,712. SAFETY APPLIANCE FOR ELECTRIC RAILWAY TRAINS. Adolph H. Daus, Chicago, Ill. Electromagnetic means placed on the car which prevent the operation of the controller except when shunted through a low-resistance path, which is maintained as long as the brakes are in operative condition.

892,713. SAFETY DEVICE FOR ELECTRIC TRAINS. Adolph H. Daus, Chicago, Ill. A device for rendering both controllers on an electric car inoperative when the brake system is out of order.



892,763.—Induction-Coil Unit.

892,734. SAFETY APPLIANCE FOR ELECTRIC RAILWAY TRAINS. Harley A. Johnson, La Grange, Ill. A magnetic device permitting car controllers to be used when the brakes are in operative condition.

892,749. ELECTRIC SIGN APPARATUS. Richard F. Le Brocq, Etna, N. J., assignor of one-half to Edwin J. Selley, New York, N. Y. A switching device for controlling a number of lamp circuits.

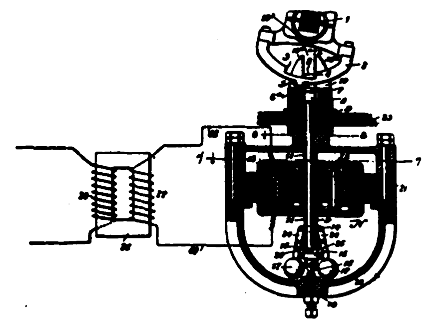
892,755. PLUG FOR ELECTRICAL CONNECTIONS. Walter S. Mayer, Philadelphia, Pa., assignor to the Machen & Mayer Electrical Manufacturing Company. A plug formed of nonconducting material with perforations for receiving the conductors.

892,763. INDUCTION-COIL UNIT. Carl A. Pfanstiehl, Highland Park, Ill. A coil section formed of a pair of outer spools, one of which fits over the other.

892,764. HIGH-FREQUENCY APPARATUS. Charles C. Ruprecht, Cleveland, Ohio, assignor to the Cleveland High Frequency Company, Cleveland, Ohio. The combination of a circuit, having in series therewith the primary coil of a transformer with a circuit including the secondary winding of the same transformer.

892,768. ELECTRIC ARC LAMP. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. A smoke flue is provided within the lamp.

892,770. APPARATUS FOR GOVERNING THE PASSAGE OF CARS OR VEHICLES ALONG A RAILWAY. John D. Taylor, Wilkinsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. The controller on the car is unlocked electromagnetically.

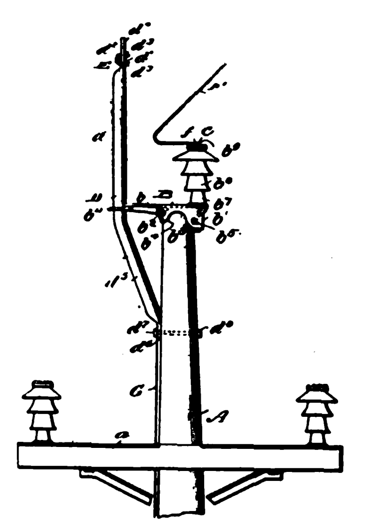


892,770.—Apparatus for Governing the Passage of Cars or Vehicles Along a Railway.

892,814. ELECTRIC INDICATING SYSTEM FOR RAILWAYS. Herbert G. Dorsey, Ithaca, N. Y. A pair of conductors is carried parallel to the track and each train is equipped with a generator, the voltage of which depends upon the speed of the train, the current from which actuates indicators on other trains.

892,822. POLE-TOP CAP. James W. Fraser, Charlotte, N. C. A cap for a transmission-line pole, which provides a support for an insulator pin.

892,841. SYSTEM OF CONTROL. Henry D. James, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A plurality of electromagnetic switches is provided for cutting out steps in the starting resistance.



892,822.—Pole-Top Cap.

892,857. ELECTRICALLY OPERATED SIGNAL FOR RAILWAY CROSSINGS. George W. Lancaster, Richmond, Va., assignor to Lancaster Automatic Railway Crossing Company, Inc., Richmond, Va. Certain of the signals at a railway grade crossing are released by the approach of a train, the others remaining locked.

892,868. CLUTCH. Thomas G. Morse, Erie, Pa., assignor to Morse Iron Works, Erie, Pa. The clutch is applied by two electromagnets.

892,872. ELECTRIC SWITCH. Hervey H. McIntire, South Bend, Ind. A switch the contacts of which are movable longitudinally.

ELECTRICAL REVIEW

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CONTENTS

THE OSCILLOGRAPH IN THE SHOP.

The oscillograph is certainly one of the prettiest of research instruments devised by physical science in recent years. Thanks to the ingenuity of Duddell and others we have here an instrument capable of following rapidly changing physical effects; and by the means of auxiliary devices we may either make permanent records of transient phenomena or actually watch these changes as they take place. Until the development of the oscillograph the student of electrical science was considerably handicapped, as all his instruments gave merely averaged values, and when these are used for measuring rapidly changing quantities, such as exist in a circuit through which an alternating current is flowing, the values thus found seem to indicate a departure from the laws known to apply to circuits in which the current is steady. For these reasons it has become more or less customary to study the flow of alternating currents from the mathematical rather than the physical standpoint; the fact that Ohm's law is always the fundamental law of electric flow, no matter what the type of current, is often overlooked.

When attempts are made to study the character of change going on in the alternating-current circuit, before the oscillograph was available, tedious step-by-step methods were necessary, and these were applied at times under a disadvantage, since the points of the curves thus obtained were not instantaneous values, but averages of many such values. But the oscillograph enables us to trace not only the true instantaneous changes, but also to record, when desired, the average series of changes which are going on. The instrument thus became one of considerable scientific importance, and we must credit it with many valuable researches. Nevertheless, it is usually looked upon as a purely scientific instrument, whose place is in the laboratory, not in the shop. For this reason, a short paper contributed to the July issue of the *Electric Journal* by H. H. Gallehar is interesting, as he takes the stand that a suitably designed and equipped oscillograph is an essential piece of apparatus for every testing floor. Such an instrument is not difficult to use and may be easily set up and is not easily influenced by external forces. When such a device is available many troublesome questions which arise during the testing of any electrical device may at once be answered. It will not only show the true character of the current and electromotive-force waves, but it will also show the true difference in phase between them. It gives the testing-floor staff the ability to watch the effects of any changes in conditions upon the apparatus being tested and to determine when the desired conditions for testing have been obtained. It thus forms a valuable addition to the usual equipment of the testing floor.

It is always interesting to notice the adoption of what is considered a purely scientific instrument to the utilitarian purpose of the testing floor, but it is even more interesting to notice how scientific the methods of the testing floor have become. Indeed, so far as the study of electrical apparatus is concerned, it would be pretty difficult to draw a line separating the so-called practical from the really scientific work.

A NOTEWORTHY HYDROELECTRIC SYSTEM.

One of the interesting and instructing papers presented at the recent meeting of the American Institute of Electrical Engineers at Atlantic City was that by Mr. J. W. Fraser which describes some of the important phases of the hydroelectric developments in North and South Carolina.

On the Pacific Coast and in other sections of the Far West fuel is expensive, and cheap power, or rather cheaper power than can be produced in a steam-driven station, is the desired end and the engineers of the transmission systems which have been built up out there have had this end constantly in view. To supply this demand for power it has been found profitable to transmit it electrically over distances far greater than those covered by transmission systems elsewhere in the world. On the other hand, at Niagara Falls and one or two other places a different condition exists. Here the reason for development was not the high cost of fuel but the opportunity offered by the enormous power represented by the falls and the possibility of producing mechanical power in large quantities at a less cost than could be done by the use of comparatively inexpensive fuel. There was, at the time the work was undertaken, no immediate market for this power; the nearest large market was Buffalo and it was anticipated that the output of the power plants at the falls, after it had been decided to develop them electrically, would be transmitted and sold at distant points. The outcome, however, was somewhat different, for while a good deal of energy was disposed of in Buffalo and other nearby towns, a greater part of it was sold to new industries established at the falls to take advantage of the low rates made them.

In the Carolinas, however, a condition different from either of the above faced those who undertook to develop the water powers of these states. Here there is a large market for power, not concentrated in one point, but scattered over a not very large territory. There are many cotton mills thickly dotted throughout the central part of the two Carolinas which offer the main outlet for the sale of energy. At these mills power was already supplied by steam-driven plants of fairly good efficiency and reliability. Fuel is not particularly costly, and as many of the plants are comparatively new they were not handicapped with old and inefficient machinery. The electrical system must, therefore, compete with good steam-power plants and it must not only be able to sell energy to the mills at a less cost, all things considered, than the mills can make it for themselves, but it must insure as great reliability as a simple steam engine belted to a series of line shafts.

For these reasons reliability became the controlling factor in design, since no mill could afford to depend upon unreliable power, however low the price; yet it was necessary to secure this reliability without an excessive cost of construction. To this end the engineers of the Southern Power Company, whose system is the one described by Mr. Fraser, studied carefully the insulation problem and adopted a factor of safety higher than that usually deemed satisfactory. The apparatus was selected with special reference to reliability and the protective system was thoroughly planned. On one of the more recent lines the factor of safety has been again raised, but this is with the expectation of doubling the transmission voltage on this line some time later. The practical reasons which lead to the selection of 44,000 volts for the present system of transmission lines and for the adoption of the frequency of sixty cycles are given in Mr. Fraser's paper, which is published elsewhere in this issue. Had the present company initiated the work the selection might have been different; but it had to consider one hydroelectric station already existing and the many motors which were in operation in certain of the mills.

There is another interesting phase of the power development of the Southern Power Company's system which was brought out in a few remarks made by Mr. Lee in discussing Mr. Fraser's paper. As on most of the southern rivers the problem of handling floods is serious and the variation in the flow of the rivers is great, the main power station is primarily planned for only the minimum flow. The question then rises if it will be profitable to install more apparatus in the power station and a reserve steam plant which will run during, say, two months of the year. This is one of the points discussed by Mr. Fraser and his conclusions are interesting; but Mr. Lee brought out another phase of the question which we do not remember to have heard discussed before. It will be remembered that a large number of these southern mills have adopted the electric drive because of the increased and improved output of the mills thereby secured, and although a power company might not be able to offer them terms sufficiently low to induce them to abandon their own power station, it might sell them energy at very low rates for about six months of the year and let them run their own power plants during the months when the water is low. To make such an arrangement profitable would require a much larger hydroelectric development than the usual considerations would warrant, but the plan may lead to a solution of the secondary power development entirely different from that arrived at by Mr. Fraser.

To indicate the importance of this southern power system, it may be said that it owns eleven power sites aggregating 150,000 horse-power, and as Mr. Fraser's paper deals mainly with the transmission-line problems some may be interested in learning in more detail the character of the hydroelectric stations which the Southern Power Company is installing. An excellent description of these was given by Mr. Fraser in the ELECTRICAL REVIEW, September 8, 1906.

SLAVES OF THE CLOCK.

Until recently we have looked upon the clock as an interesting physical device adapted by man to divide the day and night into convenient arbitrary periods; but it seems that in London, at least, the clock has risen from this menial position to one more dignified and important. Over there, it appears, the clock regulates man's actions, rather than man the clock's. It fixes the time for his getting up and going to bed; when the office is to be opened and when closed and the time of day when he shall rest his weary body. His brain, we surmise, needs no rest, either because it is never greatly exercised, or else, perhaps, because it has been worn beyond repair. At least, these are the impressions given one when reading the discussions of the proposed plan to shift the working period of the day an hour ahead during the summer and back again to its normal position during the winter, merely by moving the hands of the clock. As a simple suggestion and with the idea of saving a part of the expense of lighting streets and homes by inducing men to start their work earlier in the day, stopping, of course, just that much sooner in the evening, the idea might call forth a few interesting psychological remarks, but when a bill is introduced into Parliament for carrying out this plan, one begins to wonder by what mental process the originator of this plan and those who favor it arrived at the conclusion that the mere shifting of the hands of a clock at the dead of night will bring about a complete rearrangement of the working hours in the British Isles.

The measure is known as the "Daylight Saving Bill," a name which fits it about as well as it itself will fit in with human habits. Those in favor of the scheme seem to be under the impression that since the banks and telegraph offices of London do not open until the summer sun has been trying to shine through the London fog for five or six hours, no one else goes to work any sooner than that, and because custom has fixed the hour for opening certain offices at nine or ten o'clock, or even later, as the case may be, the only way they see of changing this custom is to change the clock. It seems to be a childish way to bring about a reform. Every one is to start to work during the summer an hour earlier than he is accustomed to, but his clock is to show the same old time; therefore, he will not be able to resent the change. But why, if the plan should work successfully during the summer months and show an unquestioned saving of daylight—why should the country return to the old plan during the winter, as it is not apparent that either method would be more economical of light than the other during the short winter day in England?

These questions, however interesting, are psychological rather than electrical and hence we should perhaps be more concerned about the effect the proposed plan would have upon the electric light companies of the British Isles; should not any such attempt to curtail their sales of energy be resented? Yet we have not been so careful in our use of light heretofore, and too frequently we are satisfied if we pay the lighting bills, caring little how the light itself is used. Hence this sudden conversion and a consequent effort to abandon old and wicked ways should be received with caution. Yet we doubt very much, even supposing every one minded the clock, if there would be such a great saving of artificial light as is promised. Would not those who now enjoy the night as a time for pleasure rejoice so much the more at having an hour more for enjoyment that they would unwittingly draw out the time to an hour and a half, or maybe two, with considerable benefit to the lighting companies and with perhaps some detriment to their own welfare? With the latter consideration we have no concern, and since it does not seem likely the lighting companies will suffer seriously from the plan, we are not much alarmed at the prospect presented. We therefore await the issue of this campaign without undue anxiety, leaving it to the Englishman to fight the matter out with his clock, for as Humpty Dumpty said, "The question is, Who is to be master?"

REFUSE DESTRUCTORS AND POWER PLANTS.

During the presidential address of Mr. Herbert Talbot before the Incorporated Municipal Electrical Association of Great Britain at the meeting held in June, the speaker referred briefly to the performance of the refuse destructor plant at Nottingham, England, and from the experience gained there drew an interesting conclusion. The conclusion is about as follows: Town refuse is a more expensive fuel than coal under the conditions existing at Nottingham; hence, it would be cheaper for the electrical system not to utilize the steam produced in this destructor and to produce all of its steam in its boiler plant. To do so would not involve any increase in the staff of the station and indeed would rather improve, as a whole, the operation of this plant, since the load-factor of its boilers is lowered by the operation of the destructor plant. Taking a broader view, however, it is admitted that burning is the best method of disposing of city refuse, and the heat thus produced might as well be utilized. It is then merely a question whether the destructor plant is to be operated for destroying purposes alone and the cost of so doing frankly paid, or whether it is to be operated in connection with the electrical supply system and the latter is to be saddled with the cost of destroying the refuse. The latter arrangement probably results in a small saving to the town, but it rather complicates the work of the electrical department.

THE MANUFACTURER AND THE ENGINEER—AND ENGINEERING.

A somewhat unusual communication on the subject "Should Manufacturers Cease Doing Free Engineering" appears in this issue. For its originality, if for no other reason, it is entitled to consideration. The suggestion therein embodied is certainly radical and, whatever the merits of the case presented, it could only be introduced by a series of transition stages. It would be difficult to conceive of a sudden reversal of the custom which has heretofore obtained, even though the resulting benefits should be all that our correspondent would expect. The subject is important and timely. No doubt there will be forthcoming expressions of opinion from the various sources interested.

Should Manufacturers Cease Doing Free Engineering?

To the Editor of the Electrical Review:

The series of communications on the subject "Is the Consulting Engineer Necessary?" which have appeared in recent numbers of the London *Electrician* and your own British namesake, the *Electrical Review,* and the editorial comments thereon, have probably come before you and your readers.

The consideration of these writings has induced an idea which I herewith lay before you in the hope that it will either be approved and confirmed and lead eventually to a change in the present order of things, or its fallacy pointed out.

My suggestion is, that no manufacturer should bid on apparatus except under specifications from the prospective purchaser or his engineer, and that the manufacturing companies cease making plans and specifications. This suggestion is made in the interests of both the manufacturer and the consulting engineer, but the benefits would accrue principally to the manufacturer. The reasons which appear to make this course advisable are:

(1) The manufacturers would eliminate the cost of an enormous amount of futile engineering, done for people who have not the means to carry out their schemes nor the power to interest capital in them.

(2) The sales departments would have their work, records and expenses greatly reduced because of the elimination of projects which can never be brought to fruition.

(3) Manufacturers of high-grade apparatus would have a better opportunity of getting business on a basis of merit and worth.

(4) Business would be done between the manufacturer and an engineer, and therefore more understandingly, and on a better basis and at a lower cost.

(5) The practice of having one manufacturer prepare plans and specifications at his own expense, to be hawked about to other manufacturers, would be done away with.

(6) Where a prospective buyer applies to several manufacturers for plans and specifications it means that an equal number of specifications—no two of which coincide—are made for a single installation. This obvious and expensive waste of work would be avoided.

The manufacturers could confine their attention to turning out apparatus at the lowest cost consistent with the production of high-grade machinery, reducing their general and sales expenses, because in nearly every instance requests for quotations would come from responsible parties who would be actual purchasers, for no penniless promoter would retain a consulting engineer.

The adoption of this proposed system would require either an agreement among all the manufacturing companies or the independent action of the head of some company who is sufficiently big, broad, strong and wise to take this action, knowing that by his reduction in cost and the friendly attitude of the engineering profession toward any policy which would thus advance its interests, his company would possess no small advantage and would reap the reward of sanity and good judgment.

Engineer.

New York, July 11, 1908.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

KANSAS CITY HOME AND LONG DISTANCE TELEPHONE COMPANIES.

The report of the Kansas City Home and Long Distance Telephone Companies for the year ended March 31, 1908, shows gross earnings of $955,212, an increase of $162,338; net earnings of $462,901, an increase of $85,738, and surplus after charges of $258,917, an increase of $68,033.

The Toledo Home Telephone Company, of Toledo, Ohio, reports gross earnings for the year ended December 31, 1907, of $354,618, an increase of $39,330, and surplus after charges of $129,091, an increase of $15,033.

The Kinloch Long Distance Telephone Company, of Missouri, shows gross earnings for the year ended December 31, 1907, of $1,139,151, an increase of $148,911, and surplus after charges of $282,425, an increase of $89,858.

LAKE SHORE ELECTRIC COMPANY.

The Lake Shore Electric Company reports gross earnings for May of $69,538, a decrease of $4,344; net earnings of $29,498, a decrease of $1,421, and surplus of $3,686, a decrease of $3,919. For five months the gross earnings were $307,439, a decrease of $10,521, and net $118,251, a decrease of $4,941. After allowing for interest charges there was a deficit of $10,174, an increase of $15,227.

CHICAGO RAILWAYS COMPANY.

Since the beginning of the present fiscal year, on February 1, the Chicago Railways Company has shown increases in both gross and net earnings. The April, March and February reports, which complete the first quarter of the fiscal year, are given in detail as follows:

Earnings.	April, 1908.	March, 1908.	February, 1908.
Passenger	$847,220	$840,743	$742,826
Sales of power	1,440	1,552	......
Other income	16,775	15,437	16,116
Gross	$865,435	$857,732	$758,942
Expenses:			
Maintenance of structure	$54,262	$47,262	$30,087
Maintenance of equipment	80,688	69,943	61,245
Operating cars and power plants	356,190	371,276	364,525
General	113,585	99,595	88,362
Real estate income	5,000	3,624	4,008
Taxes	16,608	16,609	16,609
Totals	$626,333	$608,309	$564,836
Balance (actual)	239,102	249,423	194,105
Balance, 30 per cent of gross	259,630	257,320	227,683
Interest, 5 per cent on value of property	136,492	136,065	135,788
Net income	$123,138	$121,255	$91,895
Division:			
City's 55 per cent	$67,726	$66,690	$50,542
Chicago Railway's 45 per cent	55,412	54,565	41,352

As shown by the above figures, the actual operating expenses in April were seventy-two per cent of gross, in March the percentage was seventy-two, and in February they were seventy per cent. This is due to the work of rehabilitation, but after the first part of the work is completed the ratio should decrease rather than increase.

The terms of the ordinance provide that seventy per cent shall be charged to income account for operation. At the end of the year any excess of that figure will be paid into the earnings account out of the capital account, unless the cost of operating should fall below that figure during succeeding months of the year.

The Chicago Railways Company's balance sheet, as of April 30, 1908, compares with that of March 31, 1908, as follows:

ASSETS.	April 30.	March 31.
Road and equipment	$33,030,238	$32,758,146
Cash	323,866	1,357,241
Total	$33,354,104	$34,115,387
LIABILITIES.		
Capital	$32,589,047	$32,589,047
Reserve for damages	580,098	545,758
Due city of Chicago	184,959	980,582
Total	$33,354,104	$34,115,387

The total passengers carried by the Chicago Railways Company lines, cash fare, free and on transfer, increased 1,603,376 in April and 1,092,794 in March. The earnings per car-mile and per passenger are also given in detail for the two months named.

Passengers carried:

	April, 1908.	March, 1908.
Revenue passengers	17,132,869	16,935,066
Free passengers	215,777	184,724
Transfer passengers	11,667,959	11,866,843
Total	29,016,959	28,486,633

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

EIGHTH ANNUAL MEETING, HELD IN CHICAGO, ILL., JULY 15, 16 AND 17.

The eighth annual meeting of the National Electrical Contractors' Association was held at the Auditorium Hotel, Chicago, Ill., July 15, 16 and 17. The convention was opened with a session of members and guests on Wednesday morning, July 15. A number of contractors from several states were in attendance and there was present also a large representation of manufacturers.

The address of welcome was made by Henry Newgard, president of the Illinois Electrical Contractors' Association. The first paper, entitled "The Electrical Contractor's Opportunities in the Illuminating Field," was read by the author, George Loring. An abstract of this paper is presented elsewhere in this issue.

A paper entitled "The Relations Between the Underwriter and the Contractor" was read by W. H. Merrill, Jr., manager of the Underwriters' Laboratories, Chicago, Ill.

These papers were discussed briefly, both Mr. Loring and Mr. Merrill replying to numerous questions. Mr. Merrill invited those attending the convention to visit the laboratories, which are conducted under the direction of the National Board of Fire Underwriters.

The contractors were the guests of the Chicago Electric Club at luncheon, and in the afternoon a business session was held at two o'clock.

On Wednesday evening banquets for both the ladies and gentlemen were held in the Auditorium Annex, the banquet rooms being thrown together after the repast and a fine vaudeville programme thoroughly enjoyed.

On Thursday morning there was an open session for members and guests. J. R. Cravath presented a very interesting discourse on "Illuminating Engineering." In the course of his remarks Mr. Cravath said: "The contractor who has a sufficient knowledge of illuminating engineering so that he can go to the dissatisfied user of an unsatisfactory lighting installation and guarantee him more results for the money he is expending for light can create business and get work which otherwise would not be available." He called attention to some of the first principles of interior illumination and indicated the proper method of attacking such problems of artificial illumination as would ordinarily come within the province of the electrical contractor.

Alex Dow addressed the session on the topic, "The Relations Between the Lighting Company and the Contractor," followed by Seth B. Wetherbee, on the topic, "The National Electrical Contractors' Association."

On Thursday afternoon a brief business session was held, and the members were later taken in tally-hoes to the National League Park, where an exciting baseball game between the New York and Chicago teams was witnessed. The party returned to the Auditorium in tally-hoes. During the afternoon the ladies enjoyed an automobile trip through the south parks and boulevards.

At 7.30 o'clock Thursday evening the members met in business session, the ladies attending the performance of "The Top o' the World" at the Studebaker Theatre. At nine o'clock a Rejuvenation of the Sons of Jove was held at which fifty new members were initiated into the mysteries of the order.

On Friday all the members and guests enjoyed an all-day outing to Michigan City, going by way of the steamship Theodore Roosevelt. A repast was served on both trips and while at Michigan City there were races for the ladies, a fat men's race, potato race, swimming race and a baseball game between the eastern and western contingents, the former winning by a score of ten to seven.

The following officers were elected for the ensuing year:

President, G. M. Sanborn, Indianapolis, Ind.

First vice-president, M. L. Barnes, Troy, N. Y.

Second vice-president, Charles R. Krieder, Chicago, Ill.

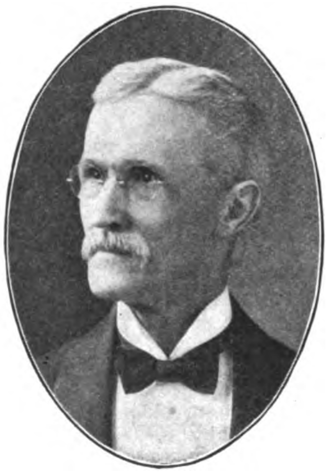
Third vice-president, H. S. Potter, Boston, Mass.

Treasurer, John R. Galloway, Washington, D. C.

Secretary, W. H. Morton, Utica, N. Y.

Sergeant-at-arms, J. C. Sterns, Buffalo, N. Y.

G. M. SANBORN,
President National Electrical Contractors' Association.



JOHN R. GALLOWAY,
Treasurer National Electrical Contractors' Association.

W. H. MORTON,
Secretary National Electrical Contractors' Association.

There was very little display of electrical apparatus by the manufacturers, but there was a fine attendance of representatives, among whom the following were present:

George S. Searing, Chicago sales manager, Hart & Hegeman, Hartford, Ct.

W. W. Cheney, Jr., president; Julian S. Jackson, sales manager; A. Benson, secretary, International Electrical Meter Company, Chicago.

G. W. Cooper, district sales agent; Frank E. Johnson, district sales agent, the Ohio Brass Company, Mansfield, Ohio.

John Brooks, sales manager; G. V. W. Ingham, Chicago sales manager, Pass & Seymour, Solvay, N. Y.

I. A. Bennett, W. J. McKenna, I. A. Bennett Company, Chicago.

Sherman M. McFedries, secretary and treasurer; W. R. Harvey, J. L. Schureman Company, Chicago.

J. G. Pomeroy, western sales manager, Adams-Bagnall Electric Company, Cleveland, Ohio.

G. A. Furbeck, Furbeck & Hurt, St. Joseph, Mo.

Arthur O. Einstein, sales manager, Crescent Company, Chicago.

James G. Gilchrist, general manager;

H. W. Markham, sales manager; H. F. Frosch, Federal Electric Company, Chicago.

Frederick L. Merrill, Chicago manager Triumph Electric Company, Cincinnati, Ohio.

George Loring, Shelby Electric Company, Shelby, Ohio.

W. J. Guntz, G. R. Clover, Nernst Lamp Company, Pittsburg.

M. B. Austin, president; W. A. Brown, treasurer; R. J. Thorne, Michigan representative; Arnold H. Friend, M. B. Austin Company, Chicago.

Edwin R. Rockwell, secretary Guarantee Electric Company, Chicago.

C. E. Corrigan, vice-president and general manager; Milton Mill, southwestern sales agent, National Metal Molding Company, Pittsburg, Pa.

Victor L. Crawford, W. N. Matthews & Brother, St. Louis, Mo.

George C. Knott, H. E. Watson, Benjamin Electric Manufacturing Company, Chicago.

H. B. Crouse, president; F. F. Sheel, western manager, Crouse-Hines Company, Syracuse, N. Y.

Homer E. Niesz, manager Electrical Trades Exposition Company, Chicago.

M. F. King, George C. Richards, P. J. Cratty, Richard Wildauer, Thomas Grier, American Circular Loom Company, Chelsea, Mass.

Henry Newgard, president Henry Newgard & Company, Chicago.

J. R. Wiley, J. E. O'Neill, R. S. Hopkins, E. J. Pietzcker, Standard Underground Cable Company, Pittsburg, Pa.

H. D. Haring, O. O. Tucker, M. R. Lash, F. H. Van Gorder, H. W. Dye, H. F. Boardman, J. H. Dutton, G. H. Lounsbery, George H. Porter, H. M. Kennedy, F. A. Henderson, L. J. Baldwin, H. M. Post, E. S. Kiefer, E. H. Peterson, Western Electric Company, Chicago.

E. J. Johnson, Consumer's Rubber Company, Bristol, R. I.

William Low, president; E. R. Field, H. R. Remington, Perry R. Boole, C. A. McCarthy, H. E. Sanderson, A. J. Seltzer, Robert Mitter, Electrical Appliance Company, Chicago.

A. S. De Veau, T. C. Walsh, De Veau Telephone Manufacturing Company, Brooklyn, N. Y.

F. F. Corby, C. W. Larsen, D. L. Markle, Mark Manufacturing Company, Chicago.

U. S. Armstrong, American Conduit Manufacturing Company, Pittsburg, Pa.

E. P. Bartlett, H. G. Wilson, John A. Roebling's Sons Company, Trenton, N. J.

W. Ennis, manager Pittsburg office, Buckeye Electric Company, Cleveland, Ohio.

Oscar Carman, General Electric Company, Schenectady, N. Y.

W. Johnson, Clark H. Methot, Manhattan Electric Supply Company, Chicago.

C. M. McDonald, Allis-Chalmers Company, Chicago.

P. F. Lyons, National India Rubber Company, Bristol, R. I.

E. B. Kittle, manager Chicago office; Alfred E. Braddell, Harry H. Hornsby, Sprague Electric Company, New York, N. Y.

F. B. Badt, P. A. Westbury, F. B. Badt & Company, Chicago.

Robert Garland, H. D. Hodskinson, H. O. Waterman, Safety Armorite Conduit Company, Pittsburg.

Skyles R. Fralick, Blake Signal and Manufacturing Company, Boston, Mass.

H. M. Frantz, H. W. Johns-Manville Company, New York, N. Y.

E. R. Blyler, Crescent Insulated Wire and Cable Company, Trenton, N. J.

E. W. Kearns, Monarch Electric and Wire Company, Chicago.

W. P. Crockett, Bossert Electric Construction Company, Utica, N. Y.

Maurice Lewison, Detroit Insulated Wire Company, Detroit, Mich.

B. J. Moorenhaupt, Dale Company, New York, N. Y.

A. C. Crockett, Hart Manufacturing Company, Hartford, Ct.

C. D. Gordon, Alphaduct Company, Jersey City, N. J.

James Olson, Habirshaw Wire Company, New York, N. Y.

F. R. Bryant, Central Electric Company, Chicago.

A. I. Appleton, president; John V. Painter, secretary, Appleton Electric Company, Chicago.

Peter F. Hensel, S. H. Couch Company, Boston, Mass.

Charles Mosser, Dearborn Electric Company, Chicago.

A. L. Willard, Westinghouse Electric and Manufacturing Company, Pittsburg.

H. S. Greene, Nungissen Electric Battery Company, Chicago.

J. E. Ham, Waterbury Company, New York.

R. M. Van Vliet, H. P. James, Charles Klien, V. C. Gilpin, Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

Frank N. Jewett, Thomas T. Richards, Wagner Electric Manufacturing Company, St. Louis, Mo.

James Wolff, New York Insulated Wire Company, New York, N. Y.

P. R. Fisher, Condit Electric Manufacturing Company, Boston, Mass.

H. J. Wilms, Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.

R. L. Thayer, St. Louis Malleable Castings Company, St. Louis, Mo.

F. T. Finney, Western Installation Company, Chicago.

F. D. Phillips, Wesco Supply Company, St. Louis, Mo.

William W. Merrill, secretary and manager; Arthur S. Merrill, Miller Mill, Chicago Fuse Wire and Manufacturing Company, Chicago.

C. R. Wood, R. H. Mills, Moline Incandescent Lamp Company, Moline, Ill.

Harry C. Rice, G.-I. Incandescent Lamp Company, Cleveland, Ohio.

Warren Ripple, president J. Lang Electric Company, Chicago.

George Cutter, president George Cutter Company, South Bend, Ind.

Albert Scheible, president Ajax Line Material Company, Chicago.

American Telephone and Telegraph Company.

Hayden, Stone & Company have prepared a circular giving an exhaustive analysis of the American Telephone and Telegraph Company. The circular says that the company is fully financed for all present requirements, having paid off on July 1, $10,000,000 of American Bell Telephone four per cent bonds maturing on that date, and is now free of any floating indebtedness, and has an excess of $10,000,000 cash on hand. The capitalization, including bonds and notes amounting to $330,484,855, as well as the capital obligations of the subsidiary companies, is represented by property, the replacement value of which, without considering any value in rights of way or franchise or patents, is estimated at $10,000,000 in excess of the entire capital of every kind. The franchises and rights of way are in the greater part permanent, and could not be secured at the present time at any cost within limits. Never since its incorporation in the present form, in 1900, has the company failed to earn its entire fixed charges more than three times over. The circular says:

"No company could possibly attain the tremendous scope of the American Telephone and Telegraph Company, and remain local in any particular. As the American company has become national in the operation of its business, so it must surely become national in the method of its financing and in the demand for its securities. The evident and increasing attraction of its securities will draw capital from all parts of the country, and the shares of the company, already held by 25,000 investors, will become still more widely owned. The inevitable result will be the development of a large and active market for both the bonds and stock of the American company in the financial centre of the country, New York."

The New York, New Haven & Hartford Railroad to Build New Lines.

The New York, New Haven & Hartford Railroad Company has announced that it would expend $1,000,000 on the construction of three new trolley lines. The contracts are to be let at once, and work will be begun on all three lines this fall. One of these lines is to be run from Hartford to Middletown, another from Hartford to Boonfield and the third from Willimantic to South Coventry.

The expenditure on these roads will be the first that the New York, New Haven & Hartford road has made since the financial flurry of last fall, when the company began a policy of retrenchment.

Samuel Higgins, general manager of the New Haven, in discussing the electric system of the road, has expressed his own satisfaction with it and added that the company was well pleased with it. The system was constructed by the Westinghouse Electric and Manufacturing Company, and has a high-potential alternating-current with an overhead trolley.

Mr. Higgins said that the electrification of the New Haven had been so satisfactory in every respect that there had been no thought on the part of the company to substitute another system for the one now in use.

The last payment for the installation, said the general manager, had been made to the Westinghouse company about four months ago, which was further proof of the satisfaction of the railroad company.

SOME ENGINEERING FEATURES OF THE SOUTHERN POWER COMPANY'S SYSTEM.[1]

BY J. W. FRASER.

It has been aptly stated that in order to build a hydroelectric power system there are three fundamental requirements:

1. A sufficient source of power.
2. A market for the sale of power within economical transmitting distance.
3. The necessary capital.

It is not the intention of the writer to discuss these three fundamentals in a general way, but to take a concrete example and show how the conditions governing the sale of power must affect the design of the system as exemplified in that with which he is connected; to describe in a general manner this system and proposed ultimate extension of the same.

We will assume for the purpose of this paper a sufficient source of power, as any discussion of the hydraulic conditions would lengthen this paper undesirably. In passing, attention will be called only to the location of the various sites shown on the map, Fig. 2. These aggregate not less than 150,000 horse-power. One only, the Catawba plant of 10,000 horse-power capacity, was partially developed. The nine others are scattered along the Catawba River for a distance of 120 miles, with one on the Broad River about thirty miles west of Catawba station.

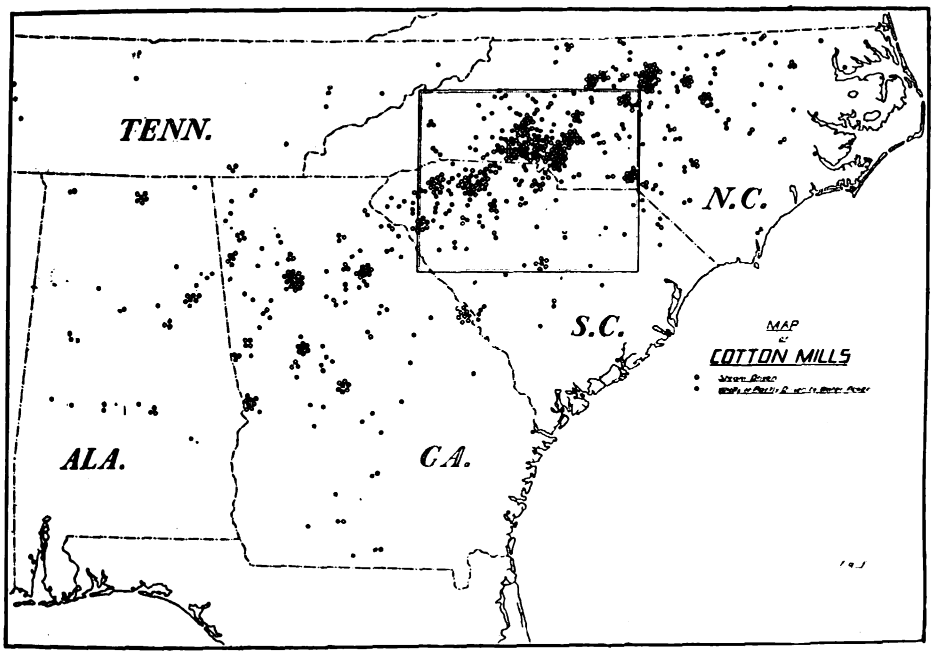


Fig. 1.—Map Showing Location of Cotton Mills.

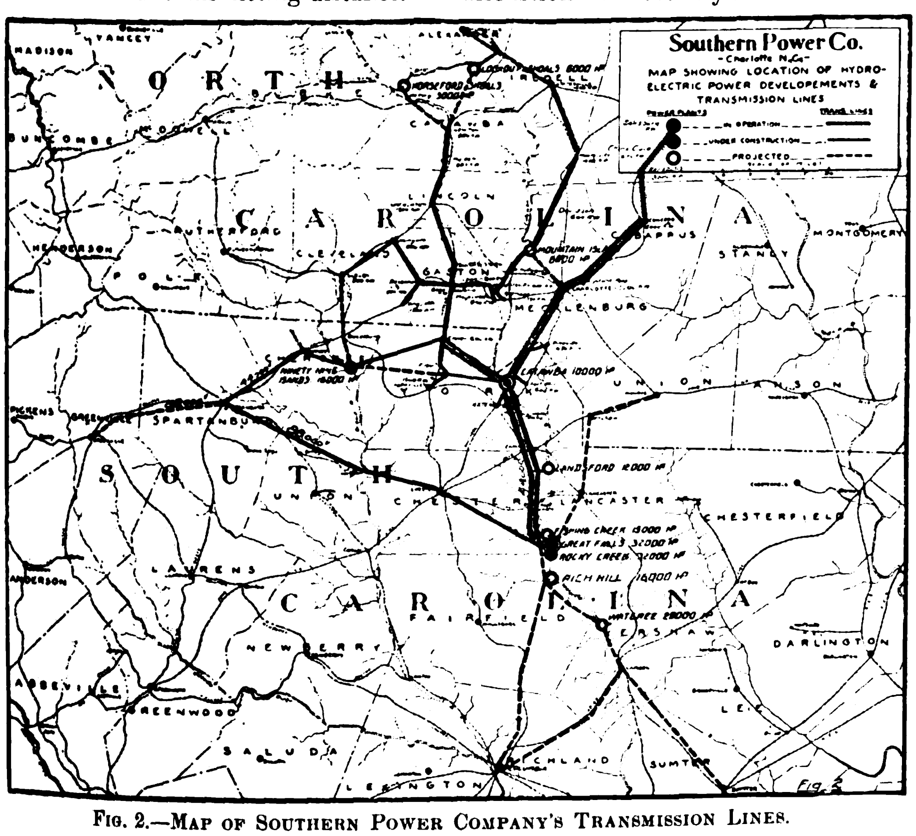


Fig. 2.—Map of Southern Power Company's Transmission Lines.

In discussing the market at the time when the Southern Power Company was organized (1905), attention is first called to the map, Fig. 1, showing the location of cotton mills in the South, on which is shown a rectangle covering an area of 140 miles north and south by 180 miles east and west, about equally distributed in North and South Carolina. This area is enlarged on the map, Fig. 2. It will be noted that it contains the largest number of mills that can be taken in by any such area in the South. It represents a power consumption of approximately 200,000 horse-power, one-fourth of which is water power. It is all within easy transmitting distance from the various power sites referred to in the above paragraph.

Before investing in these sites a careful investigation showed the average cost of power to be in the neighborhood of $34 per brake-horse-power-year of 3,366 hours; that, although a few of the larger mills had got this cost down to $30, the majority of the smaller mills could not produce power for much less than $40. With coal at $3.50, power could not be distributed for less than $28, even from large central steam stations. Experience acquired from the Catawba station and some smaller stations, to the records of which access was had, showed a fair margin of safety after transmission and other losses were taken into account.

True it is that in recommending investment in these sites it had to be considered that although the electric drive had demonstrated in some instances its reliability, convenience and economy, yet the unsatisfactory history in other instances, the general impression that power was produced for much less than it actually cost, and the fact that mill owners were averse to further investment, would make the sale of power a difficult matter. Still the main question which interested the investor was the cost of steam power, for prejudice could be overcome and the real cost of power could be demonstrated. In a further discussion of the market it is found convenient to treat of it under separate heads embodying the various engineering features.

Frequency—In determining what frequency would best suit the market condi-

[1] A paper presented at the annual convention of the American Institute of Electrical Engineers, Atlantic City, N. J., June 30. For a description of the different power sites owned by the Southern Power Company see Electrical Review, September 8, 1906, p 367.

tions the following had to be taken into consideration:

a. That the sixty-cycle generators at Catawba station and some 8,000 to 10,000 horse-power in induction motors receiving power from that station would have to be rewound or exchanged, if other than sixty-cycle were used, on account of the fact that separate lines would be too expensive and would complicate matters. Motor generators would make the cost prohibitive, because of the large number of distributing points.

b. That sixty-cycle motors to a total of approximately 8,000 horse-power were driving mills in the vicinity of proposed lines, which load might be obtained, provided the frequency was the same.

c. That there were also quite a few small city plants operating at sixty cycles. At present this might not amount to much, but the growth of these cities had to be considered, particularly in reference to arc lighting. In three years 2,500 arc lights have been put in service and if motor-generators had had to be installed the cost to small mill towns would have been excessive.

d. That a high frequency would give a better power-factor, due to the leading charging current.

e. That twenty-five-cycle generators, transformers and motors would cost at least ten per cent, twenty-five per cent and ten per cent, respectively, more than sixty-cycle generators, transformers and motors.

f. That there was very little prospect in the near future of a rotary converter or railway load, and there were plenty of cotton mills in the district covered to use all the power which could be generated from the rivers.

Against the above is the extra line drop, but when all the developments are completed very little power will be transmitted more than forty miles except over trunk lines where the drop may be taken care of by raising the generator electromotive force. For instance, the voltage at Catawba and at Spartanburg, two centres of distribution, can always be maintained at 44,000 volts.

These considerations seemed to favor sixty cycles, but as exact figures were necessary in this case the following rough calculation was made: The saving in cost of generators and transformers amounted to $75,000, and if the saving in copper due to increased power-factor is added the total will be in the neighborhood of $100,000.

There is an additional loss of about ten per cent of the loss which there would have been at twenty-five cycles and the integrated loss over the present lines when fully loaded will be in the neighborhood of twenty-seven per cent. In power

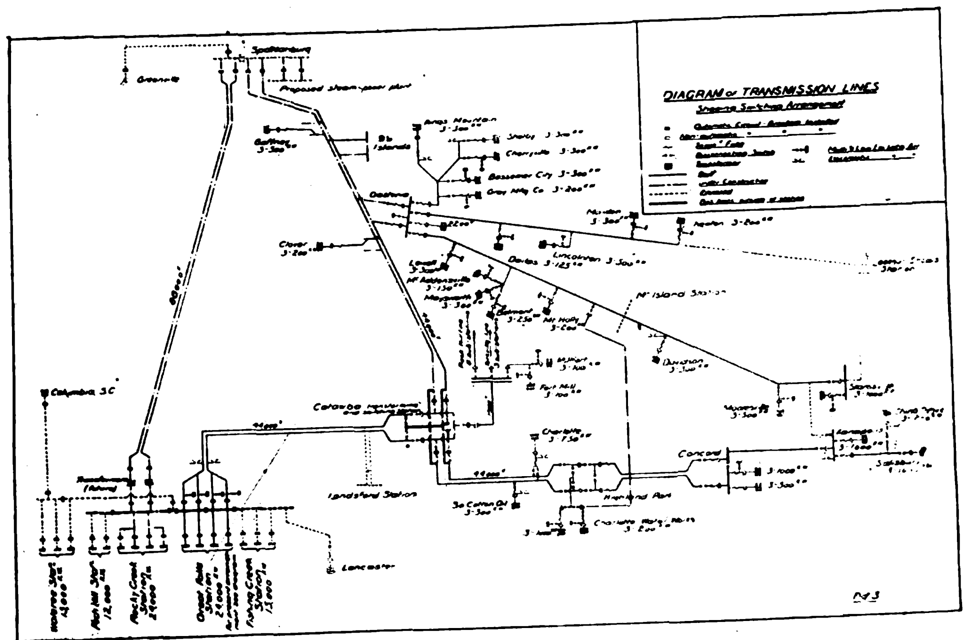


Fig. 3.—Transmission Lines and Switching Arrangements.

this amounts to ten per cent of twenty-seven per cent of 26,000 kilowatts = 700 kilowatts, which at $5 per kilowatt is $3,500. Capitalized at six per cent this amounts to $60,000—a balance of $40,000 in favor of sixty cycles. It is possible that a very careful analysis might show this loss to be a little greater but the error

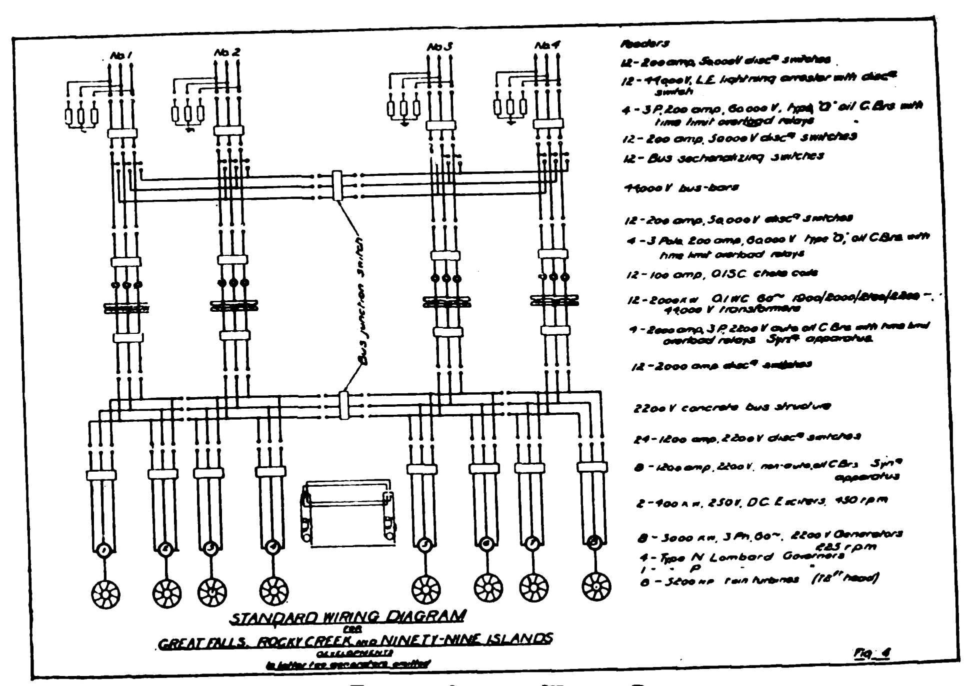


Fig. 4.—Type of Station Wiring Diagram.

can not be over twenty-five per cent, as the integrated loss referred to has been taken over a period of six months and covers losses from generators to meters on load. The only other error which could be made would be in estimating the line drop when the present lines were fully loaded, but as the drop on the present load has been measured the error could not be very large.

Considerations (*a*), (*b*) and (*c*) have been left out of the above numerical calculation but might easily amount to several times the figure mentioned.

Voltage—Some of the reasons for keeping the electromotive force as low as 44,000 volts were:

a. That 44,000-volt transformers would cost from eighteen per cent to thirty-three per cent, depending on the size, less than for 66,000-volt transformers.

b. That transformers and switches were more reliable at 44,000 volts.

c. That insulators would cost about eighty cents less each.

d. That line operation would be more successful.

e. That smaller transformer stations could be built.

It was estimated that the extra copper to give the same drop over the entire system at 44,000 volts as compared with 66,000 volts would not exceed the extra cost of transformers, insulators, substations, switches and other apparatus. The estimate proved correct. With the present 30,000-horse-power load there are on the system 72,000 kilowatts in step-up and step-down transformers and the additional cost if 66,000-volt transformers had been used would have been $64,000; additional cost of 30,000 insulators at eighty cents, $24,000; additional cost of thirty 66,000-volt substations, *i. e.*, twenty per cent on $125,000, $25,000; additional cost of step-up transformer stations, *i. e.*, ten per cent on $200,000, $20,000; a total of $133,000. Against this is the saving in copper in the transmission line had the higher electromotive force been used, roughly, fifty per cent, $130,000.

This shows a saving of only $3,000, but the present lines will carry a great deal more power than they are now carrying, which will increase this amount materially.

One line only of those proposed stands out as an exception, the trunk line running from Great Falls to Spartanburg and thence to Greenville, about 100 miles in length. This line now under construction will be so built that when overloaded at 44,000 volts delivered electromotive force it can be changed to 88,000 volts (*i. e.*, 100,000 volts at generating station). This will be accomplished at a very small additional expense by mounting pins and insulators similar to those now used on our wood-pole lines on the towers as shown in diagram, Fig. 5, for after conversion to a higher electromotive force these pins and insulators can be used on 44,000-volt lines, or this line may be permanently used for local distribution. The intention is that this 88,000-volt trunk-line will not be tapped at any point except Spartanburg. This could be done more easily by using 100,000-volt suspension-type insulators but it is felt that by the time it is necessary to change to the higher electromotive force there may be enough improvement made in these insulators to warrant the extra expense which would be incurred.

Transmission Lines—Further examination of the transmission-line map will show that two-thirds of the obtainable power is in the neighborhood of the Great Falls development, which position was selected as a main switching station, the idea being to mass the output of Great Falls, Fishing Creek, Rocky Creek and Rich Hill at this point on outdoor bus-bars and control the line switches from the operating room in this station.

The generators and transformers were designed to operate continuously at eighty-five per cent power-factor to take care of an induction-motor load, and at 115 per cent normal electromotive force to take care of line drop as the load increased. The main trunk line, from Great Falls to Catawba station, will take care of 20,000 kilowatts at eighty-five per cent power-factor, with a line drop of 13.5 per

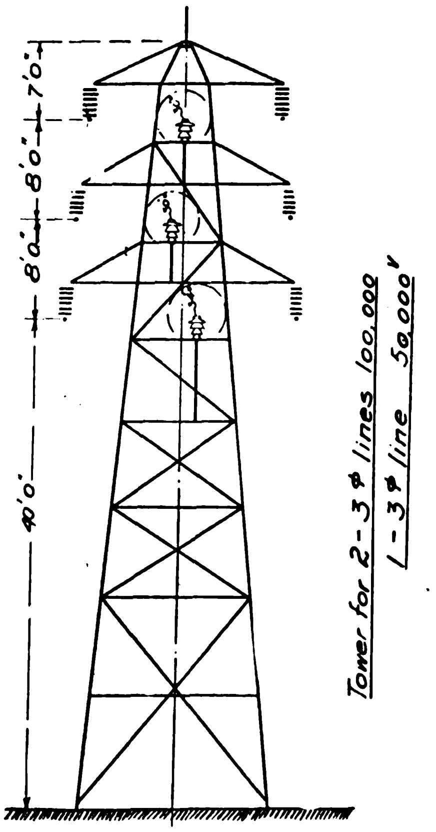


Fig. 5.—88,000-Volt Tower.

cent and a loss of 7.25 per cent. This represents the economical section of copper at twenty cents per pound with power costing $5 per kilowatt-year.

It should be pointed out before leaving the subject of transmission lines, that the impossibility of making contracts with mill owners on account of their skepticism with regard to the electric drive, before the greater part of the present lines was actually built, made the estimates on the amount of power to be sold in any one territory so difficult that the location and size of transmission lines could not be determined even approximately. In other words, where and in what amounts power was to be sold was a very uncertain matter.

This brought up the question of wood-pole lines *versus* steel towers. A little consideration showed that if the cost of towers per additional foot in height erected were $7 and copper were at twenty cents per pound, a No. 0 Brown & Sharpe gauge would be the smallest wire which could be strung economically on account of the increased sag in wires below this size for 500-foot spans; that a single-circuit tower line would cost approximately twice as much as a pole line and would last probably twice as long; that a double-circuit tower line would cost very little more than a double-pole line; and that it would be more economical for cotton mills to shut down for a small percentage of time than to pay the additional price for power which would be necessary to cover the extra expenditure for steel-tower lines. It therefore seemed good practice to build main trunk-lines of steel towers and all single lines below No. 0 gauge of wood poles.

Still another factor increased this difficulty. One large development under construction and several others recently financed by competing companies tended to make mill owners hold off for better prices. I refer to this merely to show how such a matter may affect the design. Considerable discussion resulted as to whether Great Falls and Rocky Creek should not be made into one development by means of a canal and pipe-lines. This would take at least as long again as to develop one source and would cost the same as separate developments.

(To be concluded.)

Extensive Trolley-Terminal Plans.

Plans were made known on July 16 for a new trolley terminal in Jersey City, which, it is said, would be one of the largest in the world. The terminal will be operated in connection with the tunnel system to Manhattan, and work on the improvement will be started in a few weeks.

It is planned to draw many of the New Jersey trolley lines to a point in Exchange Place, Jersey City. An underground passageway will run from the tunnel station to Exchange Place. A half dozen loops will be laid for the cars and sheds will be built. Trolleys from almost every district in Hudson County will be brought to the terminal.

Another transfer point in Jersey City may be at Henderson street and Newark avenue. It is proposed to divert several main lines to the point, thus enabling passengers to gain time in reaching the McAdoo tunnel.

Annual Convention of the American Institute of Electrical Engineers—III.

Report of Concluding Sessions, Thursday, July 2.

THURSDAY MORNING SESSION.

THE seventh session of the meeting of the American Institute of Electrical Engineers, which was held at Atlantic City, N. J., June 28 to July 2, inclusive, was opened on Thursday morning, July 2, at 9.30 o'clock, with President Stott in the chair.

The reports of the preceding sessions were given in the issues of the ELECTRICAL REVIEW for July 4, 11 and 18.

Dr. C. P. Steinmetz read a paper entitled "The General Equations of the Electric Circuit." Due to our incomplete knowledge of the phenomena resulting from the stored energy of the electric field, we are greatly hindered in a practically unlimited extension of high-potential transmission and distribution. The study of these phenomena represents the most important problem of electrical engineering. Dr. Steinmetz has been investigating the general equations of the electric circuit and here presents his first results. The work is still incomplete and in some instances may require modification. The paper represents an attempt to investigate mathematically the phenomena which may occur in the most general case of an electric circuit.

Dr. Steinmetz said that the investigation was incomplete, but brought out some important facts. One is that the general equation of a circuit shows that it may be considered as having two electric waves moving in opposite directions, each of which gives rise to a reflected wave. Another point is that when a transition takes place from one part of the circuit to another having different characteristics, there is both a voltage and a current transformation, and since both at the point of transition must be identical, there must be a sudden change in phase. In concluding, Dr. Steinmetz said that from what has already been done, he thought it safe to predict that in a few years we shall be able to treat the transient phenomena of electric circuits with as great accuracy as we can now deal with simple alternating currents. When we are able to do this we will be in a far better position to handle those disturbing effects on transmission systems which he calls lightning, and these will probably lose their terrors.

Dr. F. Bedell said that one great value of Dr. Steinmetz's classic paper was his interpretations of his own results. This is often neglected in such analytical studies. He pointed out that in the general case the current may not be the same in all points of the circuit, and said the hydraulic analogy might be applied to the general case by substituting an elastic tube for the rigid pipe. He pointed out that different components travel at different rates along the line, and this is the reason distortion takes place in telephone circuits.

D. C. Jackson said that in looking over Dr. Steinmetz's paper many old friends reappear, but there are also new equations which go much further than the old ones. He thought the best analogy for the general case was a vibrating string having different characteristics at different parts, these corresponding to different values of inductance and capacity.

Dr. Charles P. Steinmetz presented a paper entitled "Primary Standard of Light." In this it is pointed out that since light is a physiological effect, and not a physical quantity, it can not be measured in absolute physical units, but must be measured by comparison with an arbitrarily chosen standard of physiological effect. As a result of this, even the difficulties of reproduction and of maintaining its constancy are such as to involve errors very far beyond those considered permissible in physical measurements. A radical increase in the accuracy of reproduction and maintenance of a primary standard of light appears possible only by relating the standard of light in such manner to physical quantities that it can be determined by energy measurements. This led to the recommendation of defining the primary standard of light by the energy of radiation; but this requires a definition of the quality of radiation, since the physiological effect of radiation has no direct relation to the energy of radiation. Moreover, the physiological effect is not merely a function of the quality or color of the light, as lights of the same intensity and color—that is to say, physiologically identical—may be entirely different physically and represent different amounts of power. The power of the visible radiation is, therefore, not a measure of light. For this reason the definition of the absolute unit of light as the effect of one watt of power of visible radiation requires an arbitrary definition of the distribution of power throughout the visible range. Such a standard of light might be that given by black-body radiation at a different temperature and included between certain wave-lengths of the spectrum, but Dr. Steinmetz does not think that such a standard would be satisfactory, because the intensity of the red end of the spectrum is too high, the physiological effect too small, the absorption constant of glasses is different for different wave-lengths, any deviation of the radiator from black-body radiation offsets the result, and the color of the light would be yellow and not white. He thinks a more satisfactory primary standard of light, based on measurement of radiation power, can be produced by selecting three primary colors of the visible spectrum. Let these colors be of definite wave-length, about equally distant from each other, and of such character that they can be absolutely reproduced at high intensity; such, for example, as the spectrum lines of a luminous gas. Then define the unit of light as that given by one watt of power radiated at these three wave-lengths in different proportions, chosen so as to give white or yellow-white light. The primary unit of light may be taken as the physiological effect produced in this way. Such a standard requires three sources of monochromatic radiation which can be maintained constant with any desired exactness. The mercury-vapor lamp constitutes such a source. By properly adjusting the current density in the mercury-vapor lamp, three bands may be picked out: one in the violet, one in the green and one in the red, which are about equally distant. These are the lines having respectively the wave-lengths 43.55, 54.6 and 69.1 microns. To obtain them two low-temperature mercury lamps will be required for the blue and green and one high-temperature quartz lamp for the red. These could be maintained at constant radiation by maintaining the currents constant and also the condition of ventilation and surrounding temperature. By properly selecting the proportions of these colors, a white or, better, a yellowish-white light could be fixed upon as a standard. Such a selection of colors would give an exact numerical expression of the physiological color of any light by defining the ratio of three intensities of the primary elements.

A communication from Dr. W. S. Franklin was read, which said that the plan proposed by Dr. Steinmetz was novel and important, and he suggested that the Bureau of Standards, at Washington, take up the proposed standard and see whether it could be employed with any success. He did not expect complete success, as the inherent errors in any photometric measurements are too large.

Carl Hering said he was pleased to see the scientific standard of light proposed based upon the unit of power. He pointed out several advantages of the standard, one being that it did not require the determination of a new mechanical equivalent.

Dr. C. H. Sharp thought that the proposed standard gave promise of offering a general solution of the problem of devising a standard of light. He referred briefly to some of the other attempts, particularly that proposed by Violle, which depends upon the light emitting from a given area of molten platinum at the moment of solidification. He questioned whether such a mixture of monochromatic light as proposed would give the same color as a corresponding mixture of polychromatic light.

J. B. Taylor asked why Dr. Steinmetz had used the wave-length of the light waves for the scale of abscissas. The wave-length depends upon the medium, while the frequency is absolute and should therefore be employed. He asked also why Dr. Steinmetz had used the musical analogy in arranging his scale of colors. Pitches are recognized in sound, but not in color.

Dr. E. B. Rosa thought it would be a good plan to make a trial of Dr. Steinmetz's proposed standard, for even if the attempt to secure a satisfactory standard was unsuccessful, the investigation would be worth while for its own sake. He said the work was clearly one suitable for the Bureau of Standards.

Dr. H. S. Carhart pointed out that the proposed plan made use of three different wave-lengths, giving rise to three distinct sensations. He called attention to the fact that this method of mixing colors was entirely different from that of mixing colored pigments.

Mr. Hering then moved that the convention recommend to the board of directors the presentation of this proposed standard of light to the Bureau of Standards for investigation. The motion was carried.

Dr. Steinmetz, in closing the discussion, said that he had selected red and blue lights which were equidistant from the green, as this seemed to be the logical method of procedure. Regarding the criticism of his scale of abscissas, he had merely followed custom, as, of course, the proper factor to be considered was frequency and not wave-length. The mixture which he proposed would probably produce a yellowish light, and the proper proportion of colors to give a pure white light would probably be about fifty-five per cent of red, fifty-five per cent of green, and minus ten per cent of blue. Put in another way: The color of the mixture which he proposed as a standard would probably be identical with pure white light if ten per cent of blue be added. Referring to a statement which had been made that the value for the mechanical equivalent of light indicated that with an efficiency of 100 per cent we should get five and one-half candles per watt, Dr. Steinmetz said more recent researches had indicated that the true equivalent was probably 0.018, or something over fifty candles per watt for pure white light.

The paper by Carl Hering on "An Imperfection in the Usual Statement of the Fundamental Law of Electromagnetic Induction," which was read before the Philadelphia section of the Institute, on February 10 last, and which was discussed in the ELECTRICAL REVIEW for March 21, was brought up for discussion and a number of communications were read. The experiment consists in passing a loop formed of two springs attached to a galvanometer circuit over the pole of a horseshoe magnet and then drawing it off across the middle. The first movement gives a deflection; the second does not. Dr. C. P. Steinmetz considered the paper interesting since it called attention to a looseness in the form of expressing the law of electromagnetic induction which is frequently the cause of serious misunderstanding and the waste of much energy and time. This is illustrated in the many attempts to invent a coil-wound homopolar machine. The experiment described is not startling, as the reverse case—the continuous production of electromotive force without any change in the number of interleakages of the circuit with the magnetic flux—is illustrated in practically every unipolar machine. Maxwell's law is an integral expression derived from the general or differential law by integration over the whole circuit under the terminal or limit conditions of continuity of conductor and continuity of motion, and does not apply to Mr. Hering's experiment or to the general design of unipolar machines which do not fulfil the conditions of continuity of motion, but have parts of the conductor sliding over other parts. Faraday's expression is the general law, but in its application to unusual cases it must be kept in mind that the line of magnetic force is merely a pictorial representation of the magnetic field in space as characterized by two constants—intensity and direction. This pictorial representation, when carried so far as to apply to its physical existence, may lead to wrong conclusions; for instance, when discussing whether the lines of magnetic force of a revolving magnet move with the magnet or stand still. In such a field, if the intensity and direction do not change, the field is constant regardless of the motion of the magnet. Unfortunately, in teaching, instead of the general law of induction, there is frequently given to the student its specific application to the term of the closed continuous conductor as more convenient to illustrate and understand. While this is permissible in giving an elementary introduction for a complete understanding, it should be supplemented by an exact discussion of the general induction law; that is, the mathematical formulation of Faraday's pictorial representation.

Dr. A. E. Kennelly does not think that the experiment is in disagreement with either Faraday's or Maxwell's statement of the law. Maxwell's specifically rules out the case of multiple-connected regions, and when the law is stated it is inherently assumed that the circuit is not interrupted and re-established around a new boundary. In Mr. Hering's experiment this is practically what is done. The experiment shows, however, that the cutting of the flux is the primordial conception, and it is well to remember that this electromotive force occurs as much in insulators as in conductors, although it is only revealed in the latter case. In Mr. Hering's experiment the law is juggled by changing it from a simple connected to a multiple connected space, which is not permissible.

Dr. Elihu Thompson accepts the views expressed by Dr. Kennelly, holding that the slipping of the clips over the leg of the magnet virtually opens the circuit, inasmuch as an immovable section of the conductor is substituted in the gap where all the flux to be cut then exists. There seems to be one universal law which may be expressed as follows: "It is not possible, without chemical or thermoelectric action, to generate a continuous current in a closed circuit without sliding contacts"; or, to put it in another way, "A magnetic induction machine for direct currents must have a commutator or sliding contacts of some sort." Although apparently some such rectifying action might be secured by means of the change in resistance of selenium, due to its exposure to light or bismuth, due to its exposure to a magnetic field, such effects would be rather pulsating than rectifying.

Dr. W. S. Franklin, while agreeing in general with Mr. Hering, will not admit that Maxwell's statement of the law is not strictly correct. He does not think that those who accept Maxwell's generalization have forgotten the ideas of the actual cutting of lines of force, but it may be that they are likely to be led to forget this because of Maxwell's statement. Although we are obliged to think of one variable only changing at a time, we should never forget that all things may change together.

Percy H. Thomas said that the experiment is not conclusive, as the slipping of the springs over the magnet practically cuts off a portion of the circuit. The same view is held by G. T. Hanchett.

W. P. Graham believes it is open to question whether Maxwell's statement of the law is sufficiently precise, and he thinks that the cutting of the flux by the conductor is the point to be emphasized if Faraday's statement is to be preferred.

R. E. Hellmund, in a paper on "The Graphical Treatment of the Rotating Field," evolved diagrams by means of which nearly all the phenomena of the rotating field may be easily studied and the various factors necessary for the calculation of flux, exciting current, etc., are exactly determined. He develops diagrams for the fluxes in the individual teeth, for the space values of the total field, the potentials, time values of the total field, the equivalent sinusoidal field, showing the characteristics of the rotating field, the reactive effect of the secondary, and shows how the different coefficients may be deduced from these and the values thus found used in practical calculations.

C. A. Adams expressed his appreciation of Mr. Hellmund's paper, as the diagrams which the latter had developed show clearly the various relations existing in the motor. Such studies are good, not only for the student, but for the designer as well, because they give a visual picture of what is going on. In closing, Mr. Hellmund said that one of the difficult parts of the problem is the study of magnetic leakage and the determination of this factor.

Harold Pender presented a paper entitled "A Minimum-Work Method for the Solution of Alternating-Current Problems." The complex forms for impedance and admittance render the formulas for most alternating-current problems exceedingly complicated and numerical calculations become extremely tedious after the first and second operation. To avoid this a simpler method is desirable, and the one here described makes use of certain factors, namely, the ratio of the reactance to the resistance, which is called the reactance factor, and the ratio of the resistance to the impedance, called the power-factor. Introducing these factors into the expressions for the different quantities reduces them to simple forms and greatly lightens the labor of solving problems. The use of this method is illustrated by applying it to a number of alternating-current problems.

The discussion was opened by P. H. Thomas, who said that he did not think Mr. Pender's method and the use of the factors which he proposed would save much labor, but that his careful tabulation should be given the credit for lightening the work.

C. A. Adams said that he had used a similar method without, however, making use of the two factors proposed. He did not think that such short-cut methods were desirable for students' use, as the latter are then apt to lose sight of the true relations. They are, however, of value when there are a number of similar problems to be solved.

C. J. Fechheimer, in a paper entitled "The Relative Proportions of Copper and Iron in Alternators," discussed those features in the design of alternators which affect this ratio. The early generators were designed by rule-of-thumb methods, and the relative proportion of copper to iron was high. These machines had poor regulation and gave way to the so-called iron machines, in which the proportion of copper was less than that of the copper machines and the regulation was better, but the design more expensive and heavier. Hence it was endeavored to develop a cheaper design without sacrificing good regulation. This is the stage which has been reached to-day, and it demands an intimate knowledge of the results of previous work and careful balancing of the conflicting factors. The author derives equations for the weights of the principal parts of the alternator, the weight in each case being easily expressed as some factor which is easily determined, multiplied by some power of the flux per pole. The weight of these parts is then multiplied by the price per pound of material used and certain other factors introduced to allow for waste and for parts not included in the equation. The sum of these costs will give the cost of the material and the principal parts of the machine in terms of the flux, and it can then be determined what value of flux will give the minimum cost of the material. This being known, the rest of the design follows at once. The method is illustrated by the design of an 800-kilowatt alternator.

W. L. Waters, while expressing appreciation for such studies, said that machine design is an art rather than a science, and there is little real value in such academic studies. Past experience is the best guide in actual design.

C. A. Adams, while admitting that past experience must be depended upon to guide the designer, said that a general analysis of the different factors entering into the design is always of value and should help to reduce materially the amount of cutting and trying.

The session was then adjourned.

THURSDAY AFTERNOON SESSION.

The eighth and concluding session of the convention was called to order Thursday afternoon, July 2, at two-thirty o'clock, by President Stott, and three papers dealing with educational topics were presented in abstract.

M. W. Alexander presented a paper entitled "A New Method of Training Engineers." This calls attention to the desirability of giving the college student practical experience at the same time that he is following the theoretical studies. After some years' experience with the student course offered by the General Electric Company, at its Lynn works, Mr. Alexander has come to the conclusion that the best way of giving this practical training is to combine it with the theoretical work. The colleges should confine themselves strictly to teaching theory and underlying principles, and the student should alternate between the college and the shop. This should go on for four years and the entire senior year should be given up to theoretical work. This method is being tried at the University of Cincinnati, but Mr. Alexander thinks that the length of the period selected there—one week—is too short. The proper length can only be determined by experience.

D. B. Rushmore, in a paper entitled "The Relation of the Manufacturing Company to the Technical Graduate," discussed those qualities of the young engineer which render him most valuable to the manufacturing company. Naturally the man who has had a college training is more efficient than the one who has not, and the ranks of industrial concerns are now largely filled with college graduates. The importance of the technical organization is insisted upon, and it is thought that one of the most promising signs of the times is the close study and co-operation between manufacturers and colleges.

A suggestive paper, entitled "The Relation of the Manufacturing Company to the Technical Graduate," was read by B. A. Behrend, chief electrical engineer for the Allis-Chalmers Company. Mr. Behrend says that the qualities necessary for a man to rise to a high position in an engineering company are integrity, moral courage and intellect, and while there are many possessing any one of these qualities, there are few who possess all three. Yet it is such men that the manufacturing companies are looking for. He thinks that in supplying such men the colleges are doing remarkably well, but they are not always supported in the right direction by the manufacturing companies. The latter should not seek the man, but force the man to seek a position, thus not giving him an exaggerated opinion of his own importance. There is, unfortunately, among the colleges and graduates a most ominous disdain for painstaking accuracy and devotion to laborious detail which are so essential to all really great work in engineering. The wish to take up the work of some one else and make it a commercial success is easily explainable, but not so easily excused. This condition is really a menace to the stability and continued prosperity of manufacturing interests which must be remedied lest it produce a far-reaching result in discouraging graduates from the pursuit of new and important creative engineering work. Those who have been engaged in the building up of large manufacturing organizations have been impressed with the fact that the absence of moral qualities frequently mars a successful career, as frequently, perhaps, as the absence of purely intellectual qualities.

Before the discussion was taken up, the usual resolutions of thanks to the convention committee for the excellent arrangements it had made for the visiting members; to the Philadelphia section for its assistance in making the convention a success, and to Mr. Gummey, the proprietor of the Casino, who had allowed the Institute to make use of it for the reception Monday night, were adopted.

President Stott announced that, according to custom, Percy H. Thomas, the chairman of the papers committee, had tendered his resignation, and that A. H. Armstrong has been appointed chairman of the new committee. President Stott then thanked the various committees for their excellent work during the year.

The discussion on the three papers which had been read was opened by Professor J. P. Jackson, who said that if the results obtained by the training given in technical colleges are not satisfactory, the manufacturing companies have themselves to blame. They should get in close touch with the engineering departments of these colleges, find out what they are doing, and if they do not approve of the work as conducted, they should not hesitate to criticize. The manufacturers, however, should take care that they do not crowd out the so-called culture courses entirely in the technical work. Professor Jackson said that part of the blame for the present conditions must be laid on our general educational system. The study of history deals mainly with political movements and wars; it neglects scientific progress and the engineering work of the countries with which it deals. He suggested a number of subjects which might be profitably included in the engineering courses, such as railroad economics, labor problems, economic geography, etc. One method of improving the engineering courses, which is now to be tried, consists in appointing a number of consulting professors—men who are not engaged in teaching—whose duty it will be to advise with the department regarding the work to be taken up and the method of presenting it.

Mr. Behrend said that the co-operative courses recommended by Mr. Alexander and Mr. Rushmore could be adopted at but few colleges. Moreover, there are comparatively few manufacturing establishments at which the student really learns a great deal. He is more apt to be put to some manual work, such as drilling holes in name-plates, and kept at that for months without any opportunity to increase his knowledge of the process of manufacturing. One serious objection to such courses would be the prevention of concentration. No important problem can be solved in a week, or even a month, and to oscillate the students between the college and the shop would simply fritter away their time without giving them any thorough training. His criticisms were not directed toward the trade schools, which are necessary, but he thinks the co-operative courses would be a mistake for the college of high standing. He said frankly that the suggested plan would be one of the most vicious and dangerous innovations that could be made at a university.

P. H. Thomas believes that more commercial work is necessary to give the student true appreciation of the value of costs. The best way to secure this would be to overlap the last end of theoretical study with the first part of practical work. There is, however, a chance of overdoing this. It would not be safe to cut out shop work from the technical school, because it is there that the student learns the reason for the best methods. To send the students into the shop would distract their attention from theory and concentrate it on the commercial side. This would be dangerous.

Professor Morgan Brooks said he looked at the subject from the side of the technical school. The object of the school is to train men in character, and it would be difficult to do this if the student were oscillated from college to shop and back. For example, all colleges encourage athletics, but no student taking such co-operative courses as had been proposed could take any part in athletics at the college. There would also be much difficulty in administration with such co-operative work, particularly when special courses are offered. He thought it was a good plan for the students to enter some shop during the summer and possibly to take one year off and devote it to practical work, but these periods should not be less than one-half of the college year. He thought that a man who has done good practical work would have done still better work if he had had a college training.

Secretary R. W. Pope said he thought the Institute might profitably devote some of its energies to the training of parents. Few parents to-day seem to know what to do with their sons, and try to throw the responsibility for selecting their profession on the Institute or elsewhere. Moreover, the greater number of the members of the Institute could improve their own work by giving more attention to minor details. There is hardly an associate who applies for transfer to full membership in the Institute who seems capable of filling out properly the application blank.

Professor H. H. Norris said that the college work must necessarily be arranged for the average student, but unfortunately the average student prefers to work with his hand rather than his head. The favorite position in laboratory work is holding speed. A co-operative plan such as proposed would cause a severe loss of time when changing from one occupation to another. There is generally about a week lost after every term in college work, and to overcome this it had been suggested by the faculty of Sibley College, Cornell University, to break up the year into two long terms without any vacations at all, long vacations being allowed between the terms. Professor Norris thinks that the students are apt to lose interest in the theoretical work if their attention is directed greatly toward practical problems. They should be given just enough practice to enable them to think. The shop work must be kept at the college, as that is really the preparatory laboratory of the manufacturer.

Dr. Steinmetz said that from the college professor's standpoint, instruction in practice is desirable, but there is not time enough for it. The question, therefore, is not to teach what is desirable, but to teach what the student can not learn elsewhere. Hence the main effort should be to ground him thoroughly in science and give him a broad general culture. It is no criticism of the college to say that it does not turn out men fitted to drop into commercial positions. Indeed, he would suspect the training given at a college which claimed to do this, as it could only be done by omitting essentials. What the college should do is to make the students understand that upon graduation they have really only begun their work. The technical colleges are not the only educational institutions at which practical work may be taught, as there are trade schools which devote their entire time to training in the various trades. Then come the correspondence schools, which do work of a little higher class, and do it well. Next come the technical schools, which should carry the training of the men still further. There is one serious defect in the schools offering higher education: this is the inefficiency of the system, as the effort is made to work up the entire mass of material into engineers, although but few of them are really capable of developing into good engineers. In this way time and effort are wasted and the good men are neglected. Dr. Steinmetz spoke of the foreign colleges, particularly the German schools, where instruction is offered in every possible subject, but the responsibility for learning it is thrown upon the students. In this country, on the other hand, the college assumes a good part of this responsibility. The result of this is that American colleges produce few leading engineers. Far better results would be accomplished if the men were sorted out more stringently.

Professor D. C. Jackson said that the question is physiological and psychological. There is as good material to-day for producing such men as Watt and Newcomen as there was in the early days of the steam engine. He thinks that there is need for real professional education—that is, education similar to that given to law and medical students. These men first obtain their general college course and then attend a school where their entire time is given to professional studies. He thought in the future that we would have to depend upon the great engineering schools for producing the leaders. Professor Jackson approved of Mr. Alexander's plan and did not think it necessary to have the shop near the school. This matter could be adjusted. There should be closer co-operation between the manufacturers and the schools.

Professor C. A. Adams said that Mr. Alexander's scheme was being tried. The result remained to be seen. He did not take the same view of professional schools as did Professor Jackson, for at the law schools the students study cases and do not argue them; and at the medical schools they attend clinics, but do not operate. There is another difference which should not be overlooked. When the medical student is given his degree he must be equipped to be able to take the responsibility of his patients' lives, while the technical graduate is not required either to be responsible for life or for the success of the company with which he first connects himself. The plan advocated by Dr. Steinmetz is being tried at Harvard, as the students are allowed to take a general course in science or arts, obtaining the A. B. or B. S. degree in three years. After this they enter the Lawrence Scientific School as graduate students and obtain the engineering degree.

Professor Albert F. Ganz said that Mr. Alexander's plan would cut down the study of theory to three years by the elimination of laboratory work. This can not be cut out if Dr. Steinmetz's plan is to be followed. The first two years should be given to scientific instruction, and only in the third year should much time be devoted to practical questions. He asked President Stott whether he would like to have Mr. Alexander's plan applied in his power stations so as to give the students experience in the operation of large electric plants. To this suggestion Dr. Steinmetz interjected that the experience would certainly be good for Mr. Stott.

Charles F. Scott said that the discussion seemed to overlook the most important feature of the college education. The aim of this is to develop men of character and power, not to turn out men manually dexterous. There is need of great teachers to develop the proper type of man. The study of theory and practice must go hand in hand, and if the time lost in changing from one to the other is not too great the plan proposed would be good. The object of the college courses should be to turn out men thoroughly trained, and not graduates plastered with learning.

G. S. Dunn said that his experience had shown that the best graduates had usually had some practical experience. He thought that the students should come in contact with manufacturing methods before graduation. The discipline and training in the shop are good, and even if the men are kept at drilling name-plates for months, this is in a sense military training. If the man has any ability he will be able to pick up, while drilling, a great deal of useful information. He did not think it was necessary to have the college work and shop work as intimately mixed as Mr. Alexander's plan, and for this reason he was opposed to it. The college graduates are better than the other men, because of the discipline and experience which they have had. There would be some difficulty in applying Mr. Alexander's method generally, as it would be necessary for all factories in the country to take some of these students, while not all of them are in shape to do so.

E. R. Taylor said that one phase of the general problem should not be overlooked. At present we have good manual training schools in the cities. Such schools should be established in all the smaller towns, and they should be depended upon for selecting men for the technical colleges.

This completed the discussion on the educational papers, and then resolutions were adopted sympathizing with Dr. F. A. C. Perrine on account of his illness, which had lasted during the entire convention.

J. H. Finney spoke of the necessity for teaching the general public the great need for conserving the natural resources of the country. He quoted Speaker Cannon as saying recently that there is but one grain of wheat to the bushel of chaff of what the engineers have said. Mr. Finney said that if every member of the Institute, particularly those connected with local sections, would see to it that the true need for conserving our resources was appreciated by all with whom they had any influence there would soon be a good deal more than one grain of wheat to the bushel. He urged every member of the Institute to become a missionary in this work, and said he hoped that the engineers of the country would become the leaders in the movement.

The business of the convention having thus been completed, President H. G. Stott declared the convention finally adjourned.

ELECTRICAL CONTRACTORS' OPPORTUNITIES IN THE ILLUMINATING FIELD.[1]

BY GEORGE LORING.

What is the position of the electrical contractor in the field of artificial illumination and how may he extract profits therefrom? Lamp manufacturers devote their time to building illuminants with the highest attainable commercial efficiencies in hundreds of different sizes and styles to meet every conceivable lighting condition. Central stations generate and sell, at the lowest possible cost, the energy necessary to operate the lamps. The electrical contractor may profitably see that the public, the consumer of the lamps and the current, is made aware of every convenience and advantage which may be secured by their proper use, and is thoroughly posted as to the economical methods of producing a most satisfactory illumination at the lowest total cost. Lamp manufacturers, central stations, electrical contractors and the consumer should work in harmony. It is to their advantage to always have one another's welfare at heart.

HOUSE-LIGHTING SUGGESTIONS.

A plan, the carrying out of which gives much satisfaction and is also extremely economical to the consumer and creates business for the contractor, is the equipping of many parts of a domicile, whether it is or is not already electrically lighted, with fourteen-watt (three-candle-power) carbon lamps in addition to the larger ones which are always installed. Small lamps may generally be operated only when any of the sections in which they are located are not occupied. Larger lamps should naturally be out of service at such times. The utilization of fourteen-watt lamps will result in decreasing the number of rooms and halls now left in darkness after dusk, especially when the family is away for the evening; thus adding to the general comfort and appearance of the home and to the safety and security of the people and property therein.

As an example, showing how these small illuminants will work out, we will take a nine-room, three-story house which has a piazza in front. A fourteen-watt (three-candle-power) lamp equipped with Holophane reflector No. 2,677 and placed seven feet above the veranda, one foot out from the middle of the front door, will produce an illumination with an intensity of 0.2 foot-candle upon the centre of the door, making, in the majority of cases, the number thereon, if there is one, and there always should be, distinctly visible from the street. The fourteen-watt lamp will also sufficiently light, during the cold

Copper declined 5s in London with spot closing at £58 and futures at £58 10s. The local market was dull and unchanged with lake quoted at $12.87½@13.00; electrolytic at $12.62½@12.87½ and casting at $12.50@12.62½.

FIG. 1.

evenings, the piazza, the steps, and at least a portion of the path leading up to same. The imprint, shown in Fig. 1, with an illumination upon it of 0.15 foot-candle, may be read by the average person at a distance of eighteen inches. This will give an idea of the amount of illumination necessary to make clear from the highway a number upon a house.

There should also be located over the centre of the piazza a large lamp, such as a forty-watt tantalum or tungsten or a fifty-watt metallized-filament, which could be used when people are sitting upon the veranda in the summer and care to read or desire a higher illumination for any other purpose.

We will suppose that there is a hall, living room, library, dining room and kitchen on the first floor of this house. When any of these sections is not occupied, a fourteen-watt lamp could always be burning therein at a very low expense between the hours of dusk and the time the party retires.

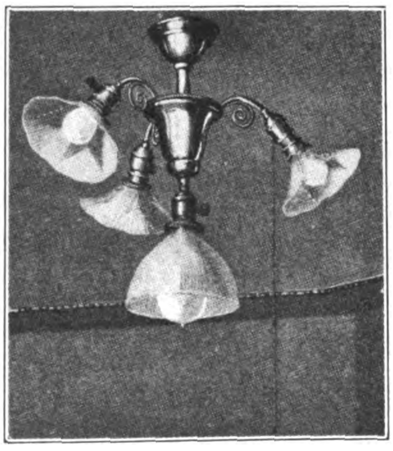


FIG. 2.—LIGHTING FIXTURE IN LIVING ROOM.

In the hall on the second floor a fourteen-watt lamp may be left burning all night and will also be found to give a sufficient light the majority of the time when it is necessary to have artificial illumination. The same may be said regarding a fourteen-watt lamp in the bathroom. In these places there should also be lamps of sufficient luminosity to furnish a higher illumination when necessary.

It costs only one-seventh cent an hour to operate a fourteen-watt lamp when current is ten cents per kilowatt-hour. It will therefore be seen that when the family is not using the first floor of this house, low-candle-power lamps, giving a surprisingly satisfactory light, may be operated in the hall, living room, library, dining room and kitchen for five-sevenths cent per hour, and may be in service in the hall and bathroom of the second floor at a cost of only two-sevenths cent per hour, and that one of these illuminants may be left on in the hall of the second floor all night at an expense of burning from 10 P. M. to 7 A. M. of one and two-sevenths cents.

We will assume another case where these low-candle-power lamps may be used to good advantage. Imagine a six-room apartment, consisting of a living room, two bedrooms, a hall thirty feet in length, dining room, den, kitchen and bathroom. Let the living room, dining room, hallway and bathroom each be equipped with a fourteen-watt lamp as well as a larger one. When any of these places is occupied, the large-candle-power lamp should be operated, the small-candle-power lamps being in service in the other sections. The bed chambers are off the hall and will naturally receive a small amount of light if their doors are left open. By following out this plan you have an illumination practically throughout the dwelling, and persons desiring to go from one place to another do not have to hunt around in the dark for a switch before making their way about. The home is also far more cheerful, as instead of certain parts being dark and gloomy, it is all comfortably lighted. The fourteen-watt lamps in the living room, hall and dining room may be left on any evening, when the home is temporarily deserted, at an expense of three-sevenths cent per hour. This is certainly a most cheaply acquired protection against theft.

In planning the lighting of a house utmost care should be used in placing lamps where they are most needed and employing only those which are efficient to the highest degree commercially and are equipped with accessories which will aid them in producing the necessary illumination at the lowest total cost. The accompanying illustrations show several inexpensive, highly efficient fixtures which may be used respectively in the living room, hall, dining room and a compart-

[1] Abstract of a paper read before the National Electrical Contractors' Association, Chicago, Ill., July 15.

ment, which, for lack of another name, we will call a den.

The living room is fifteen by twenty feet. The lighting fixture is hung from the centre of the ceiling, as is shown in Fig. 2. The lamp placed in a vertical position and suspended from the end of the fixture has its centre of luminosity eight feet above the floor. It is a forty-watt -tungsten, bowl frosted, equipped with Holophane reflector No. 6,046. With the tungsten lamp alone in service, the light directly from it produces an intensity of illumination upon the floor, at any place within a radius of seven feet from a point directly under the tip of the lamp, of from 0.3 to 0.4 foot-candle. This illumination is at least doubled on account of the light reflected from the walls, the reflecting coefficient of which is not less than 0.5. The direct intensity of illumination upon a book or table placed two and one-half feet above the floor, and located within a radius of five feet from a point under the tip of the lamp would be from 0.6 to 0.8 foot-candle. This illumination would be doubled by wall reflection. In other words, from this one lamp we receive a uniform illumination of high intensity over a large area. When no one is in the room the tungsten lamp is not operated and one of the fourteen-watt lamps, which will be seen upon the arms of the fixture, is lighted.

In the hall, placed as high as possible above the floor and suspended from the centre of the ceiling, is a fixture (Fig. 3). This is only a temporary device, but it demonstrates how easily a small and a large-candle-power lamp may be installed in one bracket. In this case the results are most satisfactory. The large lamp is a forty-watt tungsten, which gives an excellent light throughout the hall, the length of which is thirty feet. The small (fourteen-watt) lamp is used alone for low illumination, and at such times there is a sufficient light to allow everything in the hall to be plainly seen. It will be noticed that a Holophane reflector is used also with this lighting unit. The adoption of this accessory, when correctly located, increases the ordinary illumination of the lamps at least forty per cent.

Fig. 3.—Hall Light.

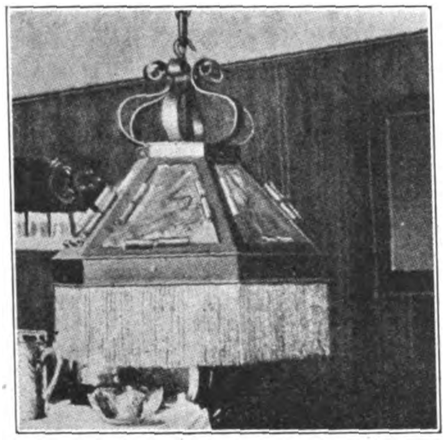


Fig. 4.—Dining Room Light Fixture.

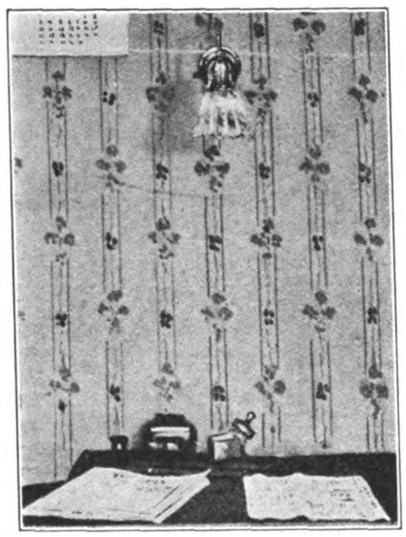


Fig. 5.—Den Lighting Fixture.

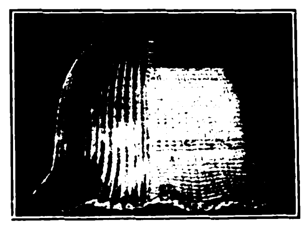


Fig. 6.—Special Reflector.

Fig. 4 shows a fancy dome used over the dining-room table. Enclosed within the dome is a fourteen-watt lamp and also a Holophane No. 6,045 reflector, used in conjunction with a forty-watt tungsten lamp and nearly hidden from view when parties are seated at the table. The reflector is employed for the purpose of preventing the great waste of light which would take place if all the upward rays from the lamp were allowed to come into contact with the glass of the dome. This glass would, on account of being highly colored and fairly thick, absorb about eighty per cent of the light which fell upon it and only part of the remaining twenty per cent would be reflected downward upon the table, whereas, by the use of the Holophane reflector the dome is made sufficiently bright, and the mean lower hemispherical candle-power of the tungsten lamp is increased forty per cent. In lighting this dining room, which is fifteen by eighteen feet, the intention is to have an illumination of as high intensity as is comfortable upon the covering of the table, which, by reflecting the light falling upon it will cause the rest of the room to be satisfactorily illuminated.

The den is seven by ten feet. The paper has a reflecting coefficient of about 0.6. Upon the centre of one of the narrow walls, and five feet above the floor, is a bracket supporting an eight-candle-power lamp and Holophane No. 245 reflector (Fig. 5). This reflector (Fig. 6) has one side consisting of prisms intended to reflect light and one side made up for diffusing light. It is the first side mentioned which is placed toward the wall on which the bracket is mounted. The result of the combination of the eight-candle-power lamp and the reflector is that the intensity of illumination upon a table located under the lamp is at least three foot-candles, and the candle-power in the direction of the wall nearest to the lamp is from only one-half to one-third of that in the direction of the opposite wall. The sum and substance of the whole matter is that by means of this reflector the horizontal light, which has only a short distance to go before lighting a part of the area to be illuminated, and the upward light, of which only a small amount is necessary, is curtailed, whereas the horizontal rays, which have to travel the greatest distance, as well as those in a downward direction, which are most useful, are increased, and last, but not least, the light is properly diffused. With few exceptions, I do not advocate illuminating by wall brackets. When such fixtures are already installed, however, they must be used to the best advantage.

Electrical contractors to-day have greater opportunities than ever for profitably working out lighting advantages in dwellings. On account of the introduction of the tungsten lamp and also most efficient reflectors, houses may be better illuminated, whenever high illumination is necessary, with a material decrease in meter bills. By causing those now using electric lights to be better satisfied they become stronger advertisers for electricity, which will mean more business for the central station and the contractor.

STORE LIGHTING.

If the standard of illumination in the dwelling of a business man has been raised there will be little difficulty in getting him to listen to a plan to change his store lighting.

When replacing carbon with tungsten lamps the endeavor should be made to install two forty-watt tungsten units for every three sixteen-candle-power carbon lamps displaced, provided the installation is as efficient as is possible with carbon-filament lamps. This method increases the illumination thirty-three and one-third per cent, and at the same time makes a net saving of twenty per cent on total lighting expense when current is six cents per kilowatt-hour. Net saving, in this instance, means that if a party using carbon lamps is receiving them free, the saving on lighting will amount to twenty per cent after deducting the price of the tungsten lamps, provided that current is six cents per kilowatt-hour.

If a person is illuminating his store by means of gas or gasolene lamps, his business should be secured through the medium of tungsten illuminants, installed either in units consisting of one lamp with proper reflector, or with tungsten clusters. Tungsten arcs containing either five sixty-watt or three 100-watt lamps will give a more satisfactory illumination than a Welsbach four-burner gas arc. With gas at $1 per 1,000 cubic feet, the expense of operating tungsten clusters will be no greater if current is seven cents per kilowatt-hour. Two 100-watt tungsten lamps will produce better results than a four-burner Humphrey gas arc. In this case the cost of lighting will be no greater with the tungsten lamps when current is nine cents per kilowatt-hour and gas $1 per 1,000 cubic feet. The initial lower mean hemispherical candle-power of a four-burner Welsbach gas arc is under normal conditions 281 candle-power. There will be a drop in candle-power, however, of twenty per cent within the first 100 hours and thirty-three and one-third within the first 300 hours of service. In other words, at the end of 100 hours the mean lower hemispherical candle-power will be 225, and at the expiration of 300 hours 188 candle-power. Under normal conditions, during its life, which averages 800 hours, a tungsten

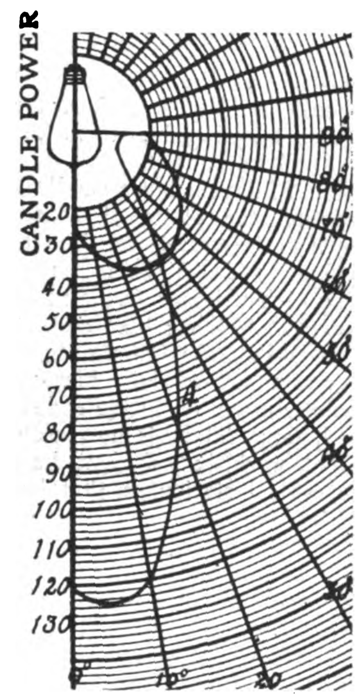


FIG. 7.—VARIATION IN DISTRIBUTION OF LIGHT WITH CHANGED POSITION OF REFLECTOR.

lamp does not drop more than ten per cent, and will therefore produce better illumination from the quantity standpoint and a clean pure light of superior quality.

GENERALITIES REGARDING LIGHTING BY ELECTRIC INCANDESCENT LAMPS.

It is most important, in order to do electric lighting justice, that the right reflectors be employed with the lamps and their relative position be correct. Untested reflectors and shade holders should not be used in a haphazard fashion.

The curves on Fig. 7 show the great variation in candle-power distribution and illumination resulting therefrom caused by simply changing the relative position of the reflector to the lamp.

Curve 1 is the candle-power distribution of a forty-watt, bowl frosted, tungsten lamp with a B2 crimped Holophane reflector in a given position. By bringing the reflector one and one-half inches nearer to the tip of the lamp a distribution such as is shown by Curve 4 is produced. This change of one and one-half inches in the relative position of this particular reflector to the lamp increases the candle-power in the direction of the tip 460 per cent. At all other angles up to approximately fifty-eight per cent the candle-power is greater than it was before. Between thirty-eight per cent and ninety per cent, however, it is materially lessened. Curves 1-D and 4-A (Fig. 8) show the intensities of the illumination received upon a horizontal plane within a radius of sixteen feet of a point directly under the tip of the lamp when it is suspended vertically over and has its centre of luminosity ten and twelve feet, respectively, above the plane illuminated, and when the candle-power distribution is the same as that shown on Curves 1 and 4 respectively. It will be seen that the intensity of the illumination as shown by curve 1-D is practically even upon a horizontal plane within a radius of five feet from the point directly under the lamp, and that if this radius is increased two feet the intensity of the illumination within that radius is very even, the ratio between the maximum and minimum being as 3:2. Curve 4-A, although depicting the intensity of illumination produced by the same lamp used with the same reflector employed to secure the illumination represented by Curve 1-D, and with all other conditions similar with the exception of the position of the reflector being altered one and one-half inches and the lamp being raised two feet higher above the objective plane, shows an illumination which is extremely uneven, the ratio of the intensity of the illumination at the point on the plane directly under the lamp compared to that

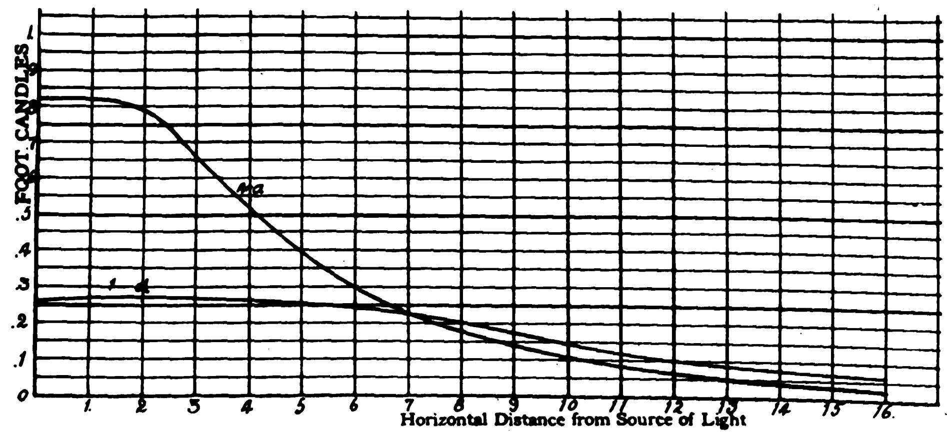


FIG. 8.—INTENSITY OF ILLUMINATION ON HORIZONTAL PLANE.

upon the plane eight feet from the point just mentioned being as 100 : 24. Lighting units having a candle-power distribution as shown by Curve 1 should be located with the distance between them equal to 1.2, 1.5, or two times their height above the objective plane to produce an even illumination upon it.

Fig. 9 represents a plane to be illuminated by lamps located with their centres of luminosity ten feet above it, the distance between them being fifteen feet. The reflectors upon the lamps are placed in such a way that each lighting unit has a candle-power distribution similar to that shown in Curve 1, Fig. 7. The intensity of illumination upon the Plane A-B, Fig. 9, when only two lamps, namely, those directly over *a*, *b* are in service, is from 0.31 to 0.4 foot-candle. The intensity of illumination upon Plane A-B, when the lamps over *a*, *b*, *c*, *d* are in use, ranges from 0.37 to 0.44 foot-candle. The intensity upon Plane A-B, when lamps over *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, *j*, *k*, *l* are operated, is from 0.54 to 0.61 foot-candle. The illumination upon X produced by the illuminants over *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *j*, *k* is 0.576. The illumination upon Plane Y-Z, from lamps over *s*, *y*, *r*, *z* and *c*, is from 0.4 to 0.5 foot-candle. The area of the plane illuminated is 5,644 square feet. Total watts used in lighting it are 1,220; watt per square foot, 0.21, and the watt per average foot-candle, 0.36. No reflection from sources other than the reflectors used with the lamps has been taken into consideration in figuring the foot-candles upon the objective plane.

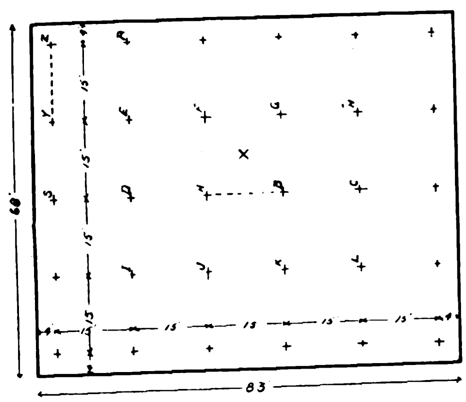


Fig. 9.—Illumination from Various Light Sources upon Horizontal Plane.

It should be the aim of every one endeavoring to produce satisfactory illumination to have its intensity, with few exceptions, highest and apparently equal and uniform upon the objects most necessary to be seen. All surfaces other than those of such objects, being of secondary importance, should, if possible, be more lowly and to a certain extent unevenly illuminated, thus forming a background for that which it is desirous to make most conspicuous and eliminating the possibility of flatness in the lighting scheme. In the majority of cases the illuminants themselves should be of such a character and so located and equipped as to make their presence absolutely unfelt.

The sale of lamps is but a small part of the work of the electrical contractor. Ofttimes it is impossible for him to sell them owing to the lighting companies furnishing carbon lamps free and disposing of tungstens at less than cost. Even when this is the case the profits of the contractor may be materially increased by giving proper attention to the lighting of stores or homes. There is no reason why he can not work in sufficient harmony with the central station so that he may secure orders for practically all materials for furnishing light, with the exception in some cases of the lamps.

The contractor should give to his customers the illuminants which are the most economical (based on lamp and operating cost combined), not necessarily the longest lived. After the lamps are sold the contractor should endeavor to see that they are properly placed and most efficiently equipped. Give a man the best which can possibly be obtained for his money, show him how he can add to his personal home comforts or increase his business through the proper equipment and use of many lamps, which at the present time he does not understand, and it will be found that the lighting end of the business, which has probably had very little attention, will be bringing in a most profitable revenue.

Condemns New York City Fire-Alarm System.

The report of the commissioner of accounts, dealing with conditions in the New York city fire department, condemns the present fire-alarm system as obsolete and a menace to the city and recommends that it be replaced by thoroughly modern apparatus.

The estimated cost of the proposed new fire-alarm system, as given in the report, is $2,680,000.

The danger that the city's fire-alarm system might be entirely put out of commission in event of a fire or other serious mishap at fire headquarters, where the main or central office is located, is pointed out in the report.

In addition to recommending an up-to-date alarm system the commissioner, to obviate the danger at headquarters, suggest that the "central" alarm station be installed in the southern part of Central Park, or, if that should prove objectionable, in the neighborhood of Fifty-ninth street.

Experiments on a Directive System of Wireless Telegraphy.

A. Tosi on May 22 read before the London Physical Society a joint paper by himself and E. Bellini on the above subject, in which they described the results obtained in the course of their work upon a further development of their original directive system.[1] In their earlier method it was not possible to say from which side of the receiving station the transmitted waves arrived, for though the radiation was practically confined to the plane of the aerial system, it was emitted equally in the opposite direction to that desired.

In the new unilateral system, it is said, the waves are sent in a single direction only, and the problem of getting rid of the backwardly extending radiation has thus been solved. The method adopted consists in superposing a bilateral directive system, as previously described, upon an ordinary or vertical antenna system. Since the two half-diagrams of the directive aerial are opposed in phase, it follows that when the two systems (directive and vertical antenna) are simultaneously excited and in phase, the one half of the directed radiation will add itself to, and the other half subtract itself from, the radiation due to the vertical-antenna system. The diagram of the vertical-antenna system being a circle, the resultant diagram of the superposed systems will, for the case where these are in phase as regards excitation, be a cardioid whose maximum radius vector is double that of the diagram of the directive system alone. Since then the directive system is able to vary the direction of its maximum emission by means of the radiogoniometer, it follows that by moving the position of this latter it is possible to shift the direction of the resultant emission represented by the cardioid, in a corresponding manner. Several energy diagrams obtained by means of the thermogalvanometer are reproduced in the paper, and these show that, even where the excitations are not exactly in phase, the only result is a slightly less good diagram. Diagrams of the scheme of connections employed during the taking of the energy diagrams are also given.

The same principle of the superposition of the two systems has been applied to the case of the reception. In this case a phase displacement of ninety degrees in the excitations is produced in a suitable manner and in this way, when the pointer of

[1] See Electrical Review, May 9, p. 727; July 18 p. 101.

the radiogoniometer is directed, say, toward the transmitting station, the reception is a maximum, while when turned at 180 degrees from this it is a minimum, or zero. Diagrams of received energy and of the connections employed are also given in this case.

The system of unilateral directive wireless telegraphy now described by the authors is of special interest owing to the facility with which it is possible to change over from one system to the other, thus, from the ordinary vertical-antenna system to the bilateral directive or the unilateral directive, or *vice versa*. The aerial arrangements, moreover, remain exceedingly simple. When a message from a station of unknown position is expected, the vertical-antenna or ordinary system would be employed; on once effecting reception, one can pass to the bilateral or unilateral directive system and thus determine the direction and on which side the transmitting station lies, at the same time making oneself independent of other transmissions. In the same way, with the transmission, the vertical antenna would be employed for calling up an unknown station or for simultaneously sending to several stations; on once getting a reply the operator can then readily determine the position of the receiving station, with the aid of the unilateral system, and thenceforth will transmit solely in that direction.

The authors further called attention to the advantages which such a directive system offers in the case of the commercial services, as well as for military and naval purposes.

A discussion followed in which Dr. J. A. Fleming, Dr. W. H. Eccles and W. Duddell took part.

Dr. Fleming, after congratulating Bellini and Tosi on their skill and inventiveness in the investigations, said that the experiments confirmed, in many ways, his own theory of the operation of a bent antenna as employed by Mr. Marconi. When Marconi described his experiments on directive telegraphy before the Royal Society in March, 1906, he gave no theory in the matter. Dr. Larmor pointed out then that an antenna partly vertical and partly horizontal was equivalent to the sum of a magnetic oscillator and an electric oscillator. Shortly after, Fleming went more carefully into the matter mathematically and showed that the observed effects could be accounted for on that theory. Both Marconi and Fleming had obtained by the same methods as Bellini and Tosi the same type of pear-shaped radiation curves by combining the effects of closed and open oscillators. Although Dr. Mandelstam had lately criticized this theory there did not seem to be sufficient grounds for objecting to it. Marconi had long employed directive antennæ in Poldhu and Clifden power stations, and had also given demonstrations showing that the position of ships out of sight could be located by means of such receiving directive antennæ. Nevertheless, Bellini and Tosi had worked out extremely ingenious arrangements for determining the direction of the radiant point without moving the antennæ themselves. Fleming said that he had also shown that, having the power to locate the radiant point, two stations equipped with such antennæ at a known distance apart could, by simultaneous observations, determine also the distance of the radiant point, and this might become important in connection with marine work.

Dr. W. H. Eccles warmly congratulated the authors upon their original and beautiful method. On this method, by merely rotating a small coil of wire on the table, a fixed aerial directive system of any size was made to do what could otherwise only be done by turning the whole system of aerial wires in azimuth. The essence of the system was the piece of apparatus styled the radiogoniometer, which, by causing appropriate component radiation from two fixed wire triangles set at right angles, brought about a resultant radiation in any direction desired—just as if a virtual aerial of the full size of the fixed aerials were being rotated in the air. Someone had compared the result so achieved with that obtained by Marconi's well-known arrangement of a number of fixed bent antennæ with their horizontal portions directed from a centre to various points of the compass.

The looped aerials used by the authors did not seem to the speaker to be the best kind of radiator for utilizing the principle they had developed. The radiogoniometer would prove to be capable of giving excellent results with two fixed antennæ of the best type set at right angles, one, for example, in the meridian plane and the other in the east-west plane. The two looped aerials of the authors may each of them be assimilated to a pair of vertical antennæ emitting waves of 180 degrees phase difference, and with the assumption that for a single vertical aerial the inverse square law holds for the propagation of electrical effects from a single aerial, the speaker showed by aid of the ordinary equation of wave-motion that a looped antenna obeying the condition stated emitted two waves of equal period, of phases differing ninety degrees and 180 degrees, respectively, from the phase of the radiation from either side of the loop, and of amplitudes having a ratio proportional to λ/x. This means that one portion of the resultant radiation obeys an inverse square law and the other portion an inverse cube law; the latter portion is the more important of the two when the distance x is small; the former is the more important when the distance x is much greater than the wave-length λ. This explains why Dr. Fleming's measurements of the radiation from closed oscillators, which were carried out at short distances, gave small promise of powerful propagation to a distance, and why Bellini and Tosi had found as a fact that good propagation occurred to great distances.

As regards the phases of the two portions of the radiation, the important portion for wireless telegraphy, namely, that obeying the inverse square law, was ninety degrees out of phase with the near side of the loop; and thus it is clear that the vertical aerial the authors had used to cancel the radiation to one side of the sending station, must for that purpose emit radiation ninety degrees out of phase with the near side of the loop. Bellini and Tosi had reached this conclusion in the course of their experiments.

After eliciting that the power-supply to the primary of the induction coil for the Dieppe-Havre experiments was 500 watts, Dr. Eccles concluded by remarking that the authors were worthy of special congratulation because in their method of unilateral transmission by phase and intensity adjustment of several radiators they had eluded the difficulties of managing the phases that had apparently baffled F. Braun when he was using the same principle.

Mr. Tosi, in reply to Dr. Fleming, stated that Braun's cardioid diagram was a theoretical diagram only; the method had not succeeded and no actual diagram obtained experimentally had ever been shown.

Referring to the similarity which Dr. Fleming said the pear-shaped diagram of Marconi bore to the authors' diagrams, Mr. Tosi could only say that they had purposely shown some bad diagrams as well as some good ones. The good diagram of Marconi's corresponded to the authors' bad diagram. With the Marconi horizontal aerial it would, moreover, be necessary, as Dr. Eccles had pointed out, to employ 360 such wires to obtain an accuracy in locating the bearing of the radiant point equal to that secured with the system now described. Further, if the emitted energy is actually represented by Marconi's pear-shaped diagram, it is difficult to understand why the transatlantic messages from Clifden to Glace Bay are readily picked up off the Algerian coast, at right angles to the line of transmission.

In reply to Mr. Duddell he said that the wave-length of the waves employed was from 350 to 400 metres.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Town Refuse as Fuel for Generating Electricity.

At a recent meeting of the Incorporated Municipal Electrical Association of Great Britain an address was delivered by Herman Talbot upon the conditions affecting the operation of electric generating stations. During this the speaker touched upon the operation of refuse destroyers in conjunction with generating stations and referred particularly to the performance of the Eastcroft destructor at Nottingham, England, which destroyed 28,302 tons of refuse last year, producing therefrom 1,069,885 kilowatt-hours. The wages of the men in the destructor plant amount to $10,730. The output averaged 240 kilowatts. As, however, this output could have easily been supplied from the generating station itself, the wages paid to the operators were unnecessary from the point of view of the station. The cost per kilowatt-hour thus produced was about 0.96 cent, which would more than pay for the additional steam which the load would have used. The destructor runs from fourteen to eighteen hours a day with a load-factor of twenty-eight per cent and generated nine per cent of the total electrical energy supplied to the city. This seems a creditable performance, but it must be remembered that the destructor station of necessity supplies the cheap units at the bottom of the load curve and leaves to the main station the task of supplying the expensive ones at the top, with a consequent reduction of the latter's load-factor. It thus seems, from the station point of view alone, that a destroyer plant is not a desirable auxiliary, but since the destruction of refuse by burning is the most effectual method, and since this cost of burning must be borne whether the heat be utilized or not, it would be a pity not to utilize it even if in so doing the electrical system contributes indirectly toward the expense of the destruction.—*Abstracted from Mechanical Engineering (London), July 3.*

Motor-Driven Wheatstone Transmitter.

One of the valuable factors of the Wheatstone telegraph system is the ability which it gives of rapidly sending messages over a single wire. Thus, in case of breakdown of a line, the entire office force may be set to punching messages and transmitting them at four times the speed over the one or two wires which may remain in service. The system as in use to-day has altered but little since it was introduced by its inventor. A number of improvements might be suggested, one of these being the substitution of a keyboard perforator and another a better method of driving the transmitter. The latter is usually driven by clockwork, which necessitates continual rewinding, thus disturbing the attention of the operators. This method is somewhat inflexible, as it is not easy to change the speed of the transmitter when this becomes desirable. The substitution of a small electric motor for the clockwork drive was suggested some years ago, but it does not seem to have been applied satisfactorily. In this article, C. C. Vyle and E. V. Smart describe a motor drive which they have developed for this purpose. The motor is rated at one-sixteenth horse-power and operates at 110 volts. It is series wound and has a German silver plate fixed at one end of the axle. This is made rigid and is used as a friction plate. On the front of the friction plate rests the edge of a friction disc, consisting of two thicknesses of compressed hide held tightly between two metal discs. The hide only touches the friction plate. A ball is held by springs against the end of the armature remote from the friction plate, forming a thrust-bearing. This holds the plate firmly at constant pressure against the disc. On the axle of the friction disc is the gear driving the transmitter. To vary the speed of driving, the friction disc is traversed across the plate, the change in speed being continuous. By placing the disc a little out of line with the centre a slight force tending to move it toward the centre of the wheel is set up, so that it is only necessary to provide a screw holding the disc away from the centre. This arrangement gives any desired speed and the series characteristics of the motor enable it to run up to its operating speed quickly.—*Abstracted from the Post Office Electric Journal (London), July.*

Wave-Form Analysis.

A discussion is given here by P. M. Lincoln of the Fischer-Hinnen method of analyzing wave forms. This system is based upon the following theory: If three ordinates of a sine wave be erected 120 degrees apart, their algebraic sum is zero if the curve be a pure sine wave. The same is true for any five ordinates, provided the interval between them be seventy-two degrees. In the same way it holds for *n* ordinates, provided the distance between them be 360 degrees divided by *n*. If a third harmonic wave be imposed upon this sine wave the algebraic sum of three ordinates taken 120 degrees apart is no longer zero, but is equal to three times that of the ordinates of the third harmonic. One ordinate of the third harmonic may thus be determined, provided no multiple harmonic of the third be present. They may, however, be allowed for by a suitable correction. In the same way an ordinate of the fifth harmonic or of the seventh may be obtained. The method of determining these harmonics consists then in finding two ordinates of each, ninety degrees apart. These values are sufficient to determine the complete curve of each harmonic. The ninety degrees difference between the two values must be measured in terms of the harmonic considered. Knowing these two values any maximum value is found by taking the square root of the sum of the squares of the two. The tangent of the arc subtending the angle representing the difference in phase between the harmonic and the fundamental, measured in terms of the harmonic, is given by the ratio of the two ordinates which have been found. The sign of this ratio determines the direction in which the harmonic crosses the axis of abscissas. Mr. Lincoln gives a general formula which can be used in determining any harmonic by substituting the proper values as measured from the wave being steadied. In applying this method to electrical work the even harmonics are usually absent and need not be looked for. If the wave is symmetrical about its maximum ordinate, the solution is somewhat simplified, as this means that all harmonics cross the base line at the same point as the fundamental. Under this condition but one set of ordinates need be determined.—*Abstracted from the Electric Journal (Pittsburg), July.*

A Simple Duplex Telegraph System.

A simple duplex telegraph system—that is, a system enabling two messages to be sent simultaneously in the same direction over one wire—is described here, which, in addition to its simplicity, is independent of the weather conditions, there being no necessity to balance up an artificial line against the varying resistance of the transmitting line. The system requires, at the sending station, two ordinary Morse keys connected in independent circuits between the line and the ground, each circuit including a battery. A third circuit connected in parallel with the two ground connections of the keys contains a resistance and a third battery more powerful than either of the other two. At the receiving station there are two receiving instruments, one of which is a simple sounder operated by a polarized relay responding to positive current impulses. The second is a similar sounder, connected, however, in the opposite direction, so that it responds only when its local circuit is broken. This may be accomplished by either of two relays, both of which are polarized. One responds to weak negative current impulses, and the other to strong positive impulses. In operation when either key of the sending station is closed it sends a relatively weak positive or negative impulse over the line, according to which key is depressed, and this impulse causes the corresponding relay at the receiving station to respond. Should both keys be depressed at the same instant this will send a strong positive impulse over the line, actuating, of course, the relay which responds also to weak positive impulses and that one in the second receiving circuit which responds only to strong positive impulses. Under this condition both sounders at the receiving station would respond. To secure operating conditions it is necessary to have the battery which comes in operation when both keys are depressed sufficiently powerful to operate both relays. When one key alone is depressed this battery does not send an impulse over the line, because at that moment it is short-circuited through a resistance and the other key, the potential thus thrown upon the line being insufficient to overcome the opposed working battery.—*Translated and abstracted from L'Industrie Électrique (Paris), June 25.*

Portable Type of High-Frequency Alternator.

A discussion is given here by R. A. Fessenden of a small high-frequency dynamo, built for use in wireless signaling. The machine was constructed to give an output of one kilowatt, but it was found that it could carry considerably more. It is approximately twelve inches high, and, including the steam turbine which drives it and the governor, is nearly three feet long. The diameter of the rotating field disc is six inches; that of the steam turbine disc is three and one-half inches. The original design was for a machine developing 250,000 cycles a second, but as it had been found that a frequency below 90,000 would give a much better range of transmission during the day the design was altered so as to give 100,000 cycles. The machine will normally run in the neighborhood of 75,000 cycles a second. For the lower frequency a steam pressure of 100 pounds per square inch is used in the turbine. To obtain the highest frequency the steam pressure required is about 135 pounds. The specifications call for constant operation for twenty-four hours without attention and this test has been passed successfully. The oiling arrangements are automatic. At present the alternator gives about 225 volts on open circuit, at 75,000 cycles, with an armature resistance of five ohms. The available output of the machine is about two and one-half kilowatts at this frequency. The excess of this output over what had been expected is due to conservative design and considerably smaller friction and windage losses than had been anticipated. These two losses aggregate about three kilowatts, but they may probably be reduced to one-half this amount by slightly modifying the design. Theoretically this machine can develop four kilowatts at the high frequency, but the field shaft is too small to carry this load. The machine is of a double-armature type, there being 300 coils on each armature; the field has 150 teeth. The two field air-gaps are approximately one-sixteenth inch in length. The machine runs absolutely without vibration. For speed regulation it has been found impossible to depend upon the governor of the usual type. For this purpose the Fessenden resonance speed indicator is employed. The method of controlling the generator consists in connecting it in a circuit attached to the antenna. This circuit is tuned to about one-twentieth of one per cent higher than the desired frequency. In this circuit is a dynamometer having two contacts which govern an electrically controlled throttle valve in series with a sensitive reducing valve in such a way that if the frequency increases one-twentieth of one per cent, the needle touches one contact and cuts down the speed. If the frequency falls by the same amount, the reverse operation takes place. By using a larger amount of inductance in this circuit, an air condenser and a low-resistance dynamometer, theoretically the speed might be kept constant within approximately one-fiftieth of one per cent; but this close regulation has not been obtained in practice. The best so far secured is one-twentieth of one per cent. By this arrangement any desired frequency is quickly obtained by setting the indicator to the proper value when the circuits automatically alter the speed for the dynamometer until the desired frequency is reached. In special cases a safety device, consisting of an additional tuned circuit arranged so as to be in resonance at a frequency about five per cent higher than that of the governing circuits, is used. Should the frequency reach that resonant with this circuit, a signal will be given or the dynamo automatically stopped. The alternator is used for transmitting signals by running it at that frequency which produces resonance in the receiving circuit. When a signal is to be sent a key is depressed which alters the frequency of the alternator about one-twentieth of one per cent, thus producing beats in the receiving instrument. This change in frequency is accomplished instantaneously by electrical means, it being, of course, impossible to change mechanically the speed of rotation. The advantage of this method is that the machine is operated continuously, generating waves of the same intensity which at their high frequency have no audible effect on any neighboring station. For a signal to be received, the receiving circuits must be adjusted so that these beats due to a slight difference in frequency will be produced.—*Abstracted from the Electrician (London), July 3.*

London Tube Finances.

The English Chancery Court on July 16 sanctioned the scheme for the readjustment of the finances of the Underground Electric Railway Company as approved by the shareholders at a meeting held in London, May 11. This plan provides for the issuance of various bonds aggregating $46,000,000, the amount necessary to this end.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The International Electric Meter Company's Measuring Instruments.

Within the last few years there has been developed by the International Electric Meter Company, Chicago, Ill., a high-grade line of alternating and direct-current voltmeters and ammeters. This business was started in a very small way by first placing upon the market a direct-current, switchboard-type voltmeter and ammeter. This line of instruments to-day consists of approximately twenty-five different types of measuring instruments, which include switchboard and portable voltmeters and ammeters, besides pyrometers, automobile and special school laboratory types of instruments. Illustrations of some of these are shown herewith. New features are continually being developed and placed upon the market.

Two distinct principles are now used. One exclusively for alternating current, which is an induction meter, known as the "repulsion" type, and one exclusively for direct current, of the Deprez-D'Arsonval or permanent-magnet type.

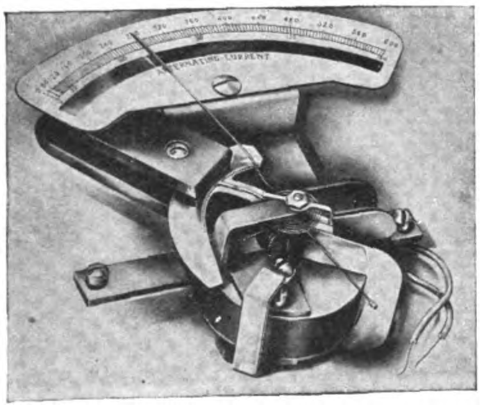


Fig. 1.—Alternating-Current Instrument, Ready to Mount in Case.

Fig. 2.—Alternating-Current Instrument Complete.

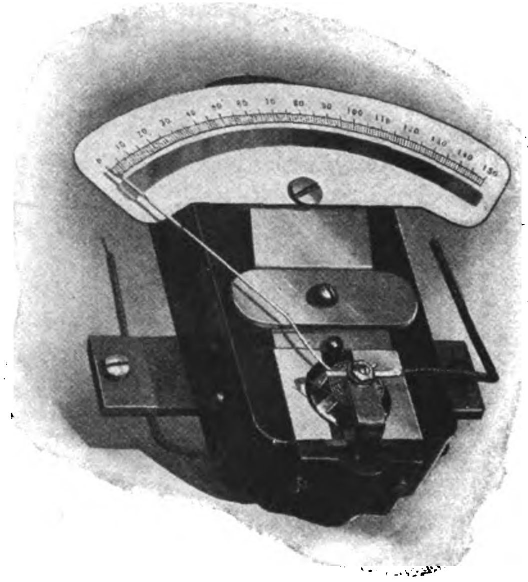


Fig. 3.—Direct-Current Instrument, Ready for Mounting in Case.

The "repulsion," or alternating-current, type is in fact a small transformer, with two secondary coils short-circuited; one being free to move. This instrument has a closed magnetic circuit of laminated iron and the torque is produced by the direct repulsion of the current in the primary upon the secondary; their currents being nearly in opposite phase. The moving element is extremely light and rigid, and is quick to respond to slight changes in current strength. The oscillation of the moving parts is magnetically dampened and swings in the best grade of sapphire bearings. Fig. 1 represents the alternating-current movement ready for mounting in the case. Fig. 2 represents the complete instrument.

Fig. 4.—School Laboratory Glass-Front Instrument.

Fig. 5.—Direct-Current. Portable Volt-Ammeter.

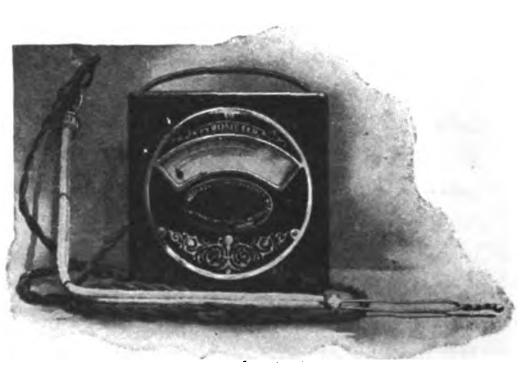


Fig. 6.—Electric Pyrometer.

The principle of the direct-current movement is well known and used by most of the manufacturers of high-grade instruments. The mechanical features, however, vary considerably. The International direct-current instrument is well balanced upon its support in the case, and parts may be readily removed for repairs. Fig. 3 represents the direct-current movement ready to mount in case. Fig. 4 represents the school laboratory glass-front instrument.

Fig. 5 represents a direct-current portable volt-ammeter, and Fig. 6 represents an electric pyrometer.

The shop and laboratory equipments are complete with special machinery and testing instruments necessary for the manufacture of high-grade apparatus.

The men employed for manufacturing, assembling, testing and inspecting the

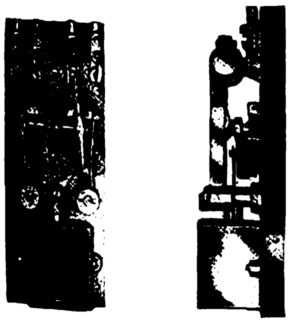
International instruments have had long experience in the work for which they have been selected.

The sales of this company are made direct to the user or through the jobber, whichever is more convenient for the customer. The electrical jobbers have been quick to learn that the International line of instruments is one especially desirable for them to handle. Shipments are made promptly and treatment secured from the International company is courteous and fair. The men in charge of the International Electric Meter Company's affairs are William W. Cheney, Jr., president; August Benson, secretary; Julian S. Jackson, sales manager, and John M. Lea, chief engineer.

Darrin Magnet Switches.

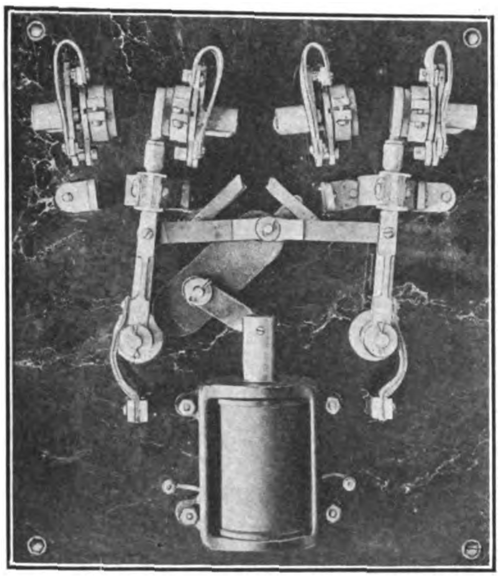
The Automatic Switch Company, 131 Liberty street, New York city, has developed a magnet switch which is of considerable interest to contractors. This is a small two-pole Darrin magnet switch with a capacity of twenty-five amperes. The Darrin magnet switch fills the requirement of a switch which will work equally well on direct or alternating current, in which the magnet circuit carries current only for an instant during the actual operation of the switch. The switch can be placed with carbon and copper butt contacts for motor control, or with knife-blade contacts for lighting work.

One of the illustrations shows the type DMS "300-2 R" reversing switch, and the other illustrations show the type DMS "25-2," front and side views. The reversing type switch has a capacity of 300 amperes.



Front and Side Views of Darrin Type DMS 25-2 Reversing Switch.

By the peculiar construction of the magnet circuit in these switches the switch can be actuated either on or off or from one position to the other without carrying current in the magnet circuit longer than necessary to throw the switch. As the magnet circuit is opened on contacts on the switch itself, there will be no arcing at the controlling point. This type of switch can thus be controlled by thermostats, pressure regulators or with ordinary push-buttons, which have no quick-break features.



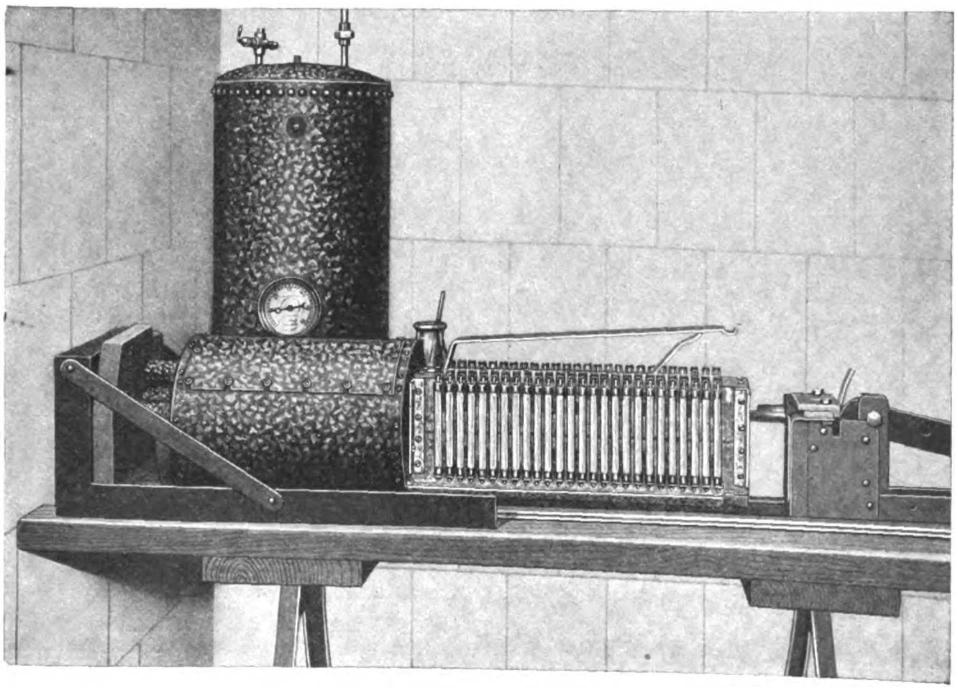
Darrin Type DMS 300-2 R Reversing Switch.

The switch is especially well adapted to the control of heavy lighting circuits from various remote points, and will be supplied, when so ordered, with magnetic blowouts at a slight additional expense.

All switches of seventy-five amperes or greater capacity continuous rating are provided with flexible carbon contacts so as to insure a level surface on closing. In the smaller sizes the contact arms are provided with springs to effect the same result.

Moisture-Proof Pole Cable Terminals and Junction Boxes.

The accompanying illustration shows an interesting corner of the factory of Frank B. Cook, Chicago, Ill., where junction boxes and non-pothead terminals are tested for leakage. Special care is exercised in the construction and assembling of these types, and every precaution is taken to render them air-tight. The final inspection consists of testing each piece of apparatus under ten pounds air pressure, this being accomplished by connecting the piece to be tested with the machine shown in the illustration. The terminal or junction box is placed on a special frame, the air pipe being placed in the self-soldering nozzle with which these types of apparatus are equipped, and this nozzle is forced against a piece of solid rubber through which the air pipe extends. When the pressure is turned on the gauge registers any decrease of pressure in the tank, thus detecting any leakage. A further test is to cover the joints with soapy water, the slightest leak causing a bubble to form at the point. These types of Cook apparatus are guaranteed to be moisture-proof.



Testing Cook Waterproof Terminal Head.

The Stave Flaming Arc Lamp.

The Stave flaming arc lamp, an illustration of which is shown herewith, has been built very carefully, taking advantage of a very valuable experience in the operation for many years of alternating-current arc lamps, and embodying many features of more than ordinary merit. The control of the lamp electrodes is attained by rotating aluminum discs in either direction, accordingly as either a series or a shunt magnet is excited. This control is ideal, three full revolutions of a disc corresponding to a feed of one-sixteenth inch.

Stave Flaming Arc Lamp.

The upper part of the lamp containing the regulating mechanism is sealed, and it is stated that in many years of operation it has not been necessary to break this seal to effect repairs. Each lamp is equipped with an internal resistance, so that it is immediately ready, burning two in series, for use on 115-volt circuits. Each lamp automatically takes care of its own voltage, and all will burn at forty-five volts.

All interior connections are made with fine stranded copper conductors, insulated with glass beads, which are impervious to fumes or heat, and all current-carrying parts are insulated by mica and air.

In the construction of the electrode holders, a substantial and easily accessible thumb-nut is used.

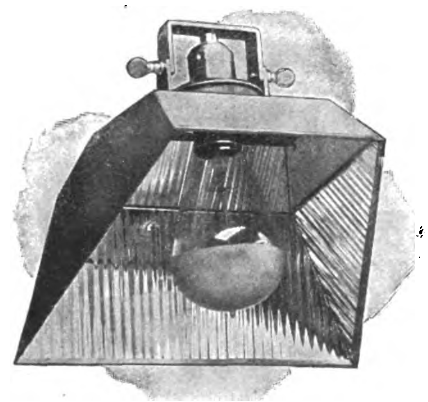
The lamp is furnished in several finishes, the brass, copper and nickel finishes being especially adaptable for the lighting of stores, halls, etc.

Theodore Stave, president of the Stave Electrical Company, manufacturer of this lamp, has been very successful in popularizing it, some 10,000 being in use in Europe, and is now making his headquarters at No. 1 Madison avenue, New York city.

Wheeler Reflector Company's New Fixtures.

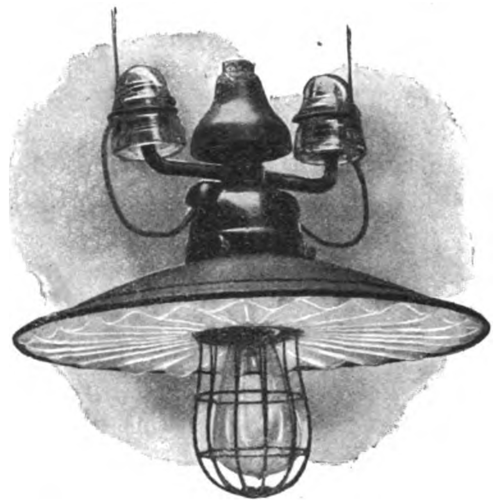
The Wheeler Reflector Company, 156 Pearl street, Boston, Mass., has placed on the market two new fixtures adapted especially for use with tungsten lamps.

The Wheeler tungsten adjustable window reflector No. 65 is a corrugated mirror-lined reflector attached to the stem of a fixture above the socket by a hinged holder which permits adjustment at any angle, the lamp remaining in a vertical position. With a 100-watt tungsten lamp this fixture distributes ample light over the average show window. The upward radiated light is all reflected down, that from three sides forward and down and that from the remaining side is radiated horizontally without interference.



Wheeler Tungsten Ajustable Window Reflector.

The Wheeler tungsten street fixture No. 770 consists of an eighteen-inch porcelain-enameled steel reflector fluted to give the most effective candle-power distribution and protected by a copper or painted steel hood attached to a cast holder. The illustration shows malleable iron cross-arms supporting pony glass insulators in a vertical position, but where desired these may be cast in one piece with the holders, so that the insulators may be held at right angles to the stem. The mica insulating joint is designed for high-tension circuits and will stand a break-down test of 34,000 volts. The important feature of this fixture is the reflector which, besides being fluted and slightly convex, is adjusted at such an angle with relation to the filament and of a sufficient diameter to intercept the light rays radiated in the direction of the base, that with a forty-candle-power lamp the light distributed shows a curve beginning at about forty-five candle-power at the horizontal, increasing to fifty candle-power at nearly every angle from twenty degrees to forty degrees below the horizontal, then gradually dropping to forty candle-power at sixty degrees and twenty-five candle-power in the direction of the tip.



Wheeler Tungsten Street Fixture.

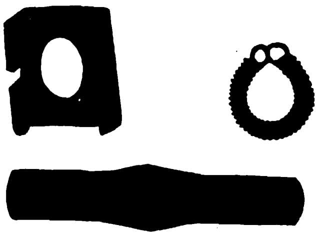
"Verus" Conduit.

Arthur P. Pierson, 23 North Juniper street, Philadelphia, Pa., is introducing a new non-metallic, flexible conduit, which is designated as "Verus." This conduit is made of narrow tubular sections of asbestos fibre treated with moisture-proof insulating compounds which have the properties of withstanding a fire test of about 400 degrees centigrade. The conduit is protected on the outside with an additional tubing, and the whole has a woven cover over all, treated with standard insulating compounds approved by the National Board of Fire Underwriters. This conduit not only has a fireproof interior, but a fireproof exterior as well.

These conduits are being manufactured by the Protecus Electric Manufacturing Company, of Allegheny City, Pa., for which Mr. Pierson is general sales agent.

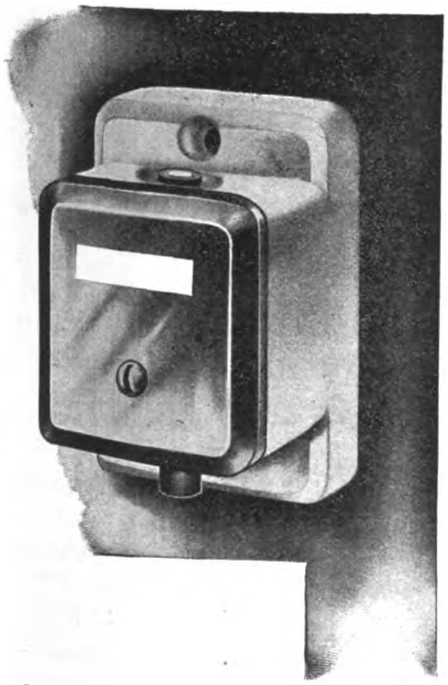
Cutler-Hammer Push-Button Specialties.

One of the most interesting, and doubtless a device which will be conceded revolutionary in its nature, is the push-button specialty which the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has placed on the market. This line includes porcelain pendent switches, porcelain surface switches, together with sub-bases, and porcelain push-button lamp sockets. The accompanying illustrations show the component parts of the mechan-



COMPONENT PARTS OF SWITCH.—A MOVING CONTACT-PIECE, A COILED STEEL SPRING AND A PUSH BAR.

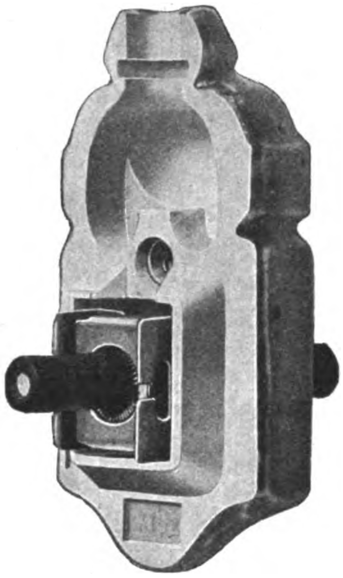
ism of these switches and also show some of the present applications. The illustrations, however, indicate only in a



PORCELAIN SURFACE SWITCH FOR CONCEALED WORK.

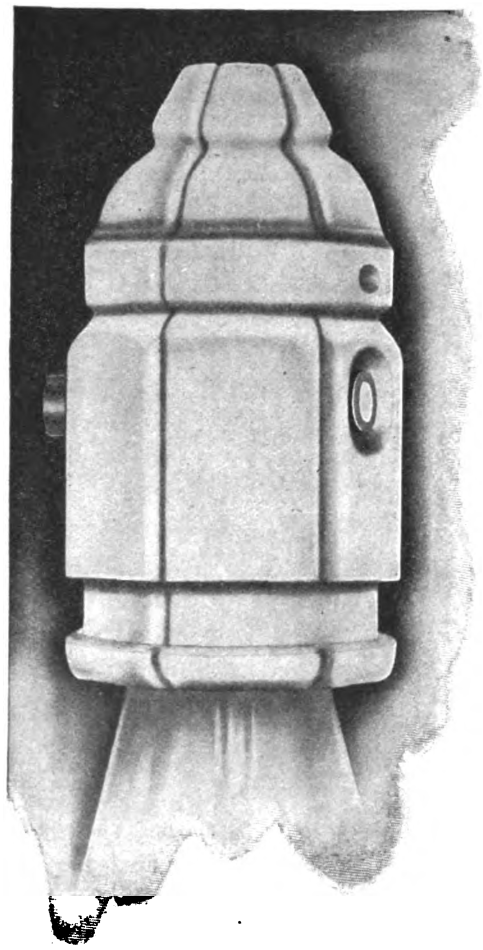
fashion the high degree of ingenuity which this device represents. The switch consists essentially of three parts, a push bar extending clear through the switch, a coiled steel spring and a moving contact-piece. These three elements may be assembled in any form of containing receptacle to perform any switch function which may be required.

The principle embodied in the switch mechanism is that of a coiled spring contracting on a tapering surface, the action being similar to that of a rubber ring slipped over the knob of an umbrella or a



SECTIONAL VIEW OF SMALL PORCELAIN PENDENT.

coiled-wire sleeve supporter which, when passed over the elbow, will travel a short distance up or down the arm of itself.

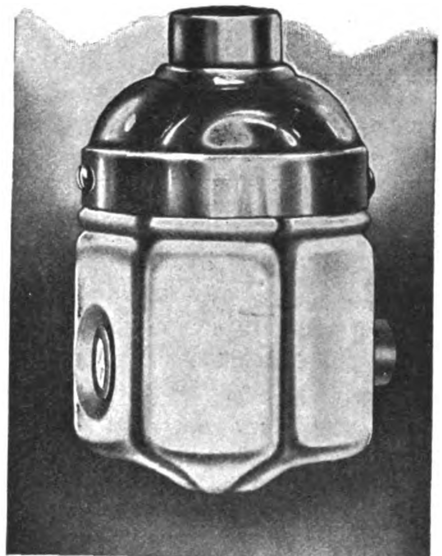


PORCELAIN PENDENT PUSH BUTTON LAMP SOCKET.

The action is snappy and positive in either direction. The mechanism gives a quick "make" as well as a quick "break," the movement of the contact-piece is the same whether the push-bar is moved fast or slow. The contact-piece can not be moved part way and let slip back again drawing an arc.

This new line of Cutler-Hammer push-button specialties is made of porcelain, which is non-corrosive and non-conductive. They will not tarnish and the user can not receive a shock, because all of the metal parts are encased in porcelain. Any slight arcing which might possibly occur is confined to a porcelain chamber away from the circuit wires and terminals. Liberal space is provided for knotting the flexible cord and the removal of a single screw gives access to the interior of the switch, making the wiring of these devices an easy matter. A removable fibre bushing is furnished with each of the pendent switches and the lamp socket, reducing the size of the outlet to the diameter of standard cord. When reinforced cord is used this bushing is removed.

The fire glaze on the porcelain is practically indestructible and the choice of



BRASS CAP PORCELAIN PENDENT SWITCH.

colors is such that a shade can be selected that will harmonize with the surrounding trim. The standard glazes are plain white, ivory tint, wood brown and neutral gray. Special glazes can be furnished to order.

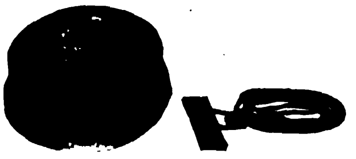
These devices have been approved by the Underwriters' Laboratories at Chicago.

A New Automobile Instrument.

The General Electric Company has lately placed on the market a new automobile instrument for use on electric vehicles. This instrument, known as the type DK, consists of a combination ammeter and voltmeter enclosed in a dust and moisture-proof aluminum case and is especially designed to withstand without injury the constant vibration and exposure incident to this class of service.

Both elements are constructed on the D'Arsonval principle. In the ammeter element a coil of wire carrying the current to be measured, or a shunted portion of it, is wound on a light aluminum frame, so pivoted in jeweled bearings as to move freely in a small annular space between a soft iron core and the pole-pieces of a permanent magnet. This element is identical with that of the type D switchboard instrument, with the exception of the permanent magnet, which is made somewhat larger in order that the voltmeter may be placed within the space enclosed by it.

The voltmeter has smaller parts throughout and differs slightly in construction. It has a circular form of armature frame instead of rectangular, and the core is a spherical piece of soft iron. Its general action is the same as that of the ammeter.



Combination Volt-Ammeter for Automobile Service.

It is a well-known fact that when magnets are subjected to constant vibration their efficiency is impaired and this must be taken into account in the design of automobile instruments. The magnets used in DK automobile instruments are made from the best quality of magnet steel obtainable, the special processes of ageing and hardening further insuring their permanency.

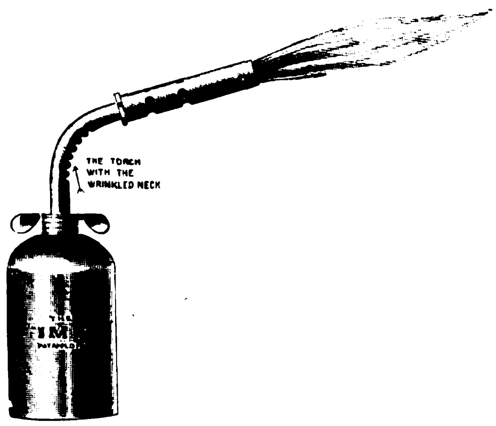
Another important advantage of DK instruments is the fact that they are strictly dead-beat, the pointer quickly coming to rest after each change in current or voltage. The scale divisions are very uniform and legible; this, together with the fact that the two scales are placed one above the other in close proximity, permits accurate simultaneous reading of volts and amperes. When desired, a suitable bracket carrying a miniature lamp with shade will be furnished for illuminating the dials.

The standard voltmeter scales are 120 and eighty volts. Either of two ammeter scales is standard, *viz.*, 150-0-150 or 70-0-150, the scales showing both charging and discharging current. Any other capacities of voltmeter or ammeter can be furnished when desired. It often becomes necessary to measure the voltage across individual cells and for this purpose a second voltmeter scale reading from 0 to 3 volts can be furnished on request.

The severe vibrations to which automobile instruments on commercial vehicles are subjected prevent the indications being read. To overcome this difficulty the General Electric Company has designed an "anti-vibration support," upon which the type DK instrument may be mounted. This is a new idea in automobile instrument construction and makes possible the use of indicating instruments on commercial vehicles. The black japan finish and the polished aluminum trimmings contribute to the neat appearance of the DK instrument.

A Powerful Gasolene Blow Torch.

The "Imp" torch, manufactured by the Frank Mossberg Company, of Attleboro, Mass., is a patented device which it is claimed will do as much work as most of the larger torches on the market, with the advantages of compactness, simplicity and cheapness. It is entirely automatic in operation, has no pump nor valve, needs no tools, starts with a match, and gives a perfectly clean, powerful Bunsen flame for over two hours on four ounces of gasolene.



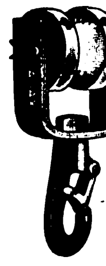
The "Imp" Gasolene Blow Torch.

The corrugated neck increases the heating surface to such an extent that the flame of a match easily generates gas enough for starting, after which the carefully designed mixing tube renders further attention unnecessary.

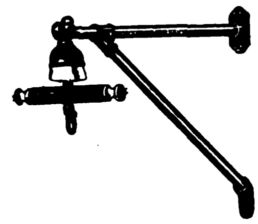
The "Imp" will be found valuable by electricians, automobilists, the handy man, and, in fact, any one who wants intense, clean heat, cheaply and quickly.

New Ajax Specialties.

The Ajax Line Material Company, Chicago, Ill., has added to its line of devices for contractors' use the three illustrated herewith. One is an insulated hook, designed as a low-priced insulator

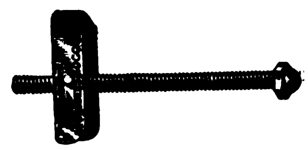


Ajax Insulated Hook.



Ajax "Mitre" Bracket.

for use with flaming and other arc lamps. Another is a modification of the regular Ajax toggle bolt having a detachable and ornamental head. This type was designed for plumbers' use, but is proving popular also for certain classes of electrical work. The third is a short arc lamp bracket for pole or wall use, with an insulating cross



Ajax Plumber's Toggle.

arm for guiding the wires and insulating the lamp. It is one of a series of easily erected fixtures designed to replace the crude riggings heretofore used.

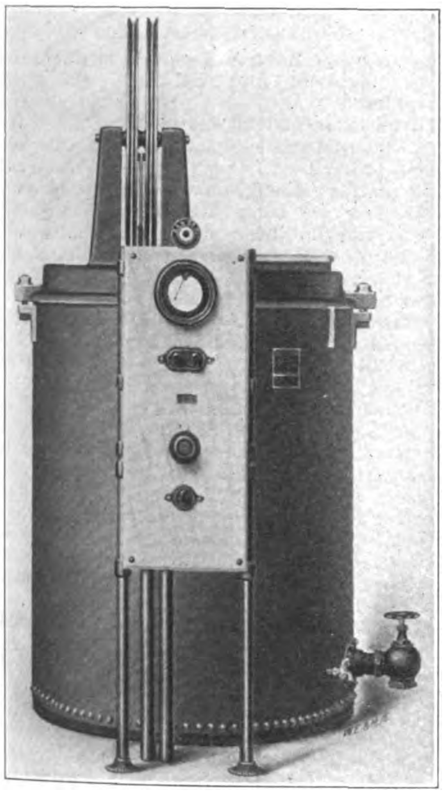
The "Success" Chemical Fire Extinguisher.

The H. W. Johns-Manville Company, 100 William street, New York city, has recently put on the market the "Success" portable fire extinguisher. This extinguisher is made of extra-heavy Lake Superior cold-rolled copper securely riveted and reinforced by heavy shoulders tested to withstand a pressure of 350 pounds per square inch. The method of attaching the dome to the body of the shell is said to make that joint the strongest part of the extinguisher. The large wheel at the top of the machine is a convenience in opening and closing it, at the same time serving as a base on which to rest the extinguisher when reversed. The framework or bottle holder containing the supply of sulphuric acid is cast brass and virtually indestructible. The bottle, of standard size and type, for holding the acid, is obtainable anywhere in case of accidental fracture from any cause. The hose, tested to 400 pounds per square inch, is only detachable with a wrench, being joined to the body by a swivel ground joint. This extinguisher is included in the list of approved chemical extinguishers issued by the National Board of Fire Underwriters.

Westinghouse Mercury Rectifier Arc-Lighting System.

In order to secure the advantages of direct-current series arc lamps and the alternating-current system of distribution and regulation, the Westinghouse Company has recently introduced a new system of arc lighting in which the most desirable points of both systems are combined. The alternating-current supply is changed to a direct-current by means of a Cooper Hewitt mercury rectifier, and this rectified current is then available for operating direct-current series arc lamps.

This system is applicable to all types of direct-current series carbon arc lamps, and also to the Westinghouse metallic flame



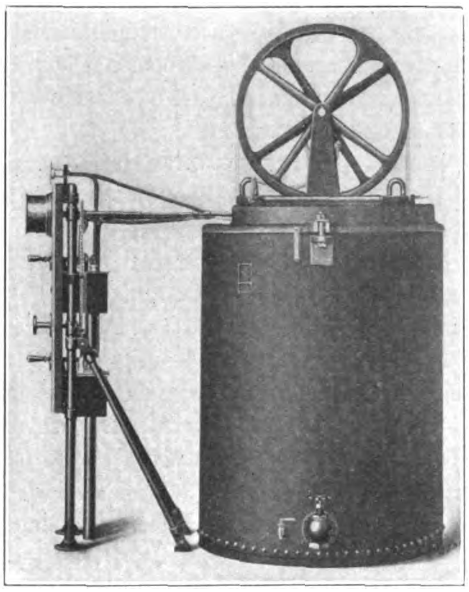
FRONT VIEW OF SEVENTY-FIVE-LIGHT MERCURY RECTIFIER, CONSTANT-CURRENT REGULATING TRANSFORMER OUTFIT.

arc lamp for which it is specially adapted. This lamp is a new development whose efficiency as a light producer is nearly double that of the carbon arc lamp. It is essentially a direct-current lamp, and as it requires a current of but four amperes, the existing arc generators as originally designed are not suitable for supplying current for it. These lamps, however, are extremely economical to operate because of their very high efficiency.

The combination of alternating-current regulating transformers and mercury rectifiers with any type of direct-current series lamps comprises a lighting system that is both simple and reliable, and that has proved highly successful in its practical applications. Its operation is devoid of any complications, and its notable economy makes its use extremely desirable.

The rectifier outfit consists of a constant-current regulating transformer, a mercury rectifier bulb, and a panel containing the necessary switches, instruments, etc. The regulating transformer and the rectifier bulb are mounted in the same tank, and by means of such outfits power may be drawn from an alternating-current circuit of either twenty-five or sixty cycles and delivered as direct current to the series arc lamp circuits. The rectifier bulb requires no manipulation except to start it, after which it operates without further attention.

The constant-current regulating transformer used with the rectifier set is of the repulsion coil type and is oil-cooled and oil-insulated. It is so arranged as to give a constant secondary current and to insu-



SIDE VIEW OF SEVENTY-FIVE-LIGHT MERCURY RECTIFIER, CONSTANT-CURRENT REGULATING TRANSFORMER OUTFIT.

late the arc lines from the primary circuit.

The rectifier bulb consists of a pear-shaped closed glass vessel about seven inches in diameter at its largest part. It is provided with four electrodes, the two upper ones being of graphite and the two lower ones of mercury. The bulb is exhausted to a high vacuum. Metal terminal thimbles are provided to which connections are readily made by spring clips or connectors.

The rectifier panels are made in four capacities, for twenty-five, thirty-five, fifty and seventy-five-lamp circuits, and are built of blue Vermont marble, supported upon a gas-pipe frame, which is braced to the floor. The three smaller-capacity panels are essentially similar and contain an ammeter, two oil switches, fuse blocks and fuses, a tilting handle and a pilot lamp in series with the arc circuit.

The ammeter is located at the top of the board and is connected in the direct-current lamp circuit. It is specially insulated so as to avoid all danger to attendants from grounding of its case.

The oil switch controlling the primary is double-pole. This may be double-throw when required. Suitable fuses are inserted in the primary leads to provide for short-circuit and overload protection. A double-pole oil switch also controls the secondary or direct-current series lamp circuit.

The seventy-five-light panels contain the same apparatus as the smaller-capacity panels, just described, except that the oil switch controlling the secondary is of a different type. In the seventy-five-lamp outfits the two bulbs are mounted so that both are tilted together. The secondary oil switch has two handles, one of which operates a double-pole switch in the lamp circuit and the other a single-pole switch which short-circuits one of the rectifier bulbs. For circuits of 6,600 volts and higher the fuse blocks are separately mounted.

The Dielectric Company of America.

The Dielectric Company of America, with factories and headquarters at Belleville, N. J., reports that its sales are showing considerable improvement and that the outlook for future business is very encouraging.

This company, although but recently organized, is meeting with marked success in its weatherproof-wire department, while its underground system is becoming more extensively used than ever. It is manufacturing the well-known DE brand of weatherproof wire which is exciting interest among the lighting plants and also among the signal engineers.

The Dielectric system of underground construction is designed to meet the demand for an underground system either for high or low potential, which is not as expensive as the present duct systems. Besides the advantage of first cost, the company claims that its system is also cheaper to maintain in that after the wires are once laid there is nothing to replace or repair. Besides these two very important lines, this company is also preparing to put on the market its HVH special wire, which is designed to be used in especially difficult places where a wire is required to not only carry a high voltage but to withstand the action of the elements and the action of acids, gas, etc.

New Receiver for New York City Railway.

By continuing Adrian H. Joline and Douglas Robinson as Federal receivers for the Metropolitan Street Railway Company and appointing William W. Ladd as receiver for the New York City Railway Company in their stead, Judge Lacombe of the United States Circuit Court on July 16 carried out his decision that the companies should have separate receivers. Mr. Ladd will take up his duties August 1. The court directs Joline and Robinson to file with the court, not subsequent to August 1, a statement of receipts and expenditures of the dual receivership to July 1. It was on a motion made by Bronson Winthrop, representing the Morton Trust Company, that the Metropolitan receivership was separated from the New York City Railway receivership. In that motion the Guaranty Trust Company joined. The separation is made for the purpose of expediting foreclosure proceedings. Mr. Ladd was appointed on motion of Benjamin S. Catchings, who represented the tort creditors' committee of the New York City Railway Company. Mr. Ladd's bond was fixed at $50,000.

Judge Lacombe said that when the same receivers were appointed for the Metropolitan and the New York City Railway the lease of the Metropolitan system to the New York City Railway still was in force and no suit to foreclose mortgage had been instituted. Since then the situation has changed, he said. A regular foreclosure suit against the Metropolitan for unpaid interest under refunding mortgage has been instituted and the court said it was fitting that the property covered by that mortgage should be taken over by receivers under that suit who would operate the Metropolitan system alone. Judge Lacombe said that the clause in the lease deferring re-entry for non-payment of rent until one year after default presented no difficulties. There was not merely a simple default, he asserts. Because of the inability of the receivers to pay from the income the mortgage interest due January 1, 1908, on the Third Avenue mortgages that line had been foreclosed upon, and an independent receiver appointed, who has taken it into possession, thus disrupting and destroying the original system covered by the lease.

It was ruled by the court that the present bonds of Joline and Robinson might be extended to cover their future operations. The court included in its opinion assurances that the receivers for the Metropolitan would adopt and affirm all contracts which related to the operation of the system which were adopted or entered into by receivers for the New York City Railway. Judge Lacombe said the court reserved the right to impose a lien upon the property itself for any obligations incurred by the court in its operation of the railways and also for the expense of the court proceedings.

Mr. Ladd, the new receiver for the New York City Railway, formerly was deputy city chamberlain, resigning that office to resume the practice of law. He was a member of the board which prepared the Military Code adopted by the Legislature in 1898. He served four years as assistant corporation counsel. He is now a practicing lawyer in No. 20 Nassau street.

International College Comity—A Unique Ceremony.

University and college degrees are occasionally, in exceptional cases, conferred *in absentia*. It has remained for Lehigh University, acting in conjunction with the University of Liverpool, England, to signalize a new and most interesting departure in the practice, replete with kindly expressions of international comity and friendship on the part of the University of Liverpool.

In June last Lehigh University awarded to Horace Field Parshall, of London, England, the honorary degree of Master of Science, this being the fourth honorary degree ever granted by Lehigh. Mr. Parshall is an American who has built up in England a practice as a leading electrical engineer. He is well known as an author; his joint work with H. M. Hobart on "Electric Railway Engineering" is an engineering classic. Mr. Parshall is a graduate of the course in electrical engineering of Lehigh University of the year 1887. For some ten years after his graduation his work was in this country, during which time he held in 1894, in the Massachusetts Institute of Technology, a lectureship on the designing of electrical machinery. Since 1897 he has been resident in London and has been engaged largely in the introduction of electric traction into Great Britain, and is now engaged as expert on the hearings before a parliamentary commission on the London and District Electricity Supply Bill. This engagement prevented Mr. Parshall coming over here in June to receive the degree at Lehigh's commencement exercises, and resulted in the arrangement by which the University of Liverpool graciously undertook the duty of conferring the degree on behalf of Lehigh University.

Vice-Chancellor Dale, of the University of Liverpool, in writing President Drinker the acceptance by the University of Liverpool of the duty of conferring the degree, gives the following kindly expressions of cousinly goodwill:

The council and senate of this university have agreed to act on the suggestions that you make, and to confer formally on Mr. Parshall the honorary degree that has been awarded to him by the university over which you preside. When the hood and diploma have reached us I will then arrange with Mr. Parshall for his formal admission to the degree.

So far as I am aware, no precedent or parallel for such an act can be found in the history of British universities. But it is our business to make precedents as well as to follow them, and we trust that in so doing our act will be regarded as an expression of fellowship and sympathy with kindred institutions carrying on similar work, established for similar services, and bound to us by many ties.

The letter of attorney from Lehigh to Liverpool was couched as follows:

Whereas, Horace Field Parshall, in the year eighteen hundred and eighty-seven, completed at Lehigh University the special course in electrical engineering then given by the university, and since that time has risen to high eminence in his profession, and has distinguished himself and has reflected honor on his Alma Mater by his scientific work and publications, and the university is desirous of recognizing his achievements in this regard, and of doing honor to one who has so honored himself; and,

Whereas, The said Lehigh University has decided to confer upon the said Horace Field Parshall the honorary degree of Master of Science; and,

Whereas, The said Horace Field Parshall is engaged in Great Britain in the pursuit of work of such importance as to make it impracticable for him to attend at the university at South Bethlehem, Pa., at the university's commencement exercises on June tenth, nineteen hundred and eight, to receive said degree, and the authorities of the University of Liverpool have graciously offered to act as the representatives of Lehigh University in the act of conferring said degree;

Now Know All Men by These Presents, That the Lehigh University, an educational corporation existing under the laws of the state of Pennsylvania, in the United States of America, hereby nominates and appoints the chancellor of the University of Liverpool or such person as he may designate to confer for and on behalf of the Lehigh University and by its authority, and as its attorney and representative, upon the said Horace Field Parshall, the degree of Master of Science, and in testimony thereof to deliver to the said Horace Field Parshall the diploma of the Lehigh University evidencing said degree.

Witness the seal of the said the Lehigh University this day ,
A. D., nineteen hundred and eight.

Henry S. Drinker,
President of Lehigh University.

W. A. Lathrop,
President of the Board of Trustees.

Seal of Lehigh University.

Attest:
E. P. Wilbur,
Secretary of the Board of Trustees.

At the ceremony of July 2 Mr. Parshall was presented by the dean of the faculty of science of Liverpool University for admission to the degree and the vice-chancellor conferred the degree and delivered to him the diploma of the Lehigh University conferring the degree.

Current Electrical News

DOMESTIC AND EXPORT.

MISSOURI ELECTRIC RAILWAY DEAL—A despatch from St. Louis states that the United Railways Company and the North American Company have incorporated a subsidiary company known as the Missouri Electric Railway Company, into which will be consolidated all the electric lines in St. Louis County. The capital is $1,000,000. The incorporators are acting for the United Railways management and the North American Company interests, which control that company.

GREAT WESTERN POWER COMPANY TO BUILD PLANT AT EAST OAKLAND—The Great Western Power Company has started the erection of what will be one of the greatest power plants on the coast. The site for the new power-house is at the end of Fourth avenue in East Oakland. The new plant will cover several thousand square feet of ground on the west side of Fourth avenue, and according to the plans of the company, will be one of the most completely equipped in the state.

A MILLION DOLLARS FOR IMPROVEMENTS—The Coney Island & Brooklyn Railroad is installing a number of improvements that Superintendent D. W. Sullivan says will cost considerably more than $1,000,000. One of the principal of these, the burying of overhead feed wires, is now practically completed. A conduit has been laid along the entire system from Coney Island, and the cables installed under the immediate supervision of Mr. Murphy, the electrician of the road. These are now in operation, and it is through them the power is now being supplied to operate the cars on the Smith street, DeKalb and Franklin avenue lines. The overhead wires have already been removed between the depot at Smith and Ninth streets and the Park Circle, and the remainder will come down in short order. The most striking improvement, however, is the new building that is being erected for the power plant at Smith and Ninth streets. There will be generated the entire power to run the lines of the road.

SYNDICATE SEEKING TO CONTROL MONTREAL LIGHT, HEAT AND POWER COMPANY—An American syndicate with $40,000,000 capital, headed by Leslie M. Shaw, formerly Secretary of the Treasury, is said to be negotiating for control of the Montreal Power Company, with the intention of subsequently gaining control of a number of other Canadian public service corporations, including the Montreal Street Railway and some Toronto franchises. The syndicate is known as the Canadian Public Service Corporation. It proposes to guarantee six per cent for the first year, seven per cent for the second and eight per cent thereafter on the stock of the Montreal Power Company in return for an option to purchase the stock during the first year at 110, during the second year at 112½, and so on at an annually increasing price of 2½ points up to 135. As a guarantee of the dividend the corporation proposes to deposit $8,000,000 with a Montreal trust company, in the event of its acquiring controlling interest.

ONONDAGA INDEPENDENT TELEPHONE COMPANY—At the first meeting of the directors of the Onondaga Independent Telephone Company, held in Rochester last week, Alexander H. Cowie, of Syracuse, was elected president; John B. Pierce, manager of the old Independent Telephone Company of Syracuse, was elected general manager and assistant treasurer of the new company. George R. Fuller, of Rochester, N. Y., was chosen vice-president and W. Roy McCanne secretary and treasurer. The other directors are Hendrick S. Holden, of Syracuse, and Joseph W. Taylor and Edward W. Peck, of Rochester. The Onondaga Independent Telephone Company took possession of the properties of the Independent Telephone Company of Syracuse on July 13. All the property of the old company, including the exchange in that city and lines to various towns and cities in central New York, was bid in on behalf of the reorganization committee at the mortgage foreclosure sale July 3. Under the plans of reorganization the title is now turned over to the Onondaga company.

ELECTRIC RAILWAYS.

FITCHBURG, MASS.—The Fitchburg & Leominster Street Railway Company has petitioned the Railroad Commission for approval of an issue of 2,500 additional shares of stock to be offered stockholders at $100 per share.

HAMMONDSPORT, N. Y.—The Appellate Division of the Supreme Court has annulled the decision of the former State Railroad Commission to grant to the Bath, Branchport & Hornell Electric Railroad a certificate of public convenience and necessity. The annulment is made on the ground that contrary to law one-tenth of the minimum amount of capital stock of the company had not been subscribed and paid.

EVANSVILLE, IND.—The annual election of the Evansville Railway Company, operating the Evansville and Mt. Vernon and the Evansville and Rockport traction lines, held in this city on July 6, resulted as follows: President, W. L. Sonntag, Evansville; vice-president, W. I. Rudd, Rockport; secretary, Fred W. Reitz; treasurer, Marcus S. Sonntag; directors, W. H. McCurdy, chairman; John M. Funke, Fred W. Reitz, C. H. Batten, Philip Speck, M. S. Sonntag, Wm. M. Ford, Chris Kanzler, W. L. Sonntag, A. F. Karges and W. I. Rudd.

OREGON, MO.—The contract for building the Oregon Interurban Railway has been awarded to W. M. Wogan, of Leavenworth, Kan., for $40,000, this amount to make the road ready for the rolling stock—building bridges, culverts and fills, and laying the ties and steel, including sidetracks and putting in all other necessary fixtures aside from the engines and cars. The road is to be completed and ready for the rolling stock by October 1 next. The Oregon Interurban Railway is to be built from the Burlington yards at Forest City to a point four and a half miles distant, at the northern edge of the city of Oregon. It will be of standard gauge, and capacity for all sizes of rolling stock used upon the main line of the Kansas City, St. Joseph & Council Bluffs Railway. Thirty-seven bids for the contract were filed with the company.

HARRISBURG, PA.—Governor Stuart has approved the merger of eight trolley lines in western Pennsylvania under the name of the Suburban Railway Company, with a capital of $150,000 and offices at Rochester. The companies consolidated are the original Suburban Company, the Freedom & Baden Electric Street Railway Company, Sewickley & Leetsdale Electric Street Railway Company, Beaver & Bridgewater Electric Street Railway Company, Beaver Falls Electric Street Railway Company, Rochester, Beaver & Vanport Electric Street Railway Company, New Brighton, Beaver Falls & Marado Electric Street Railway Company and Economy and Harmony Electric Street Railway Company. The new company will have these officers: W. A. Park, Rochester, president; Samuel Morgan, Freedom; J. H. Park, P. A. Smith and Charles Connel, New Brighton.

CLEVELAND, OHIO—The Municipal Traction Company, which is operating all the street car lines in Cleveland under the plan carried out by Mayor Johnson, reports a deficit of $34,916 for the month of May. Mayor Johnson says this deficit is largely due to the strike of the street railroad men. Taking that into consideration, he says the statement is satisfactory. The company must pay operating expenses and six per cent dividend on the stock or forfeit its right to operate the lines. The lines have been operated at three cent fare a little over two months, but one cent is charged for each transfer. Judge Phillips, in Common Pleas Court, has granted a mandatory order compelling the Municipal Traction Company to give good service and the same rate of fare to the town of East Cleveland, a suburb, as is enjoyed by the city of Cleveland. The court held this was compulsory under the original franchise granted to the street-car company by the suburban town. The Municipal Company, when it recently took over the street-car system, announced that three-cent fares would prevail only within the city limits and that the fare to and from the suburban towns would be five cents.

TELEPHONE AND TELEGRAPH.

DOVER, N. H.—The New England Telephone and Telegraph Company will construct a telephone line from Dover to Eliot.

CONESTOGA, PA.—The Conestoga Telephone Company is making a number of improvements to its exchange at Birdsboro, including the rebuilding of the switchboard.

OMAHA, NEB.—The Independent Telephone Company is preparing to start work on its building in South Omaha. This will have a capacity of 5,000 telephones and is expected to be in operation by November 1.

HARTFORD, WIS.—The special election held recently for the purpose of voting on the proposition to install a municipal electric light plant resulted favorably to the plan. A plant to cost $27,000 will be installed, to do commercial as well as street lighting.

MARSHALLTOWN, IOWA—The Marshall Telephone Company, which was recently amalgamated with the Bell system, locally, has purchased a centrally located business building, and will spend $10,000 in improving and building an addition forty by fifty-one feet.

FLORENCE, UTAH—John B. Morris, of Erie, Pa., and Robert E. Archibald, of Cleveland and San Francisco, representing a syndicate of Brooklyn and Philadelphia capitalists, have announced that they will build an electrical power plant and a custom mill in this district.

WHEELING, W. VA.—Dr. John L. Dickey and Samuel W. Harper have been elected directors of the National Telephone Company. The board organized with the Hon. John A. Howard as president; S. W. Harper, treasurer and vice-president, and William C. Handlan as secretary and manager.

PROVIDENCE, R. I.—It is announced that it is the intention of the Narragansett Electric Lighting Company to install a 4,000-horse-power steam turbine within the next four months. The present capacity of the station is 15,000 horse-power, which is not now sufficient for the winter load.

CHICAGO, ILL.—A new telephone exchange designed to provide ultimately for 10,000 subscribers has been established by the Chicago Telephone Company in the downtown business district. The new office is called "Franklin" and has been opened to relieve congestion and take care of future growth in the "Main" district.

SYRACUSE, N. Y.—The plant of the Syracuse Independent Telephone Company has been sold in mortgage foreclosure proceedings. Roy McCanne, of Rochester, bid in the property in behalf of the reorganization committee of the United States Independent Telephone Company for $25,000, but this is subject to a mortgage for $1,250,000.

LINCOLN, NEB.—A fee of $5,003 was paid by the Independent Long-Distance Telephone Company of Omaha for filing articles of incorporation with the secretary of state. The company is organized with an authorized capital stock of $10,000,000. The incorporators are: T. C. Williams, of Farlin, Iowa; C. C. Ludy, Cooper, Iowa, and D. W. Study, Jefferson, Iowa.

NASHVILLE, TENN.—The Mine City Telephone Company, of Polk County, has been granted a charter. The company proposes to own, operate and construct a telephone line from Ducktown to Copper Hill and other places in Polk County. The capital stock is $500 and the incorporators are: J. M. Kilpatrick, Carl Center, C. M. Campbell, W. S. Love and W. I. Morris.

COLVILLE, WASH.—H. R. Williams, of Spokane, has purchased the entire stock of the Northwestern Light and Power Company, which operates the plant at Meyers Falls that supplies the towns of Kettle Falls, Meyers Falls, The Mission and Colville with light and power. The system was established five years ago, the company being promoted and controlled by T. A. Winter.

OLYPHANT, PA.—The light committee appointed by the Olyphant council to investigate the condition of the municipal lighting plant and report on the advisability of accepting the offer of the Scranton Electric Company to purchase the plant have decided it would be well to buy power from the local company, but voted to maintain the electric plant under municipal management.

KANSAS CITY, MO.—The telephone line of the American Telephone and Telegraph Company between Kansas City and Denver has been completed and put into operation. Heretofore the entire United States has been divided from a telephonic standpoint by a region in a line north and south with the western half of Kansas. The service inaugurated is the first telephone line to bridge the gap.

RICHMOND, IND.—A deal has been consummated between the Richmond Home Telephone Company and the Central Union Telephone Company, as a result of which the independents will gain entrance to Minneapolis and other large cities. This will effectually open up the Northwest to the independents, Richmond being one of the most important points in the independent system of the Mississippi Valley.

BILLINGS, MONT.—Following the purchase of the electric light plants of the Billings Water Power Company and Yegen Brothers by the Eastern Montana Power Company, the work of connecting the two systems has begun. The plants are located about one-half mile apart on the Yellowstone River. According to arrangements which the new company has in view a transmission line will extend throughout eastern Montana.

PEORIA, ILL.—The Farmers' Mutual Telephone Company, with a capital of $20,000, has organized by the election of the following officers: President, John Sommers, of Elm Grove; vice-president, John Strickfaden, Groveland; secretary-treasurer and manager, Arthur Becker, Tremont. Trustees, Samuel Kinsinger, Groveland; Theodore Schwarzentraub, Morton; A. L. Robison, Elm Grove; Henry Bollinger, Tremont; Robert Kennedy, Dillon; Joseph Augsburger, Hopedale.

MILWAUKEE, WIS.—It is announced that the American Telegraph and Telephone Company, which has been engaged in laying an underground telephone system between Milwaukee and Chicago, has completed the line between this city and Racine, and expects to have the line completed to Chicago in the fall. The underground system will be connected up with the telephone exchanges in the cities and villages between Chicago and Milwaukee. The Wisconsin Telephone Company is extending its lines to Rhinelander, Minocqua and other points in northern Wisconsin.

REXBURG, IDA.—At a meeting of the city council an ordinance was passed granting a franchise for the use of the streets and alleys of Rexburg to the Idaho Power and Transportation Company, Limited, for transmission and distribution of electric current. The headquarters of this company is at Idaho Falls. The rates are $7 per month for arc lights, ten cents per kilowatt-hour and a flat rate of seventy-five cents for first lamp, fifty cents for the second lamp and forty cents for the third lamp of sixteen candle-power. The service will be twenty-four hours per day.

NEW PUBLICATIONS.

STRENGTH OF CONCRETE BEAMS—The United States Geological Survey has issued a bulletin, No. 344, on the strength of concrete beams. It gives the results of testing of 108 beams, conducted at the Structural Materials Testing Laboratory. This report, which has been prepared by Richard L. Humphrey, describes the structure of the beams and method employed in testing them.

COLUMBIA UNIVERSITY BULLETIN OF INFORMATION—Columbia University, New York city, has published a bulletin of information concerning the Schools of Mines, Engineering and Chemistry. This takes up the departments of mining, metallurgy, civil engineering, electrical engineering, mechanical engineering, chemical engineering and chemistry for the 1908-1909 course.

THE INLAND EMPIRE SYSTEM—The publicity department of the Inland Empire System has prepared a number of very handsome illustrated bulletins devoted to the pleasure resorts and routes of the Spokane & Inland Empire Railroad Company, the Idaho & Washington Northern Railroad, and the Red Collar Steamship Line. There is a description of the Bozanta Tavern, at Hayden Lake, Ida.; the system of the Idaho & Washington Northern Railroad; excursions to the shadowy St. Joe River, Idaho, the Pend Oreille River route, through the pines to Spokane Lake resorts, and profitable farming in the Spokane country. Charles E. Flagg is the manager of publicity.

PERSONAL MENTION.

MR. E. R. KNOWLES, the well-known consulting engineer of New York city, is an active member of the Building Code Revision Commission of New York city, appointed by the board of aldermen.

MR. A. W. CLAPP, who had under preparation a volume entitled "Hydroelectric Plants of United States, Canada and Mexico," and who had gathered together a considerable amount of valuable data, has some mail for him at the office of the ELECTRICAL REVIEW. If he will send us his address this mail will be forwarded.

MR. F. N. DRESING, chief of the Chinese Imperial Telegraphs and special delegate representing the Chinese Minister of Communications to the Lisbon International Telegraph Conference, was a visitor to New York and Chicago last week, where he spent some time with various electrical interests. He will return to China, by way of San Francisco, the latter part of July.

MR. DAVID S. MURRAY, general manager of the Rocky Mountain Bell Telephone Company, was tendered a banquet at the Elks Club, Salt Lake City, and presented with a handsome gold watch and fob by his associates upon the occasion of his leaving the company. Mr. Murray severed his connection with the Rocky Mountain Bell Telephone Company a few weeks ago to accept an executive position with the Pacific States Company of San Francisco, and completed his service there a week ago. His career has extended from 1884, when he began as a collector and worked his way steadily upward until a few years ago, when he became general manager. During his administration the company has grown greatly, and there is a great deal of regret among the employés at his departure. From small beginnings the company has now extended its influence over four states and spread lines into practically every town and city of that territory.

MR. WILLIAM H. BROWNE has been appointed general manager of the Rockingham Power Company, which has in progress of construction at Rockingham, N. C., a 66,000-volt, three-phase, hydroelectric development of considerable magnitude. Mr. Browne is now on the ground actively superintending construction. Mr. Browne's connection with the electrical industry dates back to 1888 in the building of the electric railroad at Richmond, Va. Following this, he was associated with the Westinghouse interests in New York city and later was general manager of the United Electric Light and Power Company, of New York city. From 1894 to 1895 he was receiver of the Flushing & College Point Railway, Flushing, Long Island. From 1895 to 1902 he was general manager of the Royal Electric Company, Montreal, Canada. From 1902 to 1906 he was treasurer and general manager of the Stanley Instrument Company, Great Barrington, Mass.

NEW MANUFACTURING COMPANIES.

HOBOKEN, N. J.—The Gross Electric Company has been incorporated with a capital of $25,000 to act as mechanical engineer, electrician, etc. The incorporators are: H. Wilkens, C. B. Wilkens and S. Gross, of Hoboken.

COLUMBUS, OHIO—The Canton Telephone Seal and Lock Company, of Canton, has been incorporated with a capital of $10,000 by E. C. Hill, Edward Rowmel, J. L. McDonald, T. E. Phillippi, E. H. Forester and W. C. Wingwire.

NEW YORK, N. Y.—Edwards & Company, Incorporated, Bronx, has been incorporated to manufacture electric apparatus, machinery, etc., with a capital of $75,000. The incorporators are: R. Edwards, Jr., Rochelle Heights; E. Lunger, Bronx; R. G. Mead, New York city.

TRENTON, N. J.—The Hicks Motor and Manufacturing Company, of Garwood, has been incorporated to manufacture dynamos, motors, etc., for the generation or use of electricity or other energy. The capital is $25,000. Incorporators: A. B. Craft, Cranford; H. E. Hicks, Plainfield; W. B. Elliott, Westfield.

ELECTRICAL SECURITIES.

All during the week stocks were buoyant on reports of bettering conditions in all phases of industry and prospects of large crop returns. Leading securities made advances ranging from a fraction to four and five points over last week. The rumors of advances in freight rates caused a little apprehension, and if these are persistent a reaction in prices of securities is not to be unexpected.

Dividends have been declared upon the following electrical securities: American District Telegraph; regular quarterly dividend of 1 per cent, payable July 22; books close July 14 and open July 22. Michigan State Telephone Company; regular quarterly dividend of 1½ per cent on the preferred stock, payable November 2, 1908; books close October 20 and reopen November 4; also regular quarterly dividend of 1 per cent on the common stock, payable September 1; books close August 20 and reopen September 2. The New Bedford Gas and Electric Light Company; regular dividend of 2½ per cent, and an extra dividend of 20 per cent. Amalgamated Copper Company; regular quarterly dividend of 50 cents per share, payable August 31 to stock of record July 23. Railway and Light Securities Company; regular semiannual dividend of $3 per share on the preferred stock, payable August 1 to stock of record of July 20. New York & Queens Electric Light and Power Company; a regular semiannual dividend of 2½ per cent on the preferred stock, payable August 10 to stock of record July 31.

ELECTRICAL SECURITIES FOR THE WEEK ENDED JULY 18.

New York:	*Closing.*
Allis-Chalmers common	10⅞
Allis-Chalmers preferred	34½
Brooklyn Rapid Transit	60⅝
Consolidated Gas	126
General Electric	143¼
Interborough-Metropolitan common	11½
Interborough-Metropolitan preferred	31¾
Kings County Electric	109½
Mackay Companies (Postal Telegraph and Cables) common	65
Mackay Companies (Postal Telegraph and Cables) preferred	66¾
Manhattan Elevated	137½
Metropolitan Street Railway	23
New York & New Jersey Telephone	107½
Western Union	55⅝
Westinghouse Manufacturing Company	60¼

The Allis-Chalmers Company continues to report an improvement in its business. Orders received in the month of June show an increase of twenty per cent over the preceding month. New business in the month of May showed an improvement of eighty per cent over April. A representative of the company says that collections are better than they have been at any time in several years.

Shares of the Westinghouse Electric and Manufacturing Company made substantial gains on reports that the success of the reorganization plan is now assured and that it will be ratified by the readjustment committee when it meets September 1.

Boston:	*Closing.*
American Telephone and Telegraph	117⅝
Edison Electric Illuminating	216
Massachusetts Electric	46
New England Telephone	113
Western Telephone and Telegraph preferred	63½

American Telephone and Telegraph for the past three years has found its banking and financing relations with its subsidiary telephone associates relatively more profitable than the purely investment and banking relationship. On the whole, and as compared with the showings of American industrial corporations, the telephone companies are doing a business of increasing size and profit, and with rather slight fluctuations in pace. While the three years culminating with 1907 was a period of enormous demands for capital for construction and development, the results in earnings are of approximately equal magnitude.

Directors of the Western Telephone and Telegraph Company have declared the regular semiannual dividend of two and one-half per cent on the preferred stock, payable August 1 to stock of record July 18.

Philadelphia:	*Closing.*
Electric Company of America	10⅛
Electric Storage Battery common	30
Electric Storage Battery preferred	32½
Philadelphia Electric	9½
Philadelphia Rapid Transit	13⅞
United Gas Improvement	87

Chicago:	*Closing.*
Chicago Telephone	138½
Commonwealth Edison	103
Metropolitan Elevated preferred	48
National Carbon common	69
National Carbon preferred	110

ELECTRIC LIGHTING.

CHARLOTTE, N. C.—The Southern Power Company has completed its transmission line to Shelby.

MUNNSVILLE, N. J.—Munnsville has raised $1,200 toward capitalizing an electric light proposition, selling the shares at $10 each.

SAN JOSE, CAL.—The Tuolumne Water Power Company has been granted a franchise by the board of supervisors of Santa Clara County.

SACRAMENTO, CAL.—The Snow Mountain Power Company, of Willows, Glenn County, will commence work on its plant some time in August.

SHREWSBURY, MASS.—The selectmen have voted to borrow $16,000 to establish an electric lighting plant, which the town authorized at a special meeting in May.

OXFORD, MASS.—The contract for the construction of the heat and light plant of the University of Mississippi has been awarded Barber & Company, of Birmingham, Ala.

BROWNWOOD, TEX.—The city council has closed a deal for twenty street lights to be installed in Brownwood within the next ninety days, the contract price being $6.75 per light per month.

TRAVERSE CITY, MICH.—F. E. Hatch, of Pellston, has purchased the Chandler dam at Leland and proposes to install a power-house to supply electricity for Leland, Provement, Sutton's Bay and Northport.

BUTLER, MO.—At the annual meeting of the stockholders of the Butler Water, Light and Power Company the following directors were elected for the ensuing year: Dr. J. M. Christy, J. P. Edwards, J. S. Francisco and J. A. Trimble.

WEST ALLIS, WIS.—Articles of incorporation of the West Allis Light and Power Company have been filed with the register of deeds of Milwaukee County by F. C. Weed, H. G. Meigs and J. B. Meigs. The new company has applied to the city council for a franchise.

ALBANY, N. Y.—The Public Service Commission for the Second District has granted the application of the Canton Electric Light and Power Company for authority to mortgage its property and franchise for $16,000 and to issue $16,000 bonds to be secured by the mortgage.

MILFORD, MASS.—At a meeting of the selectmen a contract with the Milford Light and Power Company was ratified for one year for street lighting. The contract includes fifty-eight arc lamps of 1,200 commercial candle-power at the rate of four cents an hour for each lamp.

ALBANY, N. Y.—An agreement of consolidation of the Watertown Light and Power Company and the Watertown Gas Light Company, forming the Watertown Light and Power Company, has been filed with the secretary of state. The capital of the consolidated concern is $1,500,000.

VICTOR, MONT.—An electric light company has been formed and work has begun on a plant to supply light and power to Victor and Stevensville. The plant will be located on the Bitter Root River at Victor and an excellent site has been secured. The company promises service by early fall.

ALBANY, N. Y.—The Public Service Commission of the Second District has granted the application of the Berlin Electric Light, Heat and Power Company for permission to begin construction and examine franchises in the town of Berlin, Rensselaer County, and also to issue common stock to the amount of $17,500, the necessary cost of constructing its plant.

MUSCATINE, IOWA—The city council has passed a bill authorizing the board of public improvements to let a lighting contract, the cost of which will be about $800,000 per annum, for the lighting of the public streets at the expiration of the present contract in 1910. The council also passed a bill providing a franchise for the company that bids the lowest on the contract.

SPRINGFIELD, MASS.—For the purpose of doubling its capacity, the Home Light, Heat and Power Company intends to erect another building east of its present plant in East Washington street. A permit for a $2,000 brick structure has been issued to the company. The dimensions of the building will be fifty-three by sixty-six feet, one story high. Modern machinery will be installed.

STOCKBRIDGE, MASS.—The contract between the town and the Stockbridge Lighting Company for street lights, authorized by vote of the town at the annual meeting, has been signed. It is a twenty-year agreement providing for the use of not less than eighty lamps. The town is to pay $27 per year for each light served by the underground conduit system and $15 per year for each served from overhead wires.

COLORADO SPRINGS, COL.—Pursuant to action taken at a special stockholders' meeting in this city June 22, Vice-President R. W. Chisholm and Secretary Ira A. Miller, of the Colorado Springs Electric Company, have filed a certificate of amended articles of incorporation of the company in the county clerk's office, increasing the capitalization from $1,000,000 to $1,500,000. The capitalization will consist of 10,000 shares of common and 5,000 shares of preferred stock, all of a par value of $100 each.

LEXINGTON, KY.—Agitation against the rates for electric lighting and power has resulted in the passage by general council of an ordinance for sale of a franchise for a new company. The ordinance provides that the maximum rate for lighting shall be fifteen cents per 1,000 watts; that the life of the franchise shall be twenty years; that the plant shall not be sold to a competitive company, and that the Lexington Railway Company, which now has a monopoly here, shall not be a bidder. Colonel John R. Allen stated that a company, largely of local men and ample capital, is to be formed and will bid for the franchise. It is required that work on the plant begin not later than January, 1909.

NEW INCORPORATIONS.

CLEVELAND, OHIO—Mahoning Telephone Company, Youngstown. $10,000.

DES MOINES, IOWA—Dubuque & Delaware County Telephone Company, Dyersville. $100,000.

CINCINNATI, OHIO—Belmont Telephone Company, Bridgeport. Increase of capital from $150,000 to $250,000.

NASHVILLE, TENN.—Doe River Lighting and Power Company, Carter County. Capital stock increased from $10,000 to $15,000.

PARKERSBURG, ORE.—Parkersburg Telephone Company, Parkersburg. $2,000. Incorporators: Albert Snead, Wesley J. Haga and E. M. Randleman.

CHEYENNE, WYO.—The Cheyenne Street Railway Company. $75,000. Incorporators and directors: T. A. Cosgriff, H. M. Bennett and G. E. Abbott.

ST. PAUL, MINN.—White Earth Telephone Company, Mahnomen. $10,000. Incorporators: Charles H. Sanders, Mabel M. Sanders, Kathryne Sanders and L. G. Sanders.

ST. PAUL, MINN.—Russell Farmers' Mutual Telephone Company, Russell, Lyon County. $10,000. Incorporators: A. J. Burckhardt, president; W. C. Henrich, general manager.

ST. PAUL, MINN.—Anoka County Mutual Telephone Company, of Constance. $4,500. Incorporators: William Nelson, of Constance, president; Fred Russell, of Cedar, secretary; P. J. Johnson, of Constance, treasurer; John Simonson, Charles Haglund and Gust Soderburg, directors.

ST. LOUIS, MO.—Missouri Electric Railroad Company. $1,000,000. Incorporators: Robert McCulloch, 9,900 shares; Bruce Cameron, E. P. Walsh and H. P. Taylor, ten each; James Adkins, seventy. To construct, own and operate street railroads in St. Louis, Mo., and St. Louis County and St. Charles County, Missouri.

NASHVILLE, TENN.—Gallatin Pike Railway Company, Davidson County. $25,000. Incorporators: E. B. Rucker, C. H. Gillock, M. H. Sharpe, P. A. Shelton and J. H. Zarecor. Organized for the purpose of building and operating a railroad along the line of the Gallatin Pike from the present extension of the Nashville Railway and Light Company's road to a point on said pike where it is intersected by Maplewood Lane, a distance of about two miles.

INDUSTRIAL ITEMS.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has issued bulletin 67, a handsome piece of literature devoted to "The Standard" motors.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., in bulletin 105, describes and illustrates polyphase induction motors, constant speed, large sizes, sixty cycles, fifteen to 250 horse-power, and twenty-five cycles, fifteen to 175 horse-power.

THE AJAX LINE MATERIAL COMPANY, Chicago, Ill., has issued bulletin 5, devoted to Ajax outdoor lighting specialties, listing and illustrating a great variety of devices of this character. Copies of this bulletin will be furnished to those interested upon request.

H. G. OSBORNE, 74 Cortlandt street, New York city, is publishing a very interesting booklet describing the Osborne extension brick drill. This drill consists of two parts: a hardened steel "drill head" and a piece of gas-pipe threaded on one end to screw into the drill head for a handle. Some surprising results are claimed for this device.

THE BRISTOL COMPANY, Waterbury, Ct., has published a new catalogue describing its staggered point steel belt lacing. The illustrations show the belt lacing in full size and the pictures are indeed convincing of the utility of this device. This line of staggered point steel belt lacing has been developed to meet the practical requirements of all kinds and widths of belting. They are made in ten different sizes and of different lengths, suitable for every thickness and width from the lightest to the heaviest conveyer belts. For the benefit of any one interested, who is not familiar with the merits of these fasteners, free samples will be sent on application.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has ready for distribution a series of bulletins devoted to several of its specialties, as follows: No. 3128, single-phase induction motors, frame 24 FA, one to twenty horse-power, full load, automatic start: No. 3129, single-phase induction motors, frame 28 EA, one to six horse-power, full load, automatic start; No. 3130, single-phase induction motors, frame 32 FA, one to eight and one to six horse-power, condensed type, full load, automatic start; No. 3131, single-phase induction motors, frame 28 JA, one-fifteenth horse-power, light-load start type for intermittent service; No. 3132, single-phase induction motors, frame 28 JB, one-fifteenth horse-power, full-load start type for intermittent service; No. 3906, family sewing-machine motors, for Singer No. 66 drophead machines, for alternating and direct current.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a booklet entitled "A Few Suggestions on Methods of Constructing Telephone Drop Circuits," and also calling special attention to the company's "Universal" porcelain insulators for this purpose. A considerable number of illustrations are employed, showing the various methods of attaching the insulators to crossarms, poles and walls. Another folder the company is distributing is entitled "Daylight at Night," describing the Columbia tungsten lamps, for which the company is the general western sales agent. This folder gives considerable prominence to the fact that immediate deliveries of these lamps can be made from the Chicago ware house. Data are given as to the watt consumption compared with carbon-filament lamps, this comparison being worked out on the basis of both five cents and ten cents per kilowatt-hour. An attractive thirty-two-page bulletin devoted to lighting fixtures shows a complete line for varied classes of illumination, one section being devoted to tungsten-lamp fixtures. Special attention is called to the fact that the fixtures are produced by the company's new factory organization, this insuring uniform product and prompt shipment. An important feature for those having rush orders is the "boxed" fixtures, comprising certain standard lines, carried in stock for twenty-four hours' shipment. These bulletins and catalogues will be sent to those interested upon request.

DATES AHEAD.

Michigan Electric Association. Annual meeting, Grand Rapids, Mich., August 18-21.

International Association of Municipal Electricians. Annual convention, Detroit, Mich., August 19-21.

Ohio Electric Light Association. Annual convention, Put-in-Bay, Ohio, August 25-27.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 6-7.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Record of Electrical Patents.

Week of July 14.

892,983. MANUFACTURE OF HYPOCHLORITE SOLUTIONS BY ELECTROLYTIC METHODS. William P. Digby, London, England. The decomposition product liberated at the anode and cathode are shielded from the main body of the electrolyte by porous partitions.

893,015. ELECTRIC HEATING APPARATUS. William H. Ripley, Bloomfield, N. J., assignor to the Prometheus Electric Company. A housing for an electric heater.

893,067. TROLLEY-POLE ATTACHMENT. Karl O. Garner, West Alexandria, Ohio. The pole socket is slotted to receive locking projections upon the pole.

893,082. ILLUMINATED DOOR KNOB. John W. Lind, Boston, Mass., assignor to H. G. Williams and J. A. Spiker, Salt Lake City, Utah. A hollow knob with transparent face containing an incandescent lamp.

893,125. SELECTIVE SIGNALING SYSTEM. Garrison Babcock, Chicago, Ill., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. A system employing selective devices at substations controlled from the central office.

893,147. APPARATUS FOR SIGNALING AND COMMUNICATION TO MOVING TRAINS. Henry B. De Groot and William A. Kendrick, Washington, D. C., assignors of one-fourth to Henry Copperthite and three-sixteenths to Charles E. Kendrick, Washington, D. C. A system utilizing a signaling circuit and a telephone.

893,151. DEVICE FOR TRANSMISSION TO A DISTANCE OF SOUNDS PRODUCED BY TALKING MACHINES. Eugene Ducretet, Paris, France. A microphone is attached to the horn at the talking instrument.

893,160. ELECTRIC SWITCH. David E. Gray, New York, N. Y. A battery changing switch for effecting series or multiple grouping.

893,163. COUPLING FOR ELECTRICAL CONDUCTORS. William C. Hafemeister, Cleveland, Ohio, assignor, by mesne assignments, to the Van Dorn Electric and Manufacturing Company. A coupling consisting of two similar members with plane faces and interlocking tongues.

893,214. ELECTRICALLY ILLUMINATED DOOR-KNOB MECHANISM. Henry G. Williams and John A. Spiker, Salt Lake City, Utah. A transparent knob enclosing an incandescent lamp.

893,228. DYNAMO-ELECTRIC MACHINE. Gano S. Dunn, East Orange, N. J., assignor to Crocker-Wheeler Company, Ampere, N. J. The reciprocal of the square of the air-gap length bears a constant ratio to the distance along the armature periphery from a fixed point.

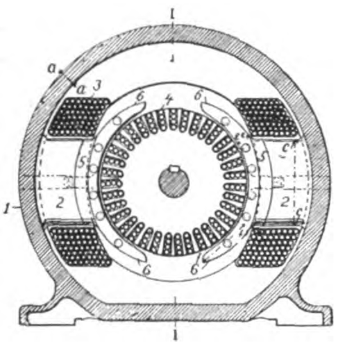
893,244. X-RAY METER. George C. Johnston, Pittsburg, Pa. A fluorescent material casts its light upon a selenium cell in a meter circuit.

893,249. TELEPHONY. Isidor Kitsee, Philadelphia, Pa. A local circuit including an enunciating device indicates the status of the trunk line.

893,250. TELEPHONY. Isidor Kitsee, Philadelphia, Pa. A trunk line closed at both terminals through sources of current in opposition.

893,265. INSULATOR. Augusto Richard, Milan, Italy. An insulator composed of two readily separable parts.

893,278. TELEGRAPHONE. Harve R. Stuart, Wheeling, W. Va. A condenser and battery attached across the recording magnet.



893,228.—Dynamo-Electric Machine.

893,285. ELECTRIC CABLE INSULATOR. Edward M. Tompkins, Chicago, Ill. A petticoat insulator having an axial cavity to receive and hold the cable.

893,286. MULTIPHONE. Kelley M. Turner, New York, N. Y., assignor to General Acoustic Company. A pair of transmitters connected in multiple and attached to a horn having a plurality of receivers.

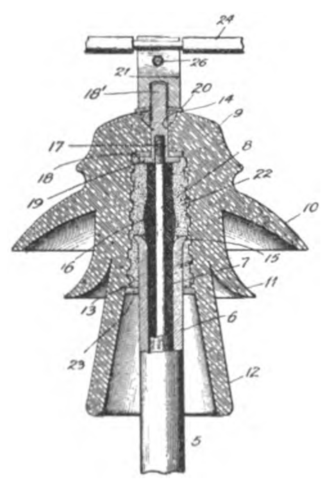
893,305. ELECTROMAGNET. Herbert W. Cheney, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. An iron-clad magnet, each of the parts having inserted a plug of higher magnetic retentivity.

893,314. MAGNET-ACTUATED SIGNAL BELL. Harold W. Eden, Detroit, Mich., assignor to P. R. Manufacturing Company, Detroit, Mich. A vibrating call bell.

893,330. SECONDARY BATTERY. John Knobloch, New York, N. Y., assignor, by mesne assignments, to Franz Sigel, New York, N. Y. The elements are built up of a series of perforated tubes enclosing the active material.

893,351. CURRENT DIRECTOR. James F. McElroy, Albany, N. Y., assignor to Consolidated Car-Heating Company, Albany, N. Y. A group of four variable carbon resistances controlling the current through the motor.

893,370. DYNAMO-ELECTRIC MACHINE. Howard H. Ralston, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. An adjustable brush gear.



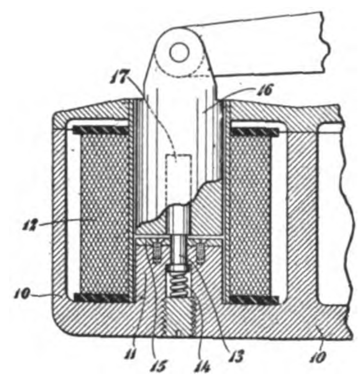
893,285.—Electric Cable Insulator.

893,382. ELECTRIC CIRCUIT CONTROLLER. Dane B. Sawyer, Paterson, N. J. A motor controller having a vertical moving contact bar.

893,402. AUTOMATIC ELECTRIC SIGNAL SYSTEM. Earle Van Briggle, Kokomo, Ind., assignor of one-half to Charles M. Brooker, Kokomo, Ind. A signal controlled by a pair of differentially operating solenoids.

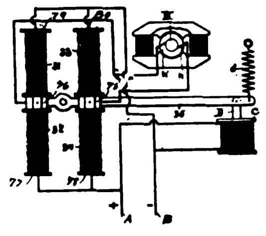
893,414. TELEPHONE SWITCHING AND SIGNALING APPARATUS. James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill., assignors to American Telephone and Telegraph Company. A signaling system for trunk lines.

893,533. ELECTRIC-LIGHTING SYSTEM. James F. McElroy, Albany, N. Y., assignor to Consolidated Car Heating Company. A train lighting system employing a variable-speed magnetically regulated dynamo.



893,305.—Electromagnet.

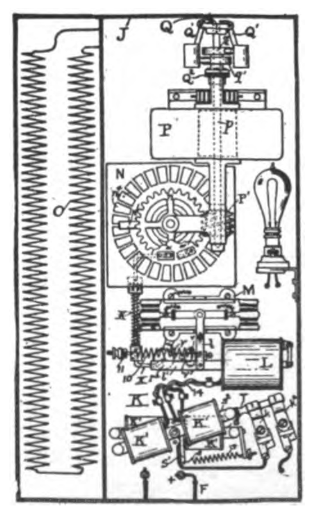
893,534. ELECTRIC-LIGHTING SYSTEM. James F. McElroy, Albany, N. Y., assignor to Consolidated Car Heating Company. A train-lighting system depending for its control on the condition of the battery.



893,351.—Current Director.

893,536. ELECTRODYNAMIC BRAKE. Frederick W. Newell, Hastings-upon-Hudson, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. A brake controlled by a differential relay to prevent generator action of a motor.

893,555. WIRE FASTENER. Cornelius F. Sullivan, Boston, Mass., assignor to Frank W. Lowe, Boston, Mass. A coupling sleeve formed of a spirally wound wire.



893,533.—Electric-Lighting System.

893,565. ELECTRODE. Henry S. Blackmore, Mount Vernon, N. Y. An electrode composed of a metal-carbon-containing compound and a binder.

893,586. THERMAL CUTOUT. Bryson D. Horton, Detroit, Mich. A fuse composed of a group of wires, none of which alone would carry the normal current.

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

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ELECTRICITY IN COUNTRY HOUSES.

We have not infrequently dwelt upon the advantages of electric power in the home, and we have called particular attention to the conveniences thus obtainable, and to the comfort and cleanliness brought by the introduction of the incandescent lamp and a few little motors. These facts are being realized by many households, and the electrical power is fairly taking up many cares of the home. This is, of course, true only in those localities where cheap electrical energy is obtainable; but in the large cities where modern electrical systems exist, and in those districts near large water powers, the comforts procurable through a well-considered use of electricity, are being realized by a rapidly increasing number of families.

There are, however, large districts where cheap electrical energy is not available. These are usually country places supplied only by small electric systems, or situated so far from the large power-house that the cost of transmission brings the price of electrical energy up to a figure which prevents its general use. In such cases, some other source of energy must be provided if the home is to take advantage of the adaptability of the electric motor. The means by which this may be done are interestingly discussed in an article by Mr. Putnam A. Bates, which appears in the July issue of the Journal of the Franklin Institute. Mr. Bates believes that the electric motor may be used with advantage, not only in the large country home, but the farmer will find that it will solve many of his problems which are now becoming serious. There has been a decided drift of men with some aspiration to become a little better than clerks or bookkeepers, from the city to the country. To support themselves, these men necessarily turn to farming or some other industry which can be carried on there. One of the difficulties with which they have to contend is the securing of competent and reliable help. Mr. Bates believes that a well-planned equipment of electric motors will enable the farmer or dairyman to get along with less help, and will make it possible for him to do much of the work which he could not undertake without some form of mechanical drive. Further, the existence of a source of cheap power will lead to improved methods of farming and dairying. A cold-storage room can easily be fitted up for preserving dairy and farm products; and mechanical devices driven by motors will transform the work of the farmer or dairyman from one of hard labor into one in which his chief duty will be the control and management of various machines. In other words, he will become the superintendent of a special mill, instead of the colaborer with his farm hands, which he was before.

To apply these methods successfully, it is, of course, essential that the cost of so doing shall not be large. It is just here that the main difficulty has lain. Mr. Bates believes that a suitably planned gas-engine-driven dynamo, operated in conjunction with a storage battery, will provide the desired supply, and will do this at a moderate cost. Such an equipment is not difficult to care for and requires little attention, and if intelligently run, would practically take care of itself, with occasional inspection. The batteries would, of course, provide the demand for energy at any time of the night or day; and they can be kept charged by running the generating unit at such times as are convenient. Equipment can, of course, only be installed at some expense, and it is hardly to be expected that every farmer will immediately adopt the system. In some cases co-operation among neighbors might produce the most satisfactory result. But in any case, an equipment of this kind should be carefully designed and not put in haphazard, or left entirely to the judgment of the first salesman who comes along. The farming industry, including all its branches, lies at the foundation of the prosperity of the country; and it will be strange indeed if the use of electrical energy, which is bringing about such important changes in other industries, does not introduce new methods here. The change may be slow in coming, but come it will in time.

JOIN THE INSTITUTE.

Too many of the younger engineers available for membership in the American Institute of Electrical Engineers neglect to join that body and bring to it their support in the form of the small contributions called dues and the resulting increase of membership. They are too apt to take a narrow, selfish view, saying they can get the papers and discussions printed by the Institute for less than the yearly dues and there is, therefore, no reason why they should pay more. Such men fail entirely to realize the advantages which come from merely being a member of a recognized engineering society. Any one who attends any of the meetings of the Institute gets far more out of the discussions than he can from any published report, while the mixing with his brother engineers brings him other returns equally as great. Moreover, the membership list of the Institute to-day is the recognized roll of electrical engineers and every one turns to it to find out where such and such a friend is, or what electrical engineers there are at any particular place.

These, however, are the selfish reasons of belonging to the Institute, and there are many more of them, as well as others more altruistic, which are convincingly presented in the article contributed to this issue by Mr. Charles B. Burleigh. Every electrical man who is not a member of the Institute should read Mr. Burleigh's argument and reflect upon what he says. But there is one reason which perhaps more than all others should induce electrical engineers to support the Institute. This was well stated by Lord Bacon in his Maxims of the Law: "I hold every man a debtor to his profession; from the which as men of course do seek to receive countenance and profit, so ought they of duty endeavor themselves by way of amends to be a help and ornament thereunto."

A NOTEWORTHY ELECTRIC LIGHTING INSTALLATION.

The Union Station put into service in Washington, D. C., recently is probably the most complete building of its kind in the world. Not only its size, but the many kinds of service connected with it presented a number of engineering problems of unusual interest. One of these is that of lighting satisfactorily all parts of this large structure. A year or so ago this problem would have been attacked by a rule-of-thumb method, and the result, which would have been accepted without comment, would probably have been far from satisfactory. But to-day few features of such buildings receive more consideration than the lighting. We have learned how negligent we formerly were in such matters, and are rapidly approaching the point where the general public will be quick to appreciate good illumination. For these reasons the description of the lighting system installed in the Washington station, which is given elsewhere in this issue, will be interesting to many.

The lighting in the small rooms and offices of the station presented no unusual features. Fixtures have been installed here enabling any of the new high-efficiency lamps to be used. One interesting part of the lighting system is that in the ticket lobby, which is lighted by skylights during the day. Here high-candle-power tungsten lamps have been placed above the skylights so as to give an illumination representing as nearly as possible that provided during the day. This plan has been tried elsewhere, with very good results.

Another difficult room to light is the main waiting room, a room 120 feet wide by 230 feet long, with an arched ceiling ninety-eight feet above the floor at the highest point. The architectural design of this room offered an opportunity for indirect lighting by means of lamps placed behind the galleries on the sides of the room and over colonnades connecting the galleries at the ends of the room. By using inverted open-arc lamps with screens of tinted glass, corrugated reflectors and magnetic deflectors throwing the arc toward the room, which produce a uniform illumination of the ceiling, a very fine effect has been secured. There is ample illumination for reading at every part of the room, so that no other fixtures have been necessary. The objection so often found with such systems of illumination, namely, that the intensely lighted ceiling is hard on the eyes, will hardly hold in this room, because of the shape of the ceiling and its height above the floor.

A third difficult room to light is the main concourse, a space 755 feet long by 150 feet wide. This is lighted during the day by skylights; and the same scheme found satisfactory in the ticket lobby was tried. Due, however, to the structural steel work supporting the roof, this was unsuccessful, there being too many shadows cast upon the skylights. The plan finally adopted was the hanging of direct-current arc lamps seven feet below the ceiling. The height of these lamps above the floor enabled a uniform distribution to be obtained, and places them out of the direct line of vision. There are other interesting features about this installation which are well worthy of careful study.

ELECTRIC CABS.

A few years ago a number of electrically propelled cabs were put in service in London, and great hopes were expressed that they would solve, in part, at least, the difficult problem of handling London traffic. The advantages of a quiet, clean and easily controlled vehicle were fully explained at that time, and all that was needed to give the electric cabs a permanent place on the London streets was a practical demonstration of the cheapness of this method of transportation. Unfortunately, it was just here that the cabs failed, and after a time they were retired from the streets.

Now again we learn that the electric cabs are about to be given another trial in London, and it is to be hoped that they will be more successful this time than before. Doubts are expressed, however, in some quarters because the preliminary estimates of the cost of running the cabs and the probable traffic they will secure do not seem to be sufficiently conservative. The cabs are expected to make about thirty-seven miles a day and to earn $10. This is at the rate of twenty-five cents a mile, including the unproductive mileage, and it is thought that this estimate is much too high. On the other hand, the cost of charging and maintaining the batteries would be about six cents a mile, and cost for repairing tires three cents a mile, and the other items of cost are in proportion. The first cost of the cabs, including batteries, but not tires, will be $2,100. Under these conditions success seems rather problematic.

However, electric cabs have been found successful elsewhere where the conditions are more favorable. There would be a much better chance to keep them on the London streets if they could make fifty or sixty miles a day, but at the comparatively low fares which are charged in London the outlook for success is none too good. There is no doubt that the electrically propelled vehicle is much the most suitable for city service. It is noiseless and under better control than any other; it can quickly take advantage of openings in the traffic and it leaves behind it no offensive trail. For use in the country it is handicapped by its limited range of travel, but in city work this disadvantage is largely removed. The electric cab will doubtless come to its own in London before long, but under the present conditions it will have much to contend with.

SCIENTIFIC SYMBOLS.

On another page of this issue we publish a communication from Mr. Miles Walker, on the subject of scientific symbols. This has been prepared at the request of the British Electrotechnical Commission, in view of the fact that different symbols are employed to represent the same thing in different countries, and the great difficulty of securing uniformity in this matter. The old and very good custom of employing the initial letter of the name as a symbol for the thing is not without faults, because the various quantities have different names in different languages, and hence the symbol in one language does not conform to the name in another. Moreover, when such symbols are employed, it may be necessary to use the same letter for a number of different quantities: hence has arisen the practice of indicating which quantity is represented by adding a subscript or accent to the symbol—an undesirable complication. On the other hand, when arbitrary letters are employed as symbols there is nothing to indicate for what they are intended, so that they must be memorized.

For these reasons Mr. Walker does not think that a modification of the present system of using letters as symbols, even though uniformity could be secured, is quite satisfactory. He therefore suggests arbitrary signs, each having some significant shape which will make it easy to remember; and in his communication he suggests a number which are unquestionably appropriate. In proposing these Mr. Walker considers not only the reader and the writer, but also the printer, and he says he has found that the latter would not be much opposed to the addition to his numbers of types. There would be objection with machine composition. But even at the present time all formulæ and other parts of articles employing special type must be set up by hand. This not only occasions delay, but complicates the work. In this respect, of course, the suggestions would not put us in any worse position than we are in at present, as even the use of accented letters very often calls for hand composition; but it is unfortunate that some plan can not be suggested which would avoid this objection. It is the only one we can see to the proposed scheme; as certainly the use of a significant symbol which can mean nothing else, and which is easily remembered, has much to commend it.

THE GROWTH OF THE ALUMINUM INDUSTRY.

One of the triumphs of applied electric chemistry has been the adding to the materials of the engineering world a new metal having very valuable properties. Prior to the introduction of the electrolytic methods of producing aluminum it was reduced from one of its compounds by the use of metallic sodium. The production then was but a few pounds a year, the metal being used for a few very special purposes where lightness was essential, and to supply chemical museums. In 1883, for instance, but eighty-three pounds of this remarkable metal were produced in the United States, although at that time its virtues were fully appreciated and there was no lack of raw material. The cost of production, however, placed it beyond consideration for mechanical purposes.

The introduction of several electrolytic methods of extracting aluminum from its ore at once raised the metal to an important position in the mechanical world, simply because the cost of production, and hence the price of the metal, were very greatly reduced. Thus by 1890 the output had increased to 61,000 pounds in this country alone; the following year it jumped to 150,000 pounds; four years later, in 1895, it was over 900,000 pounds, and it passed the million mark the following year. In 1900 over 7,000,000 were produced and in 1904 8,600,000 pounds were consumed. Last year the consumption was over 17,000,000 pounds, making the total production in this country since 1883 over 100,000,000 pounds. This has been indeed a most noteworthy growth of a new and important industry.

LORD KELVIN'S PHILOSOPHY.[1]

EXPLANATION IN TERMS OF FORCE OR OF MOTION? ACTION ACROSS EMPTY SPACE OR THROUGH A MEDIUM?

BY SIR OLIVER LODGE.

One of the most interesting and important outcomes of last year's meeting of the British Association at Leicester was the declaration by Lord Kelvin, during a memorable discussion on the constitution of the atom, in Section A, that he had found it necessary to abandon the attempt to contemplate the material universe explicitly in terms of æther and motion, and for his own part preferred to resort to the Boscovich doctrine of centres of force acting on each other according to some curiously complex law, without specific attention to the hypothetical medium in which such forces may exist.

Now undoubtedly these ancient postulates of matter and force represent the dynamical method first made feasible by Newton's achievement in celestial physics, whereby phenomena were correlated by unexplained particles of matter acted upon by unexplained forces, of statical origin and unknown mechanism, according to a specified law of distance. This was how Newton successfully solved the problems of gravitation, and constructed the working theory of astronomy; but it had been hoped, and by some is still hoped, that the time had now come for seeking to represent, in terms of something simpler and more fundamental, the nature of matter and the origin or inner mechanism of its various forces.

The most powerful and hopeful lever wherewith to attack this great philosophical problem was the kinetic theory of elasticity and rigidity, introduced by Lord Kelvin himself. By this means it has been hoped to express force in terms of the still simpler conception of motion; in fact, to explain all the forces with which physicists have to do—electrical and chemical attraction, elasticity, magnetism, cohesion and perhaps gravitation—in terms of the internal motions of a universally connecting fluid plenum.

But now the question arises, Is it at all certain that the material universe can really be understood in terms of motion alone—motion of an all-pervading continuous fluid known as the æther of space? And would such a solution be satisfactory?

To many it has seemed that this reduction to simplicity was the closest approach to ultimate explanation and unification that could be hoped for in the domain of mathematics and physics; and during the last half-century many steps, apparently in the direction of such an achievement, have been taken by the leaders in these branches of human knowledge.

The mathematical foundation was laid by Helmholtz when he reduced rotational or vortex motion in perfect fluid under the domain of mathematics; it was followed up by Lord Kelvin's kinetic or gyrostatic theory of elasticity and rigidity; so that mathematicians, such as FitzGerald, Heaviside, Larmor, Hicks, J. J. Thomson and others, as well as Lord Kelvin himself, have, from various points of view, endeavored to devise a scheme of spinning motion in a perfect fluid plenum which should be able to accomplish in general terms all that the æther is known to perform: more particularly that it should be able to imitate its faculty of transmitting the transverse or solid quiverings that we call light, yet without resisting the motion of bodies through it; and at the same time that it should be able to maintain its own turbulent or whirlpool motion in an unconfused and regularly stable condition throughout infinite time. And in this difficult undertaking they have from time to time seemed partially successful; at any rate, they have reached suggestive results and opened up stimulating vistas.

The æther must be incompressible, too, being perfectly continuous without breaks or any kind of atomic or granular structure, save such as may be conferred upon it by reason of its infra-material internal motion. An infinitesimally turbulent liquid of some kind seemed the desideratum, and many have been the attempts to devise such a liquid. An interlaced system of vortex fibres or filaments has to some seemed the most likely device; a similar scheme was a system of plates or laminar vortices; while a third modification conceived it as a collection of connected filaments all in a state of rapid internal motion, though stationary as regards locomotion in space—what might be called a vortex sponge. By some such means it was hoped to be able to combine the elastic rigidity appropriate to a solid, with the penetrable unresistance to motion of solids through it, characteristic of a perfect fluid, and with the complete incompressibility of an ideal liquid. But the mathematical difficulties of all such treatment have been rather overwhelming; and an uncertainty about the stability or permanence of such a medium has always obtruded itself in a discouraging manner.

In fact, there has always been a troublesome amount of instability in all the schemes that have hitherto been devised, so that none of the expounders of the motion doctrine was able to announce a finally satisfactory result.

Still it was felt by most of those who have worked at the subject that the outlook in this direction would be so bright, if initial difficulties could be overcome, that it was worth a long-continued effort to see if a coherent scheme could be planned on these lines, so as to secure what, if it turned out to be the truth, would surely be a magnificent generalization.

Indeed, it has sometimes seemed unlikely that a mode of explanation which offered such attractive features, and led so far in the right direction, could, after all, be a blind alley leading nowhere; or, to vary the metaphor, a mere will-o'-the-wisp which it was waste of time to pursue.

What has certainly been made out is that motion of atomic structures, in an æther with elasticity postulated, supplies a complete working scheme on which we can rest without inquiring further as to the origin of this elasticity. Beyond this, the attempt to explain the material universe on a purely kinetic basis has not made much progress in quite recent years; and, to those competent to attack it, it has probably seemed better to let the problem lie dormant for a time, until future discoveries in mathematics or in physics throw more light upon the rocky path or provide us with better instruments for climbing it.

During the epoch of waiting it now appears that our venerated chief was deflected from further attempts in this direction, and directed his attention elsewhere. Other methods seemed to him more immediately hopeful; and whereas it had been hoped to explain force in terms of latent motion, Lord Kelvin in later years sought to expound motion in terms of force, giving up the kinetic unification of the material universe in favor of a conception more arbitrary and descriptive, and permitting himself to regard force as perhaps an equally fundamental, perhaps a more fundamental, conception than motion.

It may be that philosophers will concede the (to me) somewhat improbable proposition that an explanation in terms of force and action at a distance will be as satisfactory as an elucidation in terms

[1] Being thoughts suggested by the meeting of the Mathematical and Physical Section of the British Association at Leicester in August, 1907; and referred to in Sir Oliver Lodge's recent presidential address to the Faraday Society, May 26, 1908. From *Nature*, London, July 2.

of motion and a continuous medium. To Lord Kelvin it would appear that both solutions were equally satisfactory, and that it was only a question of which was the more tractable. In any case it is noteworthy that he took up so clear and definite a position; it is the key to much of his recent work, and to the difficulties which he felt in accepting some of the hypotheses which are a natural consequence of the electrical theory of matter and of some of the facts of radioactivity. It now seems not unnatural that he should have sought to express and explain these great results otherwise. His attitude is both coherent and reasonable; though I would urge that most theoretical advance and discovery (in the hands of Maxwell and others) has been along the continuous and medium line, which, if not the line of ultimate explanation, is at any rate that of achievement.

At the same time it must be admitted that, if a longitudinal impulse is transmitted by an incompressible medium at an infinite pace, the process becomes barely distinguishable from action at a distance, through a force varying according to a specified law. Or—putting what is virtually the same thought in another way—the influence of an electron, or matter unit, whose field of force extends infinitely in all directions, need not be conceived as limited by some arbitrary boundary beyond which things can be said to be at a distance from it.

It will be remembered that some of the old philosophers saw great difficulties in the abstract conception of motion. It appears as a curious evanescent transition from one place to another, involving the attribute of "time"; it is indeed "not a being but a becoming," when position is taken as the primary conception.

But I urge that it is simplest to regard "position" and "distance" as secondary conceptions, subordinate to and arising out of our perception of motion. Unless motion is supposed to be a thing directly apprehended, it is truly rather an elusive idea. To me it seems a direct apprehension—direct information conveyed by our muscular sense. Space itself seems a consequence deduced from our perception of motion; and the idea of time follows from our direct perception of rapidity of motion. But probably to Lord Kelvin these things appeared otherwise.

The conclusion of the discussion on the constitution of the atom may be summed up thus:

The internal energy of Lord Kelvin's model atom is static or potential. The internal energy of the hypothetical atom at which others are working is kinetic.

The disintegration of radium in the former case is comparable to the explosion of an unstable chemical compound, like guncotton. In the latter case it must be represented by something more akin to the flying to pieces of a single rapidly spinning unit, such as a flywheel.

And so for the present the matter stands.

The New British Patent Act.

The effects of the new patent act, which compels foreigners exploiting patents in Great Britain to manufacture the article mainly in that country, have come as a great surprise to many manufacturers here, says the New York *Journal of Commerce*. It is understood that the full advantage is likely to be taken of the clause which advocates the legal protection of foreign patents after August 28. Such patents may be revoked on application by any person to the Comptroller of Patents if granted four years ago to any foreigner who manufactures exclusively or mainly outside of the United Kingdom.

Already a large number of foreign firms have secured factory sites, and a syndicate of German chemical manufacturers has taken a site of twenty-four acres in the vicinity of the Mersey, while a large German electric company is negotiating for another large site, and many foreign inquiries for sites in the Manchester district are being received. The Hoechst Farbwerke and Messrs. Cassella & Company are building a factory for dye manufacture at Ellesmere Port, situated upon the Manchester Ship Canal.

The Board of Trade states that last year 2,608 patents were granted to Germans and 2,792 to Americans by the British Patent Office. Sir Joseph Lawrence, who, with Ivan Levinstein, framed the act, gives the following summary of the effects of the former laxness of the British patent laws:

Estimated British loss by diversion of aniline dye industry, from £5,000,000 to £20,000,000 per year. German chemical industry, yearly overturn, £70,000,000. Amounts paid to foreign countries for telephone apparatus, £10,000,000. Yearly amount of wages lost in telephone industry, £500,000. Value of imported motor cars and cycles in the last three years, £5,500,000.

An English trader taking out a patent in Germany must work it in that country, so that the German has little to complain of if the same regulation is applied to him. Some German patentees will get English firms to manufacture their goods, but that also will mean a great increase in wages, etc., for English work people. Thousands of firms on the Continent and in America must either take this course or build factories in England if their British trade is to be maintained. France will be affected in its motor-car trade, but the chief sufferers will be Germany and America.

National Fire Protective Association on Incandescent Lamp Hazard.

The Underwriters' laboratories have issued the following bulletin dealing with the hazard of exposed bases of certain incandescent lamps:

"For the proper safeguarding of life and property the National Electrical Code prescribes that no live parts of an incandescent lamp base shall be exposed when the lamp is in the socket. Underwriters' laboratories and manufacturers of sockets, receptacles and incandescent lamps have co-operated for several years for the establishment of standards whereby this result has been accomplished for the bases of common carbon filament lamps. The newer high-efficiency lamps, such as the tantalum and tungsten, require a metal extension or 'skirt' over the bulb beyond the Edison screw base. Designs have been developed and adopted by American manufacturers for constructing these high-efficiency lamps in such a manner as to insulate this skirt from current-carrying parts of the base and so secure in these types the same degree of protection as that already obtained for the older patterns. Some of the foreign manufacturers are, however, supplying lamps having exposed skirts not insulated from the circuit.

"Your attention is respectfully called to the desirability of giving preference to lamps having no live metal parts exposed when placed in the standard socket, which has a depth of fifteen-sixteenths inch in a vertical plane from the bottom of the centre contact to the upper edge of the outer socket shell or wall."

In the equipment of manufacturing plants one of the most interesting features, during the past two years, has been the introduction of steam turbines into a great variety of industries, from factories of different kinds, where about the same quantity of power is used continuously during the day, to cement plants, steel mills, smelters, etc., where the load fluctuates violently from one moment to another. Flour-mill and sawmill operators were among the latest to join the procession of turbine users, and now a tannery—one of the largest in the world—the Pfister & Vogel Leather Company, has just ordered two Allis-Chalmers turbine units, each of 1,500 kilowatts capacity, or a total of 4,000 horse-power, for the new plant to be built in Milwaukee. Another unit of the same size has been purchased by the Pueblo & Suburban Traction and Lighting Company, Pueblo, Col., and the city of Holland, Mich., will install one of 750-horse-power capacity.

SYMBOLS FOR PHYSICAL QUANTITIES.

BY MILES WALKER.

It is very desirable to have a notation for the representation of physical quantities in scientific books and periodicals which shall be the same in all languages.

The subject is under the consideration of the International Electrotechnical Commission with a view to international agreement, and committees in the different countries (in England under the chairmanship of Lord Rayleigh) are discussing this particular subject. They are dealing more especially with symbols for electrical and magnetic quantities, but the system might with advantage be extended to embrace all important quantities in physical science, especially as the subject is receiving the attention of most technical societies with a view to some action being taken in the matter.

There are, however, two great difficulties which arise when we try to fix upon a standard notation.

The first is the difficulty of persuading a number of writers and readers who have become accustomed to a certain symbol for a certain quantity to change it in favor of an equally large number of writers and readers who have become accustomed to another symbol.

In the second place, there are not enough letters in the two or three alphabets at our disposal to give a distinct symbol to each quantity without resorting to the combination of more than one letter to form a single symbol. There is a great objection to this combination of letters because the use of sub-script letters and numbers is required for distinguishing between particular quantities of the same general kind.

There is, moreover, an objection to using letters at all to represent quantities in a universal notation because, unless initial letters are used, there is no connection in the mind between the letter and the quantity, and the symbol is difficult to remember. We can not always use initials because the initial letters differ in different languages. Moreover, the same initial occurs for a great number of different quantities.

One way of avoiding the above difficulties would be to create a number of new symbols which could be printed by means of type like ordinary letters, and which would represent each physical quantity in a distinctive manner.

The question, however, arises as to whether a number of entirely new symbols would be acceptable to writers, readers and printers alike, and the subcommittee on symbols appointed by the British section of the commission has requested the writer to place his views publicly before the profession with a view of obtaining suggestions and criticisms as to the feasibility of such a scheme from as wide a circle as possible.

In choosing a symbol we would try to make a very simple picture of something that reminds us of the quantity in question. For instance, ⫰ might represent temperature. If we were told that this simple outline of a thermometer represents temperature we would have no difficulty in remembering it. Similarly, / might represent force, and the various "forces" might be derived from it; for instance, ϟ electromotive force (conventional representation of lightning), and ∩ magnetomotive force.

It is not my purpose here to say what would actually be the best form of symbol for each quantity, but it is not a difficult matter to devise very simple characters which can be written quickly, easily and with sufficient accuracy, and which can at the same time assist the memory to connect them with the quantity for which they stand.

What would the printers say to the new type? The author has taken up this matter with a very large publishing firm, and is assured by their chief expert that 200 or 300 new type would be a small matter to a modern printer, who is already accustomed to deal with many hundreds of different fonts, each of which contains from thirty to 120 different symbols. He estimates that a printer in a large way of business has at his command as many as 60,000 distinct type, differing from each other either in letter, size, body or face. The addition of 200 or 300 more would be a drop in the ocean. The size of the new type could be standardized for most purposes, and it would only be in some special case that another size would be called for.

The setting up of the formulæ with the standard size of type would be simpler than with the present system, in which sub-script letters are often unnecessarily introduced. One symbol under the present system sometimes consists of four or five letters.

If it be admitted that the introduction of new symbols is advisable, the question arises what shall the new symbols represent exactly? Shall the sign ⫰ (Temp.) represent temperature in any units, or shall it represent the number of degrees of temperature, measured by some scale agreed upon, and embodied in the definition of the symbol? If the system of units employed be not prescribed, fewer symbols would be required, and the general writer who now says vaguely "Let T equal the temperature" would find the symbol sufficient for his purpose. But from the reader's point of view there is much to say in favor of a symbol which will embody in its definition a standard system of units. Any formula expressed in such symbols would be completely self-contained and would be an exact statement of a physical fact. Until the units employed in any formula are known, the formula expresses only half its meaning. Perhaps some slight addition to the symbol, or even to the whole formula, might be used to indicate that the standard system of units is employed. Without that addition the symbol would have a general meaning. For instance, ⫰ might equal temperature, while ⫰ might indicate the degrees centigrade above the absolute zero. The name of the type might be the name of the physical units which it represents; for instance, for ϟ we might read "volts."

If writers, printers and readers who have any definite views as to the best method of devising a system of symbols would communicate with the technical press, or with the author, they might assist in solving the many difficulties which arise in connection with this matter.

The Cottage, Leicester road, Hale, Altrincham, England.

Aluminum Industry.

The magnitude of the aluminum industry is shown by the following, which gives in pounds the production in the United States since the beginning of the industry in 1883:

1883, 83; 1884, 150; 1885, 283; 1886, 3,000; 1887, 18,000; 1888, 19,000; 1889, 47,468; 1890, 61,281; 1891, 150,000; 1892, 259,885; 1893, 333,629; 1894, 550,000; 1895, 920,000; 1896, 1,300,000; 1897, 4,000,000; 1898, 5,200,000; 1899, 6,500,000; 1900, 7,150,000; 1901, 7,150,000; 1902, 7,300,000; 1903, 7,500,000; 1904, 8,600,000; 1905, 11,347,000; 1906, 14,910,000; 1907, 17,211,000; total, 100,530,779.

The value of the exports of aluminum and manufactures of aluminum of domestic production for the last four years has been as follows: 1907, $304,938; 1906, $364,251; 1905, $290,777; 1904, $166,876.

The Copper Situation.

A sale of 1,000,000 pounds of electrolytic copper was made recently to a large corporation on a basis of eleven and seven-eighths cents per pound. The contract calls for delivery within the next two months.

Copper producers and selling agencies declare that the demand for copper shows some improvement locally. Many of them are of the opinion that a buying movement of some proportions from local consumers will be under way before the close of the year. The increase in orders for electrical equipment indicates a large consumption of copper.

The falling off in production in June was due largely to the big decline from Butte, a fifty per cent shrinkage, compared with May, by reason of the flood. The Butte output amounted to but 13,000,000 pounds, against 26,000,000 a year ago. With the Greene-Cananea still closed down, Mexico likewise continues to show a large decrease.

The shortage of 118,000,000 pounds of copper during the first six months of this year, as compared with two years ago, under high copper prices, must, of necessity take care of a large portion of the decrease in consumption in this country; and it helps to sustain the claim that with any improvement in business, and a stocking up by the large consuming interests, a scarcity of available copper might quickly develop.

A new source of copper supply comes in this month, namely the Ely district of Nevada. After an expenditure of over $15,000,000, the concentration of Ely ores is now taking place, and the smelter will blow in some time this month, so that from now on Nevada will figure in copper production. That state, however, will not be able to supply over 20,000,000 pounds this year, so that with a decrease already of 95,000,000 pounds this year the supply of copper will not do much to fill up the gap.

A careful canvass, made about a week ago, of all the available supplies of copper to be had of the New York selling agents developed the availability of only 5,000,000 pounds of copper at thirteen cents per pound and under. This has since been licked up, so that there is no electrolytic to be had in quantity under thirteen cents per pound. Lake is still quoted at thirteen cents.

The General Electric Company has recently contracted for several million pounds of copper at thirteen cents per pound. It bought the Lake brand, something which it never does if electrolytic can be had for less money. This copper was bought for delivery in September and October.

One of the largest producers of copper in the country says: "While I have been lukewarm with regard to the possibility of anything approaching a stampede among copper buyers, on the ground that a readjustment of the general business situation would be a matter of many months, I am to-day firmly convinced, after a thorough study into the conditions existing here and abroad, that there is every chance of another runaway market in copper after Taft is elected.

"Many buyers will postpone the placing of their orders until the election of Taft has been actually accomplished. It isn't enough for them to be confident of another Republican victory, they must read the returns.

"I notice there is considerable talk of large accumulated supplies in this country and particularly abroad. That is all humbug. Suppose the amount of stock in foreign warehouses is at the highest figures for several years and stands at 37,000 tons; what does that amount to? These figures, applied to the world's necessities, represent but a few days' supply.

"Then again there is a tendency to underestimate the present American consumption because comparison is made with the very excessive and abnormal consumption of 1906 and the first half of 1907. Compare the present consumption with 1905, or any normal period, and it will be found that the amount of copper to-day going into the manufacture of all sorts of brass and copper goods compares very respectably with former years."—*Wall Street Journal.*

The Electrical Equipment of the Royal Mint, London.

A description is given here of the electrical equipment of the Royal Mint in London, England, which has replaced the old mechanical drive installed in 1882. The old arrangement consisted of a number of underground shafts connected with the various machines through gearing and, until 1905, it served to drive the greater number of machines in the mint. As extensions to the mint had became necessary the losses due to the shifting became excessive so that the whole was converted over to the electric drive, the power being supplied to the various motors from a steam-driven generating plant, which takes the place of the old engines. This plant comprises two 200-kilowatt, direct-current generators connected to high-speed engines. There is in addition a small gas engine driving a fifty-kilowatt generator for use when the steam plant is not in service and for charging a storage battery. The latter is rated at 5,000 ampere-hours, at an eight-hour discharge, and built up of fifty-eight cells. Ventilation in this room is provided by grate openings in the walls, in place of windows. These batteries carry all the lighting when the generating plant is not in service and are capable also of carrying a considerable motor load. Lighting and power mains are kept as far as possible distinct. Until 1907 the average monthly output of the generator was 19,600 kilowatt-hours. There are sixty-four motors in the mint and the combined rating is 600 horse-power. A few typical applications are as follows: A fifteen-inch rolling mill is driven by a seventy-horse-power motor through a spur gearing, and the cutting machines are driven from two line-shafts each belted to a ten-horse-power motor. In the annealing room the gas-heated rotary furnaces are turned by motors rated at one to ten horse-power. The coin-press room contains nineteen presses driven through a line-shaft by a thirty-horse-power motor. There are a number of counting machines driven by motors rated at two or three horse-power. —*Electrical Review (London), July* 10.

Power for Montana Mines.

Various financial and mining interests, including Senator Clark, H. H. Rogers, ex-Governor Hauser and others who represent the Missouri River Power Company, have arranged with the Stone & Webster Engineering Corporation, of Boston, for the development of the extensive water-power resources on the upper Missouri River in Montana, on a scale exceeding anything that has been undertaken in this country since interest in large developments began to lag over a year ago. The plans provide ultimately for the generation of 50,000 horse-power by means of two dams and power plants.

It is estimated that the construction work planned will cost $3,000,000, and it will be done in two stages: the first will be the building of a concrete dam to afford 20,000 horse-power at Hauser Lake, sixty miles from Butte. This work will be begun by the contractors immediately.

Subsequently it is planned to build a new concrete dam about 1,800 feet long and 110 feet in height, together with a 30,000-horse-power hydroelectric plant at Wolf Creek, a few miles above Hauser Lake. From this plant the power will be transmitted at a high voltage to Butte and to Helena.

The Electric Lighting System of the Washington Union Station, Washington, D. C.

THE Washington Union Station, Washington, D. C., which has just been completed, presents some very interesting problems in lighting and power requirements. The property consists of: The Union Station, said to be the largest and most magnificent railroad station in the world; Express Building, occupied by the Southern, Adams and United States express companies; power plant, locomotive and car repair shops, coach yard and several signal towers.

The power plant supplies electric current for light and power, steam for heating, compressed air for cleaning, brake testing, signals, etc., and water for drinking, house service and fire protection, to the station, express building and adjoining yards and also light and power to the coach yard, repair shops and signal towers. Separate power plants furnish heat, compressed air and water service to the shops and coach yard.

Service connections from the power plant to the express building and station are made through a pipe subway or tunnel. Piping for water, heating and refrigerating service is carried on supports suspended along the centre line of this subway while vitrified tile ducts, with manholes at convenient intervals, are built into the wall for the electric service.

Cables for electric service north to the coach yard, repair shops and signal towers, are carried through a line of vitrified tile ducts laid in concrete between the tracks. Concrete manholes provided with cast-iron covers, are located from 250 to 300 feet apart on straight runs, and at convenient points where the duct system crosses streets. Manholes are connected to the general drainage system.

The best of materials only is used in the lighting and power systems in order that they shall be as lasting as the building construction. Conduit furnished by the Safety Armorite Conduit Company, electro-galvanized both inside and outside, is used throughout, the smallest size installed being three-quarters-inch. In the inspection of conduit the specifications, with reference to weight and dimensions, were very rigidly enforced, the requirements in this respect being the same as for standard weight steam pipe. All short-radius bends were factory made and galvanizing was performed after bends were formed. All other bends were made by hand in the field and the heating of conduit for this purpose was prohibited.

Outlet, junction and all boxes for low-tension service are of heavy cast-iron construction. In many instances it was thought advisable to use specially designed material and apparatus in order to provide a lighting and power system in keeping with the other construction. Threaded connections, reinforced by locknuts and bushings are used throughout between conduit and outlets in order to provide a continuously grounded system. In addition, the conduits are brought into contact with the steel framework of the buildings and at transformers, the neutrals of which are in every case grounded, a common ground connection is made.

The high-tension distributing system for incandescent lighting and power purposes is operated at 2,300 volts and sixty cycles. Each transformer for lighting purposes and each set of transformers for power purposes is served by an independent cable direct from the switchboard at the power-house. Cables for arc service have either four or eight conductors and serve from two to four loops. All motor-driven apparatus is operated from three-phase lines while all incandescent lighting service is taken from one phase of the generators in order to secure as good regulation as possible and to simplify the wiring.

All cables running north to the coach yards, shops and signal towers are lead-covered on account of the presence of moisture in the duct system. Those to the south are double-braided only, as the ducts in the wall of the pipe subway are reasonably dry and are protected from moisture. The single and three-phase, 2,300-volt cables are insulated with varnished cambric over a thin layer of unvulcanized rubber. These cables were subjected to and successfully withstood a test of 7,500 volts for five minutes between conductors, and between conductors and ground, after being submerged in water for twenty-four hours at the factory, and 5,000 volts for five minutes between conductors and the ground after being installed. Insulation resistance averaged well above 150 megohms per mile. The arc cables, both four and eight-conductor, have each conductor insulated with rubber with varnished cambric over all. These were made up to withstand a test of 10,000 volts at the factory and 8,000 volts after being installed under the conditions mentioned above. Insulation resistance averaged about 4,500 megohms per mile. All high-tension cables were furnished by the General Electric Company.

General Electric new type H transformers, with a ratio of ten to one, are used and are placed in fireproof vaults located at convenient points in the basement of the various buildings. The vault walls are of brick and are built solid from the floor to the ceiling. The floor space generally covers an area of about 100 square feet giving sufficient room for the changing of transformers and parts without disturbing transformers in service. Vault doors are constructed of iron lined with asbestos, and are equipped with lock and keys, and are of sufficient height and width to facilitate the removal of apparatus.

FRONT VIEW OF UNION STATION, WASHINGTON, D. C.

The high-tension cables in each vault terminate at a set of disconnecting switches mounted on the wall above the transformers. Expulsion type fuses are installed between the switches and transformers. Low-tension feeder distributing panels, encased in quarter-inch sheet-metal cabinets, are mounted on the outside of the vault walls at either side of the door, connection to the transformers being made through iron-pipe conduit.

Three-wire, 113-226-volt feeders are run from the feeder cabinets to distributing cabinets located at convenient points throughout the buildings, each feeder serving from one to five or six distributing cabinets. Distributing panels are encased in heavy sheet-metal cabinets and are equipped with three-wire busses and two-wire branches. Feeder circuits, buses and branch circuits are invariably controlled by knife switches, branch circuits being protected by plug fuses and buses and feeders by type A fuses. To secure mechanical strength no switches smaller than twenty-five amperes are used on branch circuits or smaller than 150 amperes on main circuits.

After a number of distributing cabinets had been installed a change was made in the District regulations to permit the grounding, under certain conditions, of all electric fixtures not connected to gas piping. The general scheme of wiring was accordingly changed to profit by this change in regulations. All insulating joints are eliminated entirely. The neutral wire of the branch circuits is grounded to the conduit system at both the fixture outlet and the distributing cabinet—at the latter by means of a copper wire running entirely around the panel in the wiring space and connected with each neutral wire and the conduit system. The neutral wire of feeder circuits is also grounded to the conduit system at cabinets and at transformers by means of a ground plate laid in charcoal under the vault floor. Neutral fuses in all feeder circuits are eliminated and solid copper bars substituted.

Concourse Lighting, Union Station, Washington, D. C.

West End of Waiting Room and Ticket Lobby, Union Station, Washington, D. C.

Okonite compound, of the thickness called for under United States navy yard and dock specifications for low-tension wires, is used for insulating all the secondary wires. Feeders and tie lines are single-conductor and branch circuits twin-conductor. No electrical tests were required prior to installing. After installing, tests for insulation resistance gave results from three to twenty times greater than called for by the District regulations.

The lighting of large floor spaces is generally accomplished by the use of series direct-current arc lamps. General Electric form 10 and 11 lamps are used throughout and are suspended from cone-shaped insulators screwed into the outlet boxes. Loops from the power-house control from twenty-five to thirty-seven lamps each, individual groups being controlled by Gilbert porcelain cutouts enclosed in cast-iron cases conveniently located. Solid No. 8 wire, insulated with Okonite compound and run in one and one-quarter-inch conduit is used for arc service.

All other lighting, except that in the ticket lobby, which is furnished by tungsten lamps, is furnished by metallized carbon filament lamps.

In selecting the lighting units for each particular case, careful consideration was given to the relative efficiencies, reliability and maintenance costs of all commercial lighting units, the conclusion being based upon data obtained from laboratory tests and from many installations in operation.

UNION STATION.

The Union station, passenger concourse, and train sheds cover a ground space of more than eighteen acres. Thirty-three tracks, served by nineteen platforms, enter from the north. Thirteen merge into two which continue to the south under the station and through twin tunnels running between the Library and the Capitol under First street. The sub-basement and concourse basement are used for baggage purposes. The station basement is occupied by a portion of the ventilating and other service machinery and several transformer vaults, the balance of the space being held in reserve for future requirements. The first or street floor is occupied by the main waiting room, ticket offices, baggage room, dining and lunch rooms, women's room, smoking room and state apartments. The kitchen is located on the second floor. The balance of the second floor, the third, and a part of the attic floors are used for office purposes.

MAIN WAITING ROOM.

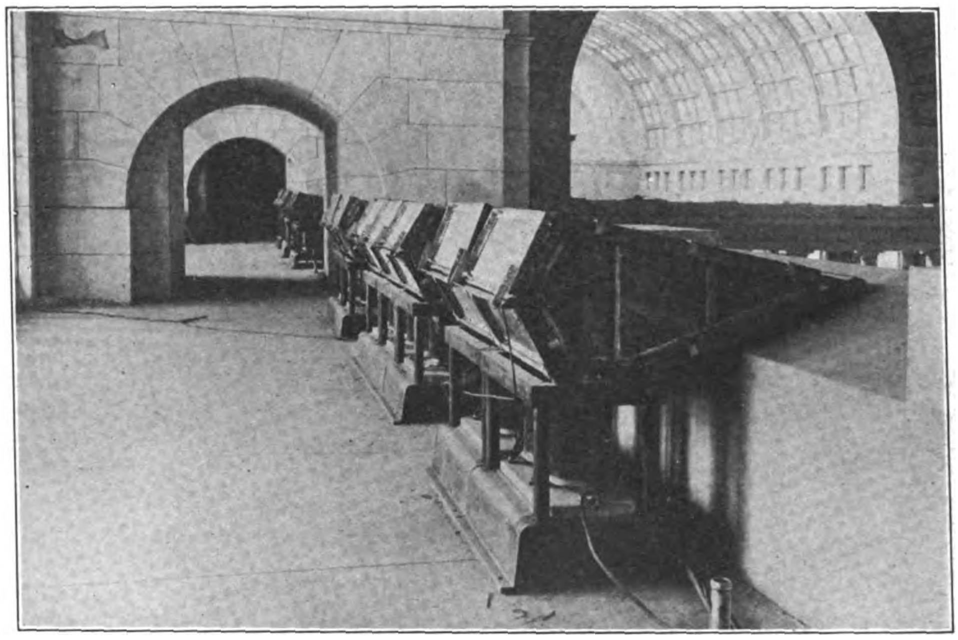
In the preliminary design of the main waiting room it was decided to use some system of lighting by which the fixtures and lamps would be concealed. The room covers a floor space of 120 feet wide by 230 feet long, and has a barrel-shaped ceiling of sixty feet radius, the highest point of which is about ninety-eight feet from the floor. A series of five alcoves which form galleries over the entrance vestibules, run along the sides of the room, with colonnades connecting the galleries across the ends of the room. The ceiling is light in color and is decorated with gold leaf. While not elaborate, the decorations are rich and in complete harmony with the fixtures and architecture.

Banks of especially constructed inverted series arc lamps are placed in the alcoves and back of the balustrade on top of the colonnades, with corrugated mirror reflectors behind them to throw the light to the ceiling whence it is reflected to the floor. As an aid to the reflectors, magnetic coils, which tend to draw the arc toward the waiting room, are installed on the lamps and give good results. To soften the light and reduce the bluish-white tint characteristic of arc lamps, "Cathedral Glass" screens of a very light yellow tint are placed over the lamps and reflectors.

The lighting equipment consists of a total of 162 lamps so arranged that several combinations in the number of lamps in service may be had. A series of luxometer readings were taken with all possible combinations of lamps. From the results of these tests it was found: That the corrugated reflectors and light-colored ceiling give almost perfect diffusion; that with all lights burning, at reading distance from the floor, about forty-two inches, the illumination is practically uniform, the curves both north and south, and east and west being nearly a straight line, and the values varying from 2.5 foot-candles in the corners of the room to 2.3 foot-candles in the centre thus making the use of auxiliary lighting on the seats for reading purposes not only unnecessary but out of harmony in color and arrangement with the general scheme employed. The light is a very close approach to daylight and gives practically true color values in every part of the spectrum. Considerable difficulty was experienced in procuring the glass used to soften the color of the light, as it is required that the glass should not absorb too much of one or all colors. By the use of the "Cathedral Glass" and clear inner globes a loss of but sixteen per cent in the light was entailed, that being less than with an opal inner globe alone.

TICKET LOBBY.

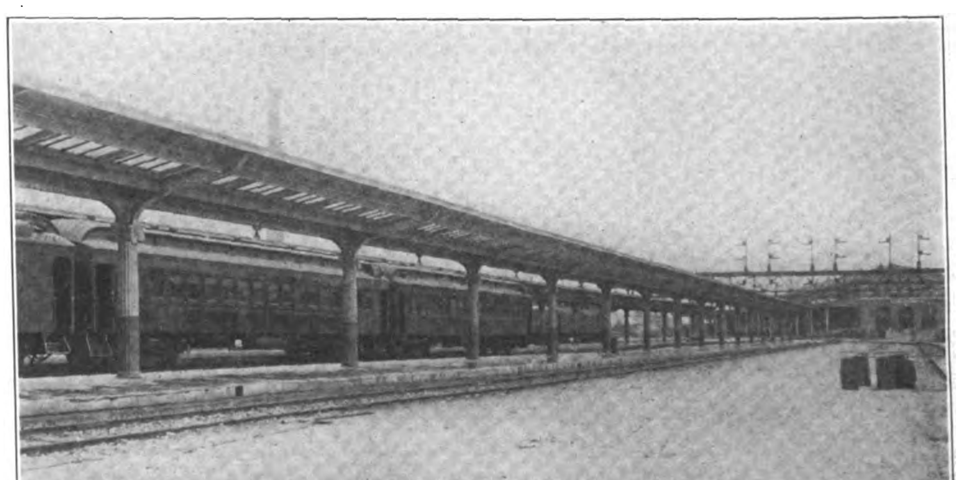
The ticket lobby, located at the west end of the waiting room, is approximately 100 feet long by fifty feet wide with a barrel-shaped skylight ceiling for natural lighting in the daytime. At first the use of a system of lighting similar to that in the waiting room, but with smaller units, was considered. A study of the conditions and tests of the glass indicated that it would be less expensive both in construction and maintenance to install individual lamps above each skylight. Tungsten lamps of 100-watt size with metal reflectors painted inside with aluminum paint are used. The lamps are arranged on four three-wire circuits, controlled by single-pole switches, so that half the lights may be cut out of service without disarranging the symmetry of the lighted panels. The illumination in this portion of the station averages about 2.3 foot-candles, the quality of the light closely approximating that in the adjoining main waiting room and the distribution being equally as good. The reflectors used are of a special design and are so mounted as to direct the light toward the centre axis of the arch. There are in all 225 lamps above the skylight, all being in a pendent position. A very small percentage of the light passes up, the major portion being directed down into the lobby below.



REAR VIEW OF REFLECTOR-FRAMES IN ALCOVE, UNION STATION, WASHINGTON, D. C.

BAGGAGE ROOM.

The baggage room on the first floor is lighted during the daytime by seventeen saw-tooth skylights through a ceiling of maze glass panels. For artificial illumination one arc lamp is placed above each ceiling panel with good results. Each lamp is equipped with a large reflector. The skylight tile-work has also been painted white with most pleasing results. The effect has been to destroy shadows and color rings, to smooth out and enlarge the distribution of the light, to make the color more mellow and in harmony with

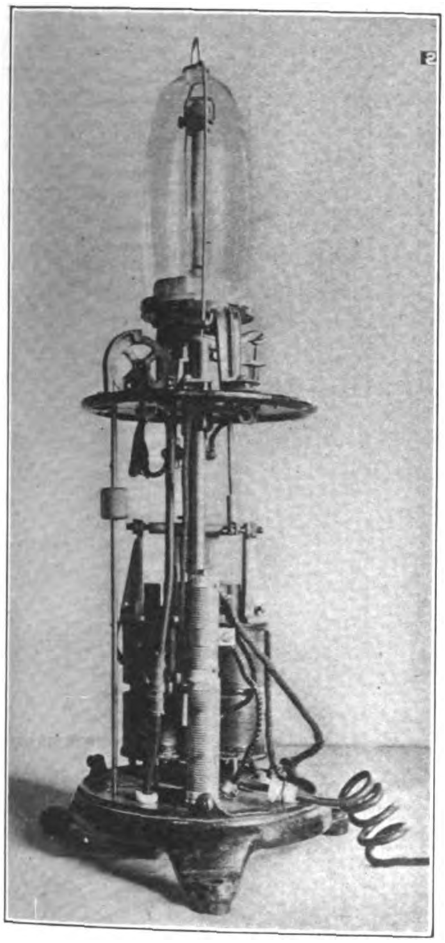


TRAIN SHED LIGHTING, UNION STATION, WASHINGTON, D. C.

that in the adjoining ticket lobby, to direct all the light downward and to reduce the annoying effects of flickering, arc traveling and feeding. The illumination in this room averages about 1.8 foot-candles and is both comfortable and sufficient for the work performed.

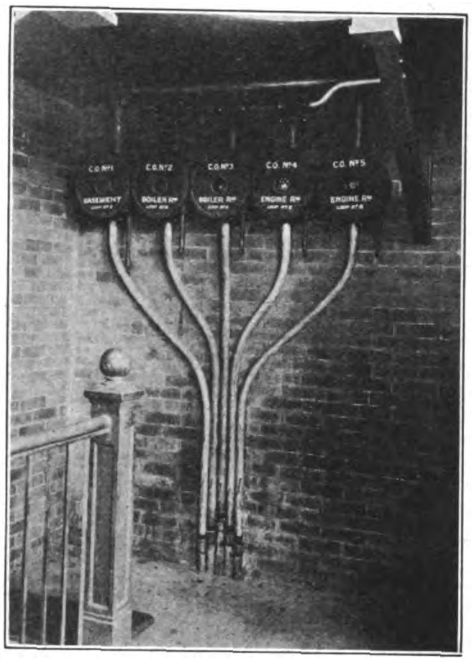
CONCOURSE.

The concourse occupies a space 755 feet long by 150 feet wide between the station building and train shed. It serves as a means of passage to and from trains and



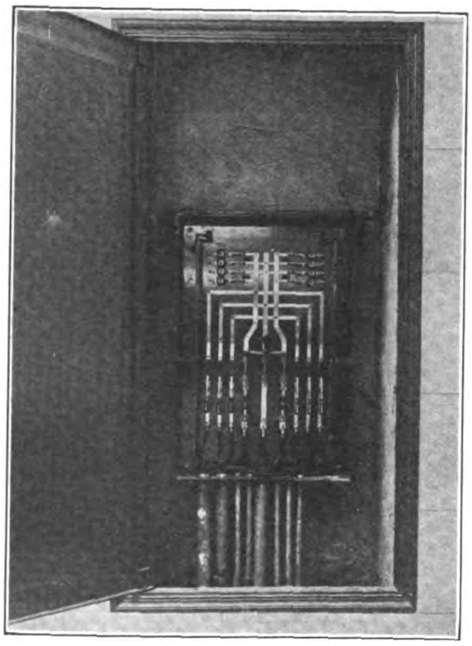
INVERTED ARC LAMP, CASING REMOVED.

is lighted entirely by arc lamps suspended about seven feet from the ceiling. At this distance from the ceiling the lamps cast very slight shadows overhead. The absence of pronounced shadows is desirable on account of the paneling in the ceiling. It was attempted experimentally to light this space by placing arc lamps between the roof and ceiling over the skylights. The scheme was condemned principally on account of the steelwork supporting the roof casting very pronounced shadows on the skylights and because the glass used has a very large absorption factor and is not uniform in color when lighted artificially. Series direct-current arcs did not give good results on account of the great loss due to absorption. Flaming arcs, by reason of their great quantity of light, gave good results but were abandoned because of their pronounced yellow color being out of harmony with the general color values in other parts of the station and the high



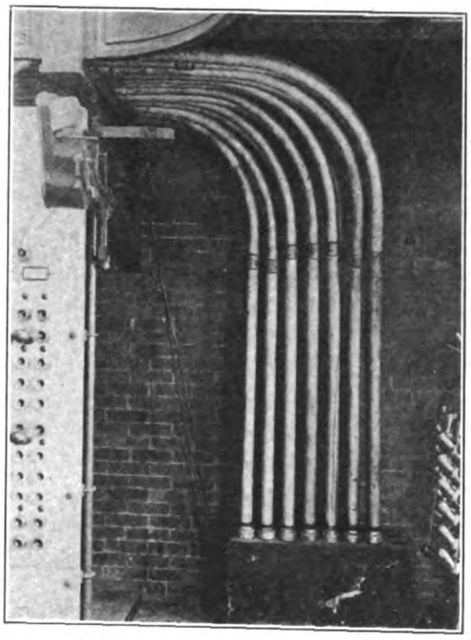
ARC CUTOUTS WITH CONDUIT CONNECTIONS.

cost and difficulty of maintenance in the positions they occupied. Other experiments were also made in an effort to reduce the total number of units used, by employing large diffusers containing four and five units each. This, however, gave the effect of large units of high intrinsic brilliancy and was for that reason aban-



TYPICAL DISTRIBUTING PANEL AND CABINET.

doned. It also produced objectionable streaks and shadows on the ceiling. This system would undoubtedly have worked out well had the ceiling been designed so as to have the diffusers set in it instead of below it. The reasons for abandoning this system were due to the original layout not conforming to its use and not to any faults in the diffusers themselves. With the diffuser installation the illumination on the floor was sufficient, pleasant and well diffused, the streaks and shadows on the walls and ceiling being due to the nonconformity of the building design and the necessary method of installation. Each lamp is equipped with a clear inner and opal outer globe and the quality and distribution of the light is as good as could be desired. Means have been provided for a suitable casing to cover the wires and insulator directly above the lamp and a canopy to improve the appearance at the ceiling outlet. A collapsible and movable extension ladder is used in trimming these lamps.



CONDUIT IN POWER-HOUSE.

MISCELLANEOUS.

The dining and lunch rooms, women's room, smoking room, state apartments and porticos are lighted from a series of ornamental bronze fixtures. These fixtures show excellent workmanship, and are in strict conformity with the decorations and architectural features of the rooms in which they are placed. The ever-present glare of exposed fixtures, however, is present and the irregularity of illumination is quite pronounced, illumination curves showing a variation in the dining room of from 2.1 foot-candles under the fixture to 0.7 foot-candles along the wall.

Some special lighting, in the form of incandescent lamps with reflectors placed in coves formed in the cornices, is installed in the main entrance to the state apartments and also in the vestibules. This system gives a very satisfactory effect but the installation is too small to be of much value in gathering technical data. The ticket cases and counters, show cases in the drug store, news stand and flower booth are lighted by Frink reflectors, the lights being concealed as much as possible.

The lighting of the offices is uniform in design. One and three-light fixtures finished in dull black are used. The sockets are arranged for vertically suspended lamps, permitting the use of Tungsten lamps at some future date, and for Holophane shades. Each office is equipped with two or more ceiling fixtures, depending upon the size and shape of the room, and floor and baseboard outlets are installed at convenient locations. All ceiling fixtures are controlled by flush pushes mounted on wood mats on the walls. Hallways are lighted by Gem lamps varying from fifty to 125 watts and are encased in eight, ten and twelve-inch globes, according to size. The kitchen apartments are lighted and ventilated to some extent by combined fixtures and fans.

The train platforms are covered by umbrella sheds supported on cast-iron columns spaced thirty feet apart along the centre line of the platform. One hundred and eighty-seven-watt Gem lamps, equipped with Holophane bowl reflectors, are suspended midway between the columns from especially designed outlet boxes attached to the steelwork of the roof. These give

POWER REQUIREMENTS SOUTH OF M STREET.

	Total watts.
Small motors at station	225,000
Train tunnel fans	250,000
Battery charging motor generator	50,000
Motors, power plant and K street tower	120,000
Total	645,000

abundant light for loading or unloading trains and are readily accessible for renewals. They may, however, be changed to 100-watt Tungsten lamps later with the desirable results of increasing the quantity of light and decreasing the total energy used. The signs and numerals over the entrance gates in the train fence are illuminated by incandescent lamps controlled by push-button switches located in cabinets containing the numeral boards for the time signs.

The ventilating fans are operated from 226-volt, three-phase service and the dumb waiters from 113-volt, direct-current, from a ten-kilowatt motor generator set. The total load is small and is carried by three seventy-five-kilowatt transformers connected in delta. The Magneta clock

WASHINGTON TERMINAL LIGHTING SYSTEM.

UNION STATION.

	Sq. Ft.	Watts per Sq. Ft.	Total Watts.	System.	Kind of Lamp.
Sub-basement	9,420	0.58	5,500	Direct.	D.-c. series arcs.
West basement	36,864	1.75	64,600	Direct.	D.-c. series arcs.
East basement	6,352	1.88	12,000	Direct.	Arcs and GEM.
Ticket lobby	5,200	4.25	22,500	Concealed above glass ceiling.	100-watt tungsten.
Ticket office	1,536	2.05	3,150	Direct and concealed.	GEM.
Baggage room	5,236	1.66	8,500	Concealed above glass ceiling.	D.-c. arcs.
Main waiting room	28,320	2.93	83,000	Indirect.	Inverted d.-c. series arcs.
Booth and special lighting main waiting room	....	....	2,000	Special.	GEM.
Smoking room	1,876	2.24	4,200	Direct.	GEM.
Barber shop	612	1.97	1,200	Direct.	GEM.
Toilets	1,818	0.87	1,640	Direct.	GEM.
Telephone space	508	2.26	1,150	Direct.	GEM.
South vestibule	957	2.82	2,700	Direct.	GEM.
Drug store	320	3.43	1,100	Direct.	GEM.
Parcel room	384	2.81	1,080	Direct.	GEM.
North vestibule	2,320	2.58	6,000	Direct.	GEM.
East collonade	320	3.28	1,050	Direct.	GEM.
Women's waiting room	2,720	1.54	4,200	Direct.	GEM.
Women's toilet	1,280	0.78	1,000	Direct.	GEM.
Dining room	7,488	1.73	13,000	Direct.	GEM.
Lunch room	8,352	1.34	11,200	Direct.	GEM.
Steward's office	300	1.00	300	Direct.	GEM.
Serving room	4,352	0.71	3,100	Direct.	GEM.
State entrance porch	2,560	1.09	2,790	Direct and concealed.	GEM.
Vestibule state entrance	720	5.20	3,750	Concealed.	Incandescent.
President's reception room	2,584	1.38	3,600	Direct.	GEM.
President's retiring room	224	2.67	600	Direct.	GEM.
Attendants' retiring room	224	2.67	600	Direct.	GEM.
Invalids' room	352	1.42	500	Direct.	GEM.
East driveway	9,600	0.52	5,000	Direct.	D.-c. series arcs.
East portico	1,344	1.76	2,400	Direct.	GEM.
South portico	7,680	0.52	4,000	Direct.	GEM.
Main entrance porticos	5,544	1.83	10,150	Direct.	GEM.
Carriage porch	11,744	0.84	9,900	Direct.	GEM.
Concourse	98,800	0.37	37,000	Direct.	D.-c. series arcs.
Concourse news stand	169	10.94*	1,850	Direct and special.	GEM.
Concourse ticket office	968	1.39	1,350	Direct.	GEM.
Concourse fire department and toilet	572	1.04	600	Direct.	GEM.
Station master's office	1,147	0.98	1,125	Direct.	GEM.
Stairways to tracks	800	1.87	1,500	Direct.	GEM.
Umbrella sheds	397,440	0.092	82,000	Direct.	GEM.
Train gates	....	....	15,000	Special.	GEM.
Massachusetts avenue tower	384	2.08	800	Direct.	GEM.
East portion second floor	23,728	1.08	25,650	Direct.	GEM.
West portion second floor	16,032	0.91	14,600	Direct.	GEM.
East portion third floor	19,968	1.20	24,000	Direct.	GEM.
West portion third floor	9,276	1.19	11,100	Direct.	GEM.
East portion attic	16,652	0.57	9,600	Direct.	GEM.
West portion attic	17,472	0.20	3,500	Direct.	GEM.
Floor outlet	....	....	30,000	....	....
Total lighting load			557,135		

*Includes show-case lighting.

EXPRESS BUILDING.

	Sq. Ft.	Watts per Sq. Ft.	Total Watts.	System.	Kind of Lamp.
Offices	25,080	1.34	33,000	Direct.	GEM.
Distributing space and offices	25,080	0.76	19,000	Direct.	GEM and arcs.
Storage space basement	25,080	0.78	19,500	Direct.	D.-c. series arcs.
Driveways	33,880	0.33	11,200	Direct.	D.-c. series arcs.
Train shelters	26,670	0.42	11,200	Direct.	D.-c. series arcs.
Plug receptacles	....	....	5,610	....	....
Total			99,510		

K STREET SIGNAL TOWER.

	Sq. Ft.	Watts per Sq. Ft.	Total Watts.	System.	Kind of Lamp.
Offices	3,630	0.60	2,200	Direct.	GEM.
Basement	1,800	0.42	756	Direct.	GEM.
Small motors	....	....	15,000	....	....
Total			17,956		

INSPECTORS' BUILDING.

	Sq. Ft.	Watts per Sq. Ft.	Total Watts.	System.	Kind of Lamp.
Store room and lunch room	4,158	1.20	5,000	Direct.	GEM.
Offices	4,158	1.33	5,500	Direct.	GEM.
Basement	4,158	0.61	2,500	Direct.	GEM.
Total			13,000		

POWER PLANT.

	Sq. Ft.	Watts per Sq. Ft.	Total Watts.	System.	Kind of Lamp.
Boiler room	7,800	1.63	12,716	Direct.	Arcs and GEMS.
Engine room	9,000	1.22	11,000	Direct.	D.-c. series arcs.
Plug receptacles	....	....	28,050	....	....
Total			51,766		

REFRIGERATING PLANT.

	Sq. Ft.	Watts per Sq. Ft.	Total Watts.	System.	Kind of Lamp.
Attic	1,050	0.76	798	Direct.	GEM.
Second story	1,050	1.42	1,500	Direct.	GEM.
First floor	1,050	1.27	1,350	Direct.	GEM.
Basement	1,050	1.85	2,000	Direct.	GEM.
Total			5,648		
Pipe tunnel	....	....	2,500	Direct.	Incandescent.
Train tunnel	....	....	10,000	Direct.	Arcs and incandescent.

SUMMARY.

Total connected lighting load south of M street	757.5 kilowatts
Total connected power load south of M street	645.0 kilowatts
Total	1,402.5 kilowatts

system has been installed, the master clock being wound automatically by a small alternating-current motor. A telautograph system has been installed for the use of employés only, its principal service being to announce to the employés of the baggage room and station and the express companies the time and incoming track number of arriving trains.

The lighting of the signal towers is special to a considerable extent, it being very desirable to have the operating rooms as dark as possible so as to permit the operators to observe readily the movement of trains. All of the track and signal indicators and the lever machines are illuminated by fifty-watt Gem lamps in connection with special Frink reflectors, no other lights being used in the operating room.

EXPRESS BUILDING.

The express building is a three-story brick building somewhat more than 300 feet long by sixty feet wide. The basement or street floor and first or train floors are used exclusively for the handling of express, while the second floor is used for office purposes. The basement and basement driveway, first floor and train shelters are lighted almost entirely by arc lamps, the lamps being controlled by some twelve or fifteen cutouts. The arrangement of the second floor permits the use of a uniform and symmetrical arrangement of lights. One-light ceiling fixtures equipped with Holophane shades and 125-watt Gem lamps are used throughout, the fixtures being placed at the centre lines of windows. This lighting especially has given general satisfaction.

POWER-HOUSE.

The larger floor spaces in the power-house are lighted by arc lamps, while the smaller machinery passage ways and offices are lighted by Gem lamps equipped with Holophane reflectors. The fixtures as a rule are made of one-half-inch conduit instead of three-eighths-inch and without ornamental tubing on the outside. This arrangement gives a very strong and serviceable fixture. A multiplicity of extension-plug outlets is provided, extension cords equipped with Frink lamp guards and Fullman plugs being supplied.

The terminal is equipped with a private telephone exchange connected with the local, long-distance and railroad exchanges. Postal, Western Union and railroad telegraph service also enters the terminal.

With the exception of the ornamental bronze fixtures which were designed and purchased by the architects, D. H. Burnham & Company, of Chicago, Ill., all of the electrical work on the Terminal company's property south of M street was designed by and constructed under the direction of the motive power department of the Pennsylvania Railroad.

All the electrical work above described was installed by A. S. Schulman, of Cincinnati, Ohio. Credit is due I. R. Prentiss, of the General Electric Company, for many valuable suggestions in connection with the lighting of the waiting room and other important portions of the station. W. D'A. Ryan, of the illuminating department of the same company, also gave valuable assistance in this direction.

The tabulation on the opposite page gives an itemized statement of the kinds of lamps used, method of lighting and wattage per square foot for floor space throughout the buildings described in this article.

Coal Production in 1907.

Advance sheets from the United States Geological Survey, George Otis Smith, director, have been prepared by Beatrice D. Wood, bearing on the production of coal in 1907.

In the production of both anthracite and bituminous coal, Pennsylvania in 1907 exceeded any previous annual record, as reported by the United States Geological Survey in an advance chapter of Mineral Resources of the United States, calendar year 1907, on the production of coal, prepared by E. W. Parker.

The total production was 235,925,749 short tons, having a spot value of $319,421,826. The production of anthracite was 76,432,421 long tons (equivalent to 85,604,312 short tons), having a spot value of $163,584,056. The production of bituminous coal was 150,321,437 short tons, having a spot value of $155,837,770.

Compared with the aggregate production of 1906, which amounted to 200,575,617 short tons, valued at $262,208,345, the output in 1907 exhibits an increase of 35,350,132 short tons, or 17.6 per cent, in quantity, and of $57,213,481, or 21.8 per cent, in value. The increase in the production of anthracite coal was 12,787,412 long tons (equivalent to 14,321,901 short tons), or 20.1 per cent, in quantity, and $31,666,362, or twenty-four per cent, in value. In the production of bituminous coal the increase was 21,028,231 short tons, or 16.26 per cent, in quantity, and $25,547,119, or 19.61 per cent in value.

Mr. M. R. Campbell, of the United States Geological Survey, estimates the amount of coal originally in the anthracite fields of Pennsylvania at 21,000,000,000 short tons and that in the bituminous fields at 112,574,000,000 short tons.

The total production of coal in Illinois in 1907 was 51,317,146 short tons, having a spot value of $54,687,382, the largest production and value yet recorded for the state, an increase of 9,837,042 short tons, or 23.72 per cent in quantity, and of $9,924,320, or 22.17 per cent in value, over the production of 1906. By this increase Illinois was again advanced to second place among the coal-producing states, a position it had held from 1883 to 1906, when it was supplanted by West Virginia.

The total production of coal in West Virginia in 1907 was 48,091,583 short tons, having a spot value of $47,846,630.

In 1906 West Virginia displaced Illinois for second place among the coal-producing states, but her triumph over Illinois was of short duration. As a result of the suspension in 1906, ranging from two months to ten weeks at most of the Illinois mines, pending an adjustment of the wage scale, the coal production of Illinois was materially restricted, whereas in West Virginia, where most of the miners are unorganized, operations were carried on practically without interruption, and that state outranked Illinois, with a lead of 1,810,246 short tons. The record for 1907, however, showed that the production of Illinois made a phenomenal increase of 9,837,042 short tons, more than double West Virginia's increase of 4,801,233 short tons, and West Virginia again dropped to third place among the coal-producing states. Compared with that of 1906, West Virginia's coal production in 1907 showed an increase of 4,801,233 short tons, or 11.09 per cent in quantity, and of $6,794,691, or 16.55 per cent in value.

During the first nine months of the year business was exceptionally active, and the demand for coal was considerably in excess of the supply of cars to transport it, but as West Virginia is one of the producers of high-grade steaming and coking coals, the influence of the monetary disturbance of October was keenly felt. Coke making fell off quickly as soon as the panic began, and the coal production of the state during the last ten weeks of the year was probably not more than fifty per cent of the capacity. Had the production kept up for the entire year at the rate exhibited during the first nine months the total production would probably have reached 53,000,000 tons.

Although a good part of the market for Washington coal in California has been lost through the increased production of fuel oil in that state, Washington shared in the general increase in the production of coal in 1907. The total output for the year was 3,680,532 short tons, having a spot value of $7,679,801, an increase of 404,348 short tons, or 12.34 per cent in quantity, and of $1,771,367, or 29.98 per cent in value, compared with 1906. The average price per ton advanced from $1.80 in 1906 to $2.09 in 1907.

During the first ten months of the year the coal-mining industry of the state was in a highly satisfactory condition. In November and December, however, owing to the financial disturbances, the output of the mines was curtailed about thirty-three per cent. But for this the production would probably have exceeded 4,000,000 tons.

SOME ENGINEERING FEATURES OF THE SOUTHERN POWER COMPANY'S SYSTEM.[1]

BY J. W. FRASER.

(Concluded.)

Substations—The first motor installations in cotton mills on this system were of 550 volts, but it was soon seen that the number of small transformer substations, besides complicating operation, would cost excessively, and after some investigation 2,000-volt motors were recommended for all mills converting from steam to electric drive. These installations proved so successful that to-day over one-half the total horse-power in motors is at 2,000 volts. The cost of the conduit in the mills for 2,000 volts is nearly offset by the smaller wire used and this electromotive force permits all mills within a radius of two miles to be fed from one substation. Many new mills, on account of using individual drive and consequently motors below thirty horse-power, are compelled to step-down at least a part of this current to 550 volts.

The sizes of transformers in substations are as follows:

11,000 Volts. (All purchased before beginning of new development.)					44,000 Volts.				
5	Stations with	3	100	kw.	1	Stations with	2	100	kw.
5	" "	3	125	"	1	" "	3	125	"
3	" "	3	150	"	1	" "	3	150	"
1	" "	3	200	"	7	" "	3	200	"
1	" "	3	250	"	8	" "	3	300	"
1	" "	3	500	"	5	" "	3	500	"
					1	" "	3	750	"
					4	" "	3	1,000	"
			7,575 kw.					34,175 kw.	

Many of the 44,000-volt substations below 900 kilowatts are now partially or wholly owned by customers, as are also some of the 900-kilowatt and 1,500-kilowatt stations, most of the mills in one town preferring to take shares rather than pay the additional price for power necessary when the station is owned by the power company. The customer usually requests that the power company buy and install the substation apparatus. The customer gets the benefit of any experience which the power company may have and obtains substations at a minimum cost. In the larger towns where attendants must be kept it has been found more satisfactory for the company to own the substation. The power company has discountenanced the buying of transformers below 200 kilowatts on account of the high cost of completed stations per kilowatt. In the case of a 900-kilowatt station (three 300-kilowatt transformers) when the transformer cost is two-thirds of the total and 150 kilowatts cost fifty per cent more per kilowatt than 300-kilowatt transformers, the power company has taken a share in the station rather than have the customer install the small transformers. The companies consider this to be to their interest in view of the facts that they get all new mills and that the interest on the additional investment for two years would not pay the installation charges for substituting the large transformers when they were needed.

All substation transformers have been purchased under a standard specification in order that a few stock transformers which the power company has made it a policy always to keep on hand, may serve as spare apparatus in case of accident.

It is believed that no transformers below 300 kilowatts and very few below

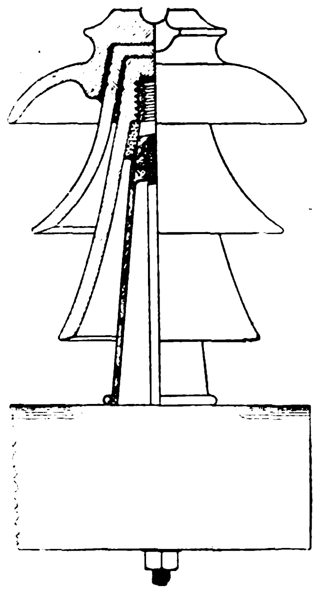


Fig. 6.—44,000-Volt Insulator.

500 kilowatts will have to be purchased in the future, for with the present rapid growth of cotton mills and the use of 2,200-volt distribution in the towns where substations are located, the small transformers will have to be exchanged for larger ones, the smaller ones being available for the new substations carrying small loads.

It may be of interest to some to know that there are now on our lines 114 50,000-volt fuses of the expulsion type and that they have proved entirely satisfactory.

Secondary Power—From government records and from six years of gaugings before the completion of the Catawba plant, together with two years' operating experience, the flow of the Catawba River had been pretty well determined. The question which presented itself most forcibly was whether to develop the average minimum twelve months' flow, or to develop for ten months, eight months or less, and to supplement with steam power; a problem which has to be determined by the first cost of development and by local market conditions.

Owing to limited library facilities at his command the writer was unable to ascertain if this question had been touched upon elsewhere and how in other cases it had been determined, and so trusts that a few words with reference to this particular case will not be amiss.

In following calculations where the cost of primary and secondary power is taken at a fixed rate, the intention is not to convey the idea that these are actual figures but relative figures which will serve the purpose of this paper.

There are many different solutions to the problem of ascertaining the amount of secondary power which may be economically developed. At one of our developments it was found that the average minimum primary power was in the neighborhood of 16,000 kilowatts and that the increase per month of secondary power was in the neighborhood of twelve and one-half per cent; *i. e.*, 2,000 kilowatts per month. In other words, if secondary power was to be developed for eight months' sale the total development of primary and secondary power would be 24,000 kilowatts. If this secondary power can be sold without an auxiliary steam plant the amount of secondary power which may be developed economically depends only upon whether or not the price received for such power will cover interest and profit on the investment; that is, the investment which is over and above that for developing primary power, but if a steam plant has to be maintained the amount of secondary power to be developed depends also on the cost of steam power. It is very clear that the cost of secondary power is practically the same whether it is sold for eleven months or one month. With this cost, say at $10 per horse-power delivered, steam at $28 per horse-power-year ($6 interest and depreciation, $22 for coal, operating expenses, etc.), if interest and depreciation on the steam plant is entirely chargeable to the months when steam plant is in operation, then

Cost of steam power per month $= 1.83 + 6/x$

When $x =$ the number of months in operation.

Amount of secondary power to be developed $= 16{,}000$ kilowatts $\times\ 12.5x/100 = 2{,}000x$

Cost of steam-secondary

$$= 2{,}000x\ (1.83 + 6/x)\ x + 2{,}000x \times 10$$
$$= 2{,}000\ \ (1.83x^2 + 6x + 10x)$$

[1] A paper presented at the annual convention of the American Institute of Electrical Engineers, Atlantic City, N. J., June 30. For a description of the different power sites owned by the Southern Power Company see Electrical Review, September 8, 1906, p 367.

If power is selling at $20, profit

$$= (2{,}000x\ 20 - \{2{,}000\ (1.83x^2 + 16x)\}$$
$$= 2{,}000\ (20x - 1.83x^2 - 16x)$$
$$(\text{For max.})\ dy/dx = 3.66x - 4$$
$$x = 1.1 \text{ month}$$

On this basis maximum profit would be made on 2,200 kilowatts secondary development.

A more practical method under existing conditions seems to be to charge the interest and depreciation of steam plant to the operating expenses of the system, inasmuch as the steam plant is an insurance

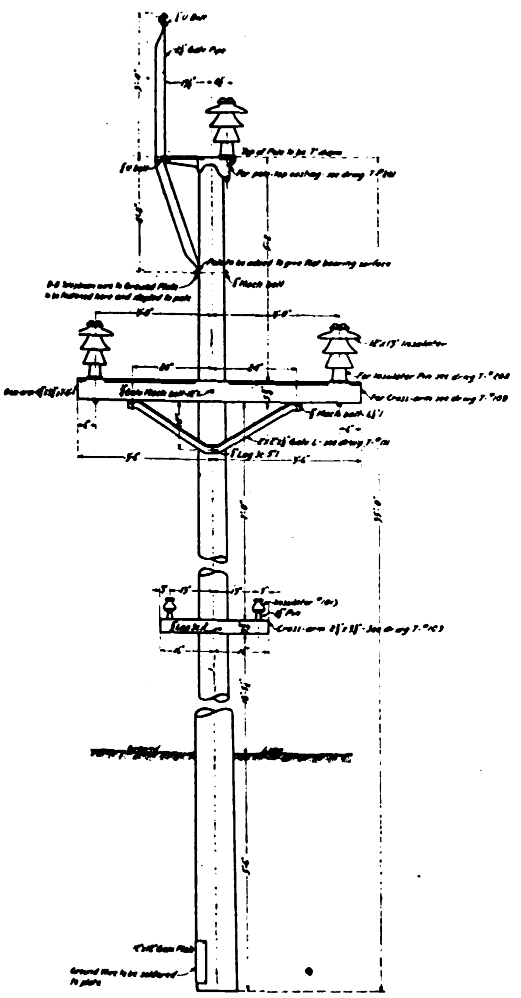


Fig. 7.—Standard Wood Pole.

against a partial shut-down and makes spare units unnecessary, and in the case of steam turbines, when run as synchronous motors, saves copper because it brings up the power-factor. The above equation now becomes:

Cost of steam + secondary

$$= 2{,}000x\ (1.83x) + 2{,}000x \times 10)$$
$$= 2{,}000\ (1.83x^2 + 10x)$$

Profit

$$= 2{,}000 \text{ X } 20 - (2{,}000\ (1.83x^2 + 10x)$$
$$= 2{,}000\ (20x - 1.83x - 10x)$$
$$= 2{,}000\ (10x - 1.83x^2)$$
$$(\text{For Max.})\ dy/dx = 3.66x - 10$$
$$x = 2 - 3/4$$

Maximum profit on this basis would be made on 5,500 kilowatts (35 per cent) secondary development.

Had $24.50 been taken as the selling price of power x would equal four months, or the total development should be made for 150 per cent of mean average low water. Although power from hydroelectric plants has been selling in the Carolinas for less than this latter figure there is no doubt that reliable service demands this price.

There is another argument in favor of developing for 150 per cent mean average low water. If it costs only one-half as much to develop secondary power as primary, twice the loss can be allowed on transmission lines; or, in other words, one and one-half times the power can be transmitted during secondary power seasons. Now, if the transmission lines are figured for an economical loss when transmitting primary power only, secondary power to the extent of fifty per cent of the primary power can be developed without additional copper. This only holds good when the auxiliary steam plants can be built in the neighborhood of distribution centres whose consumption of power is equal to the amount of secondary power.

Many mills which had steam plants already installed made contracts for secondary power for eight months in the year, but after a few months' operation by electric drive their owners found the production so much increased and their labor and other troubles so much lessened that many of them desired to change their contracts to primary power. The result of this is that the plans for a supplementary steam plant are now in course of preparation. The initial installation will be 15,000 kilowatts and will be located at Spartanburg, S. C., near the southern end of the system, sixty-four miles from the main switching station at Great Falls on the 88,000-volt line. The ultimate installation is expected to reach 40,000 kilowatts, divided between this point and some point near the eastern end of the system. It is thought better to divide the plant for safety and in order that the line loss may be kept as low as possible.

BOOK REVIEW.

"American Street Railway Investments." New York. McGraw Publishing Company. Cloth. 473 + xliv pages. 10 by 13¼ inches. Illustrated with maps. Supplied by the Electrical Review for $5.

This is the fifteenth edition of the electric traction "Red Book." It is hardly necessary to say much about this excellent reference book. The data have been brought up to date and several new maps indicating extraordinary developments have been added. There is no other reference of a similar character, and the book, therefore, stands in a class by itself. It should certainly be of considerable interest to those desiring accurate and recent information concerning street railway properties.

Resistance of a Conductor Having a Sudden Change in Size.

At a recent meeting of the Physical Society, of London, a paper entitled "On the Resistance of a Conductor of Uniform Thickness Whose Breadth Suddenly Changes and on the Shape of the Stream-lines" was read by Professor C. H. Lees. A knowledge of the resistance of a conductor whose section suddenly changes is of considerable practical importance, but mathematical difficulties have prevented an exact solution of the problem. Lord Rayleigh had given an approximate solution of the case in which a cylinder of circular section is joined at one end to the plane surface of a large conducting solid; and Professor Hicks has solved the case of a wire of small diameter ending in the surface of a conducting sphere. The mathematical difficulties of the problem disappear if the conductors are of rectangular section and one dimension, *e. g.*, the thickness remains constant while the breadth suddenly changes and the two are joined together either with their axes or with two sides collinear. The paper shows that the resistance between two transverse sections through points situated at considerable distance from the change of section on opposite sides of it is equal to the sum of the resistances of the portions of conductor between each of the two sections and the change of section, each considered as part of an infinite length, plus the resistance of a length of either conductor equal to its breadth multiplied by an expression given.

Dr. Russell congratulated the author on having obtained the exact solution of an important problem and thanked him for giving it in a form in which it could be utilized readily by electricians. Somewhat similar problems were of frequent occurrence in practice, in particular he instanced the measurement of the resistance of the bonds connecting the rails in electric tramway systems. The difficulty in this case was in knowing where the rail ended and the bond began. A small variation in the position of the potential contacts made a large variation in the reading of the galvanometer. In many cases the only way of attacking the problem was to calculate the resistance from the known resistivity of the metals by the approximate method indicated by Maxwell. An exact solution, therefore, like the one obtained by the author, would be of great value in checking the accuracy of the approximate method.

ELECTRICAL MACHINERY IN A GREAT CORN PRODUCTS PLANT.

BY C. A. TUPPER.

One of the most recent of the few great plants devoted to the processing of corn products is the American Maize Products Company, of Roby, Ind. There are not many plants devoted to this industry, owing to their great size and first cost. The corn, before it is available for food or industrial purposes, must pass through a great many operations of weighing, steaming, crushing, grinding, sieving, separating and packaging. In all of these operations the electric drive plays an important part. In this plant, alternating-current motors of the induction type, built by the Allis-Chalmers Company, Milwaukee, Wis., have been used. Most of these are of standard construction, but the motors connected to the buhrstone mills, for grinding the corn very fine, are special machines, having been developed for this purpose. The applications of these motors are well shown in the accompanying illustration. Each is of the vertical belted type designed for operation on sixty cycles, and has a normal rated output of seventy-five horse-power. The stator core is supported in a cast-iron housing provided with projecting lugs that rest on the slide rails. The stator core shows open slots that allow the coils to be readily removed in case repairs are necessary. The stator has a fourteen-pole winding, thus giving a synchronous speed of 514 revolutions per minute, the full-load speed being approximately 490 revolutions per minute.

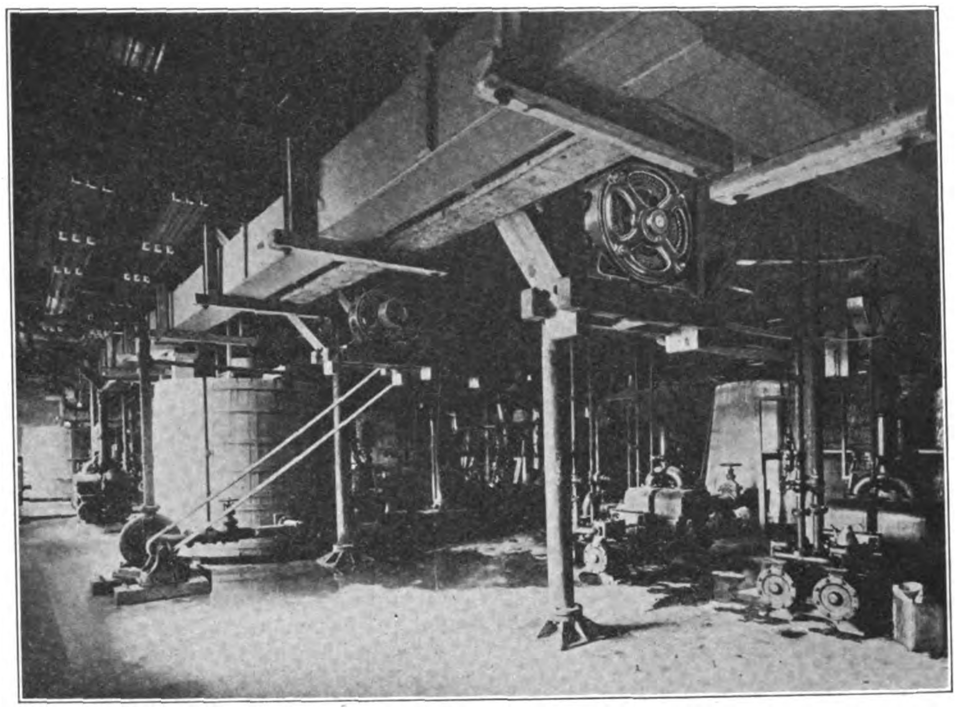
The rotor spider is mounted on a vertical shaft which passes through a guide bearing at the top of the motor. A second guide bearing is placed at the bottom, and the weight of the rotating part is carried by a multiple-disc, self-aligning thrust-bearing under the lower end of the shaft. A complete oiling system is provided whereby oil is supplied to the upper bearing from a large sight-feed oil cup and, after passing through this bearing, flows to the lower one. The thrust-bearing is designed so that all parts are thoroughly lubricated. The pulley is at the top of the motor, and the vertical arrangement allows the motor to be belted directly to the mill without the use of a quarter-turn belt.

In addition to the buhr mills the elevators, conveyers, shaking sieves, and, in fact, all of the moving machinery, are driven by motors of capacities ranging from five to thirty horse-power.

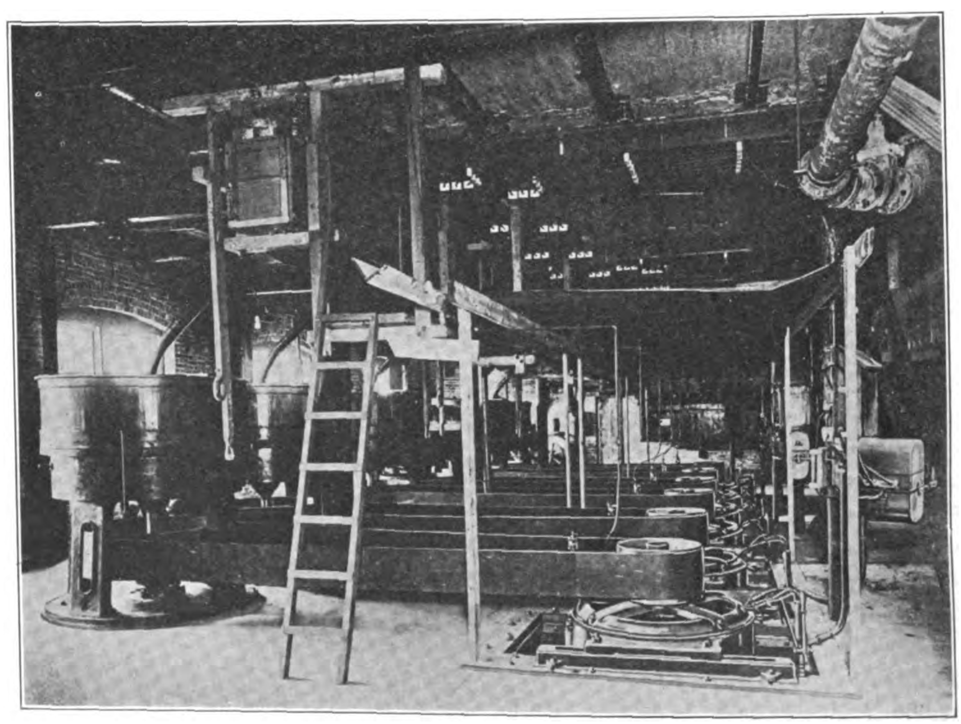
Not the least important part of this great plant is the pumping machinery, which consists of the following units supplied by the Platt Iron Works, Dayton, Ohio:

Two twelve and eighteen by fourteen by eighteen-inch duplex pumping engines of the outside centre-packed plunger type, each having a capacity of 1,400 gallons of water per minute. Three single-stage centrifugal pumps for the steeps, each having a capacity of 200 gallons per minute. These pumps are placed on extended bases and direct connected to seven-and-one-half-horse-power motors. The shaft coming in contact with the liquor is made of bronze composition. One single-stage centrifugal pump for the shakers, having a capacity of 400 gallons per minute. This is direct connected to a fifteen-horse-power motor.

One single-stage centrifugal pump for discharging slop from the buhr mills, having a capacity of 400 gallons per minute. The pump is placed on an extended base and direct connected to a seventeen-and-one-half-horse-power motor. Four



INDUCTION MOTORS FOR DRIVING PUMPS AND SPECIAL MACHINES IN GLUCOSE FACTORY.



SEVENTY-FIVE-HORSE-POWER VERTICAL INDUCTION MOTORS BELTED TO BUHR MILLS IN PLANT OF AMERICAN MAIZE PRODUCTS COMPANY, ROBY, IND.

single-stage centrifugal pumps for crushed corn, each direct connected to a fifteen-horse-power motor. One single-stage centrifugal pump for the starch-breaker, having a capacity of 400 gallons per minute, direct-connected to a fifteen-horse-power motor. One single-stage centrifugal pump for water, having a capacity of 700 gallons per minute, direct-connected to a twenty-two-horse-power motor.

The centrifugal pumps are of the balanced type, with single suction opening. The casing is circular and concentric, fitted with discharge flange, and with feet for bolting to the foundation. The suction is on the drawing side and admits the water to that side of the casing. It passes through cores in the chute case to the front end of the impeller, so that the impeller has suction on each side and is consequently balanced.

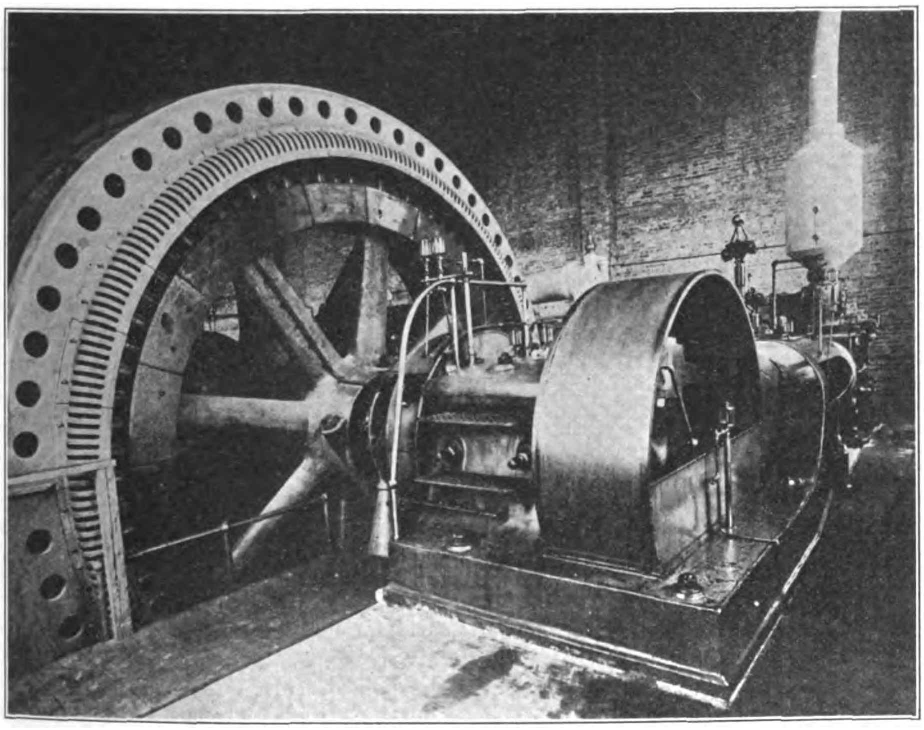
Two eight and eight by ten-inch duplex pumps and two ten and ten by ten-inch duplex pumps, with plain slide-valve steam cylinders and piston-packed water boxes for operating under a liquid pressure of fifty pounds, with an available steam pressure of 130 pounds.

Six eight and six by ten-inch duplex yoke-type pumps for the refinery. Two twelve and eight by twelve-inch duplex outside centre-packed plunger boiler-feed pumps, equipped with chilled-iron plungers, brass-covered plunger rods and brass-bushed plunger glands and boxes.

Two ten and sixteen by ten-inch duplex crank and flywheel vacuum pumps, provided with automatic governors.

One ten and ten by twelve-inch duplex clapper-valve pump, with slide-valve steam end, and brass-fitted clapper-valve liquid end.

The power plant has been designed in strict accordance with latest practice and possesses many features of special merit. In the engine room there is but one large main unit, which is a twenty-six and fourty-four by forty-eight-inch Allis-Chalmers cross-compound Corliss engine, connected to an alternator of the same company's build and having a normal rating of 800 kilowatts. The generator is a three-phase sixty-cycle machine of the revolving-field type and was designed to deliver 480 volts' pressure at a speed of ninety revolutions per minute. The rotor of the generator is about seventeen feet in diameter and weighs seventeen tons. The load carried by this machine is mostly power, consisting of 150 motors and ranging in capacities from five to seventy-five horse-power. There is, of course, a sufficient number of incandescents to light the plant. The lights are carried on three-phase feeders and as nearly as possible are distributed equally between the phases. From four to six hours a day the large unit is run on twenty-five per cent overload and apparently carries it with the greatest of ease.



800-Kilowatt, Engine-Driven Alternator in Plant of American Maize Products Company, Roby, Ind.

Besides the large unit there is a smaller direct-connected set consisting of a fourteen by fourteen-inch Chandler & Taylor engine and a three-phase Allis-Chalmers revolving-field generator. To this set is also belted a thirty-five-kilowatt direct-current exciter. The small set is used only at night or any time when there is a very small load to carry. When starting up the larger unit it is also used for exciting current, the three-phase alternating-current being transformed to direct current by means of a fifty-kilowatt motor-generator set. The belted exciter may also be used, so that there are at least two sources of excitation. When the large machine is running exciting current is obtained from the motor-generator set, the synchronous motor receiving current from the main generating unit.

For control of the electrical apparatus and distribution of the load the station has a seven-panel switchboard, which was installed by Kohler Brothers, of Chicago. The board is equipped with a full line of instruments, consisting of ammeters and voltmeters of Wagner make, Westinghouse integrating and recording wattmeters, a Westinghouse synchroscope and power-factor indicator. Condit three-pole circuit-breakers are installed and Cutler-Hammer chain-operated field rheostats.

In the same room, but at a lower level than the power-plant floor, are some of the pumps previously mentioned, that is, the two pumping engines for water supply, the two boiler-feed pumps and the two Underwriter fire pumps. In addition to the pumps are two Stilwell feed-water heaters, with space for a third, and also an air-compressor to furnish the shop with a supply of compressed air for pneumatic tools, etc.

On account of the large demand for steam throughout the plant there are six Aultman & Taylor boilers installed, each rated at 440 horse-power, set singly and each having 4,403 square feet of heating surface. The boilers carry a pressure of 150 pounds per square inch, and five of them are in constant operation, with one down for cleaning or repairs. They are equipped with chain-grate stokers of the Mansfield type and are run with natural draft supplied by a radial brick stack built by the Heine Chimney Company, of Chicago. The stack is 200 feet high from the boiler-room floor, which is six feet above grade, ten feet in diameter all the way up and has a radial brick lining for sixty feet of its height. It is located right in the boiler room, midway between the two middle boilers, and has a flue opening on either side with a six-inch baffle wall in the middle to prevent interference of draft. For a brick stack the location is unusual and a peculiar feature is the passageways under the stack. These are at right angles to each other and are on a level with the boiler-room floor. A cable is drawn around the top of the chimney and is provided with four points, each having a twelve-inch platinum tip. Two ground connections are provided and the cables are secured to the chimney by means of bronze anchor fastenings.

Special care was taken in the design of the breeching, which was built up of brick and covered with reinforced concrete. As above indicated, there are three boilers on each side of the stack, so that there are three boilers discharging their gases into each breeching. On this account the area at the entrance to the stack was made equal to three times the area of the outlet from the boiler, twice as large between the second and third boilers and at the first boiler of the same size as the outlet. This arrangement gives each boiler an equal draft and prevents any choking of the gases in its passage to the stack.

Feed water for the boilers is taken from Wolf Lake, which is only a few feet from the plant. The water in this small lake is unusually muddy, and it was necessary to install a filtration plant for its purification. The National Filter Company, of Chicago, erected the plant.

For the supply of the entire works the water is drawn from the filtration plant through a twelve-inch pipe by one of the pumping engines previously mentioned. To this main supply a four-inch tap is made for boiler feed, and before reaching the boilers the water is passed through the Stilwell feed-water heaters, which are twelve feet nine inches high and sixty-six inches in diameter. The heaters raise the water to a temperature of 200 degrees Fahrenheit. But little cold water is required, however, as the condensation from traps and exhaust is usually sufficient.

To collect the ashes, each boiler is provided with an ash hopper, from which the ashes are taken in small dump cars. These cars are pulled mechanically outside of the building and the ashes are dumped on the premises and used for filling purposes.

As the coal used in the stokers contains considerable dust after passing through the crushing machine, there is a good deal of fine material which will drop through the chain grates, and in a great many cases is entirely wasted. In the plant under description, however, each hopper is provided with a plate to divert the fine coal dropping through in this manner. Provision is now being made to convey this fine coal to the elevator and eventually return it to the stokers.

Two steam headers have been provided: the main header, which is sixteen inches in diameter, and an auxiliary header, eight inches in diameter. With the piping arrangement it is possible to utilize either header and cut out, if necessary, either half of the main header for repairs. From one to the full number of boilers can be turned onto the headers as desired, and there is no danger of any pumping back and forth between the boilers from unequal pressures, as each leader is equipped with an automatic stop valve.

Live steam is used to some extent in the plant, especially for the fan engines, steam dryers and pumps, in connection with the drying rooms. Most of the steam, however, used for the various processes is exhaust from the engine units and the pumps. For this reason condensers are not installed. This supply of exhaust steam is collected in a large eighteen and twenty-inch pipe, and at infrequent intervals, when the steam is not all required in the plant, it is exhausted to atmosphere.

Of the entire boiler room, the feature of chief interest is undoubtedly the coal-handling apparatus. This is unusually complete for a plant employing only six boilers.

A receiving conveyer has been placed parallel with the track on which the coal arrives, being between the track and the wall of the boiler house. The conveyer is provided with a hinged shoveling apron placed at an angle of about sixty degrees between it and the side of the car. To this apron the coal is shoveled and flows down on the conveyer, and is carried forward and discharged to a standard boiler-house crusher, operated by a thirty-horse-power Allis-Chalmers motor, by which mine-run size is reduced to one-and-one-half-inch maximum cubes.

The hopper that receives the crushed coal is connected by a chute to a continuous bucket elevator, which raises the coal and transfers it to a flight conveyer extending through the boiler house over bunkers. It is then delivered by the conveyer through gates placed in the trough to such bunkers as it may be desired to fill.

When handling mine-run, the capacity of the installation is governed by the maximum capacity of the crusher, which is from forty to fifty tons per hour. When handling fine coal not requiring crushing, the capacity is controlled by the elevator, namely, from fifty to sixty tons per hour. The system is electrically driven throughout with controlling mechanism located inside the boiler house. It was installed by the Link Belt Company, of Chicago.

In an installation of this kind, with the coal hoppers above the boilers and feeding the coal through chutes to the stoker, difficulty is always experienced in opening or closing the gates controlling the supply of coal, as they are very apt to wedge or become stuck in some way. To prevent this and get a straight pull or push on the gate, a bell crank-and-screw arrangement was provided. The screw has only five threads to the inch, so that a few turns of the wheel will open or close the gate.

Another feature of interest is the poke rod. This is provided with a ball which will close the opening through which it passes and at the same time allow a thrust in any direction to start the coal if it happens to become lodged at the mouth of the hopper.

The power-house, corn-storage tanks and manufacturing buildings are of fire-proof construction, and the warehouses are of mill construction. All buildings are so arranged as to have excellent light and ventilation, and the floors of the fire-proof buildings are arranged to be flushed with water at the close of each day, so as to have them at all times in a state of cleanliness and perfect sanitary condition. A complete sprinkler system is installed, and with a 50,000-gallon water tower in connection with the two fire pumps a pressure of 200 pounds is maintained all over the grounds.

This plant, which was planned and constructed under the supervision of its superintendent, P. L. Saenger, assisted by G. C. Welch, S. H. Lanyon and J. J. Waechter, is designed to handle 30,000 bushels of corn daily, the machinery for one-half of which has already been installed. In completeness and economical operation it leaves practically nothing to be desired, and the large demand for corn-starch and syrups now existing throughout the country insures a good market both for its products and those of the company's predecessors in this particular field.

Michigan Telephone Returns.

In its application to the New York Stock Exchange for the listing of additional common stock the Michigan State Telephone Company gives the following statement of income for the four months ended April 30 last: Receipts, $1,084,182; total expenses, $807,936; net earnings, $276,246; interest, $134,433; balance for dividends, $141,813; dividends on preferred stock, $45,664; surplus, $96,149.

THE ADVANTAGES OF MEMBERSHIP IN THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

BY CHARLES B. BURLEIGH.

The question has frequently been asked, What advantage is to be derived from membership in the American Institute of Electrical Engineers?

There can be no question as to the duty of every American citizen to support and maintain the Supreme Court of the United States. Can there, therefore, be advanced any legitimate reason as to why it is not a duty that he owes, not only to himself but to each and every one of his associates in the business in which he is engaged, for every electrical engineer to do his utmost to support and maintain a court of last resort, by whom all disputed technical questions in electrical engineering shall be finally settled; to assist so far as in him lies, in removing all electrical work from the region of guesswork to that of certainty, thereby increasing the stimulus to the successful investment of capital in electrical enterprises; to effect a concentration of effort and increased mentality excited by generous rivalry?

With these objects in view the American Institute was formed with the avowed purpose of "promoting the arts and sciences connected with the production and utilization of electricity and the welfare of those employed in these industries; by means of meetings for social intercourse, the reading and discussion of professional papers, and the circulation, by means of publications among its members and associates, of information thus obtained."

Appreciating this situation, affiliation with the organization is not a question of what benefit will result to the individual but is a duty he owes to the art, to his associates and to himself, to do everything in his power to aid and assist in the support and maintenance of an institution without which we would all be whirling around in our own little circle, duplicating effort, narrowing the scope of the art and our own fields of usefulness.

The electrical engineer also owes a duty to the public in general, who place in his hands the solving of problems in connection with the details of which they are totally uninformed, and only by placing himself in a position to give them the best information procurable can he be assured of rendering to them full return for the confidence imposed. Again, it is generally conceded by the world at large that the most valuable opinion and judgment on any class of work is that rendered by the leaders in that profession; for which reason the electrical engineer's standing is in a great measure fixed by the recognition of his ability by his associates, and only by an acquaintance with them, thus offering them the opportunity to familiarize themselves with his capabilities, can he establish his standing, and as the best estimate of an engineer as a man and an engineer is the opinion of the members of his own profession, it is his duty to himself, as well as to those from whom he derives his livelihood, that he become known to and acquainted with his associates.

Association with the leading organization connected with the business, composed of men who are recognized by their associates as masters of their profession, offers the most available opportunity for this acquaintance and as rubbing against the smutted kettle will besmirch, so will close contact with the bright tend toward polish mentally as well as physically.

The benefits to be derived from this association depend largely upon the individual to the extent that if he joins the organization, prompted only by selfish motives, to receive and not to impart benefit, he will receive but little, while he who connects himself with the association, hoping by his work to promote its success, receives in return inestimable benefit from the fact that his work and his contributions tend to make him known to his associates and establish his standing not only among them but in the field at large.

Again, in connection with the different matters brought before the organization for its consideration, he either attends the meeting at which they are presented or reads of them in the transactions, and as reading any similar article presented through the usual channels, forms his own opinions on the subjects treated, but his connection with this association offers him the opportunity to familiarize himself with the opinions of his associates on the subject, and by discussing their opinions, either with them or with himself, arrives at a much broader understanding of the matter.

As the association aims to take up and discuss in its earlier stages of development any and all improvements in the art, the facilities offered enable the membership to keep just a little ahead of the non-members and the public, and prepares them to pass judgment on new devices as soon as their practical consideration becomes desirable.

The scope of the art is continually broadening to such an extent that the necessity for specialization is becoming more and more apparent. The closer the lines are drawn in this direction the more important becomes an organization which offers us the facilities for keeping in touch with the whole general situation, and the more good work can the specialist do for the organization and through it for the art.

Having been connected with the electrical business for some thirty years and with the Institute seventeen years, I feel that I may be pardoned for a suggestion to the older members and a word of advice to the younger members of the profession.

To the older members I would say:

You have seen our profession grow in the last thirty years from the electrician who could set up and connect the gravity cell for the operation of the key and sounder to the electrical engineer who can carry on his shoulders the water and steam power of the world and deliver its useful energy at any point where commercial conditions make its utilization desirable, outstripping by leaps and bounds all other engineering professions.

I may have contributed individually no more than you to this marvelous development, but the association of which I am a member is in a great measure responsible for it, for which reason you owe to it in a large measure the benefit you have and are receiving from it. You would be ashamed to be accused of not paying your just debts. Here is one long overdue, and the quicker you settle by adding your assistance to the good work in becoming a member the sooner you can look everybody in the face and say, "I am in part responsible for the results attained."

To the neophyte I would say:

In any line, individual effort is always praiseworthy, but team work presents the shortest route to success.

The sooner you connect yourself with the Institute the quicker you will begin to obtain the best returns from the energy you expend in promoting the interests of the profession you have entered, to the benefit of your employer and to yourself, and if you remain in the business you can look back with pride, in the years to come, to the fact that you have always, from the first moment of entering the profession, lent your best efforts to the best advantage to the advancement of the art.

You may feel that you have completed your education and are now about to reap the benefits. Allow me to disabuse your mind of this idea. Your education has just commenced. Your school and college have provided you with an excellent outfit of tools and you are now about to be taught how to use them to the best advantage.

The art is progressing and you will find that new adaptations require new tools not in your chest and membership in the Institute will tend to keep your tool chest up to date.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Spectrum of Radium Emanation.

Having secured a preparation containing about 250 milligrammes of radium, E. Rutherford and T. Royds seized the opportunity thus offered to study the spectrum of the emanation given off by this preparation. It was found that the minimum volume of the emanation per gramme of radium was not in accordance with that to be expected from calculation. This emanation was condensed by liquid air in an exhausted tube of about fifty cubic millimetres capacity, provided with thin platinum electrodes. Two photographs were taken immediately, one of which shows about thirty intense lines and the second more than one hundred lines. The color of the discharge in the tube was bluish. Visible observation was also made. When the emanation was condensed in a side tube by means of liquid air the character of the emanation of the lines vanished. The color of the discharge changed completely and became a pale rose. At the instant of volatilization the emanation lines flashed out again. The hydrogen lines were visible in the spectrum and became more brilliant when the emanation was condensed. These lines were not observed in previous experiments where an electrodeless discharge took place and they were probably due to hydrogen given off by the platinum electrodes. It was noticed that the amount of pure emanation in the tube gradually diminished with the increase of the time of the discharge. The spectrum, however, persisted until all of the emanation had been driven into the walls of the tube. The wave-lengths of the lines of the plate were accurately measured, the results agreed fairly well with the determination made by Ramsey and Collie in 1904. —*Abstracted from Nature (London), July* 9.

Apparatus for Checking the Adjustment of Automatic Oil-Break Switches.

It is very desirable that some means should be provided for enabling the adjustment of automatic oil-break switches to be checked quickly from time to time. These switches are operated automatically by means of trip-coils which are excited from a source of continuous current or alternating current. When direct-current tripping-coils are used it is an easy matter to test them to see if they are in order. In fact, it is common practice to arrange a push button for the contacts of the controlling relay, thus exciting the trip-coil and operating the switches. But when alternating-current trip-coils are used it is not so easy to test them. Such coils are fed very often directly from the secondary of a current transformer without an intermediary controlling relay. There is not sufficient current to operate the relay passing through the trip-coil until there is an overload. Under ordinary circumstances it is not possible, without making special arrangements, to get sufficient current through the trip-coil to cause it to operate. A means of doing this has been devised by C. C. Gerrard. For this purpose an adjustable choke-coil is used. It may be fed from a source of low-tension alternating current of, say, 200 volts. By means of an adjustable core a secondary current may be obtained within fairly wide limits. The apparatus is used as follows: about once a month the current transformer is short-circuited and disconnected from the trip-coil. The latter is then connected by means of a core through the choke-coil to a low-tension circuit. By varying the adjustment of the core it is easy to determine the current required to open the switches.—*Abstracted from Electrical Engineering (London), July* 3.

The Oscillatory Character of Lightning.

A brief review is given here of a paper read recently by Dr. Bernbach before the German Technical Association, in which the author discusses the character of lightning. He argued, on the whole, against the oscillatory character of lightning discharges. Theoretically a discharge should be oscillatory when the resistance term of the impedance is less than the reactance term. As the resistance of air is very great and the capacity is likewise great, while the self-induction is probably small, it is hardly probable that the second term of the impedance should become larger than the first; the value will, therefore, remain positive and oscillatory discharges should not be expected. Dr. Bernbach contended that photographs of lightning flashes do not show any such oscillations. Such photographs sometimes show a number of successive discharge pulses, following about the same path. The second flash path being longer than the first. The ramifications of a light discharge do not mark any change of polarity and when photographs show bright spots, it is probable that these portions of the discharge appear brighter because the direction of this part of the path is more or less toward the camera. The well-known Leyden jar experiments of Lodge illustrating the peculiar, apparently capricious, deviations of the spark from its natural path do not necessarily demonstrate any oscillations in the currents. The resistance effect of conductors must be taken into consideration not only with high-frequency currents, but with very intense direct-current discharges at a very rapid rate. Although the inductance may be small the rate of change of current may be large and there is trustworthy evidence of lightning currents of more than 20,000 amperes, the time limit being about one minute.—*Abstracted from Engineering (London), July* 10.

A New Development in Cross-section Paper.

A method of using cross-section paper is described here by Henry Hess, which enables the user to deduce easily the equations for any curves of the first or second degree. Two kinds of paper are used, that usually called cross-section, or more properly co-ordinate paper, in which the divisions are uniformly spaced and that in which the ruling follows a logarithmic scale. The first kind is suitable for curves of the first degree. The usual scales, running, say, from one to ten and starting at the lower left-hand corner, are marked off and in addition two other scales are added, in this case running from zero to one, in tenths and starting at the lower right-hand corner for the scale of ordinates and at the upper right-hand corner for the scale of abscissas. The usual scales are employed when plotting the curves. The additional scales are used for finding the constants and exponents of the variables. The method consists in plotting a secondary curve parallel to the primary curve, or making the same angle with the axes, and passing through the origin. The secondary line gives the value of y in the equation $a = yb \pm z$. While the value z is given by the distance of the intercept of the curve from the axis of ordinates, the slope of the curve determines the signs of the different terms. The method of employing the logarithmic paper is the same, except that this is used when the curve is not of the first degree. The general equation being $a = yb^n + z$. The advantage of the logarithmic paper is that the equations then may give straight lines and the intercept of these lines with the new scale at the top or right gives at once the exponent of the second term of the equation. When a constant term enters into the equation the curve plotted on logarithmic paper is no longer a straight line, but a secondary curve of the former, which will be a straight line, is easily plotted. The author shows how the equations most encountered in engineering work are easily deduced without it being necessary to apply the tedious algebraic process.—*Abstracted from the Proceedings of the Engineers' Club of Philadelphia, Philadelphia, April.*

Flywheels or Storage Batteries for Equalizing Fluctuating Loads.

Flywheel storage systems have recently been coming extensively into use for taking up fluctuations of loads, especially in connection with mining work. This arrangement is thought by G. C. Allingham to be best adapted to equalizing the power demand of an individual machine which goes through a definite cycle of operations —which is repeated so that very short periods of heavy and light loads recur alternately in regular succession. In such cases the actual amount of energy that is to be stored is small, although the power to be dealt with is large and this energy must be stored for but a short time. For such arrangements it is possible to work the flywheel equalizer at a comparatively low factor. On the other hand, where the loads are irregular in frequency and amount, and where they last for longer periods or occur in rapid succession and may also be separated at times by comparatively long periods of light load, the flywheel equalizer is not suitable on account of the small amount of energy it is capable of storing and its heavy no-load running losses. In such cases the load-factor of the equalizing plant is of necessity low and the constant running loss being high the work efficiency must consequently be low. Haulage gear is an instance of a machine whose load curve is usually extremely irregular and for which flywheel storage would therefore not be well adapted; a coal cutter is another instance. The alternative to flywheel storage is the use of a storage battery in combination with an automatic reversible booster. This is more expensive than the flywheel, but it has the advantage of being able to store sufficient energy to deal with any combinations of peaks and depressions in the load curve that can possibly occur. Its no-load running loss is insignificant and the working efficiency is almost independent of the load factor. It has the additional advantage of acting as a reserve in case of a breakdown or of an unusually heavy load on the generating plant, making it possible to shut down the generating plant entirely at times of light load. There are now systems adapted to equalize the loads on alternating-current circuits, so that the battery can, without difficulty, be applied in just such cases as lead to development of the flywheel storage system.—*Abstracted from the Electrician (London), July 10.*

The Equipment of Farms and Country Houses with Electricity.

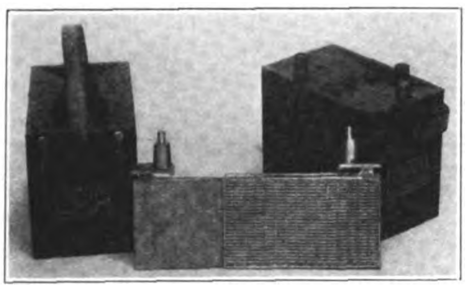
A machine which may be substituted for manual labor should be of great value to the land owner to-day because of the difficulty of obtaining satisfactory farm-hands. In this article Putnam A. Bates contends that this want is largely supplied by the electric motor and that the latter may be expected to relieve the farmer or dairy man of much of the hard work connected with his business. One difficulty which retards the rapid introduction of the motor for this purpose is the high cost of energy in rural districts so that some means of reducing the expense of running motors seems necessary. In the last few years the small internal-combustion engine and the storage battery for stationary service have been so much improved and simplified as to cause them to compare favorably with the better-known types of power-producing apparatus in reliability of operation and first cost. The simplicity of this engine and of the storage battery, together with the economy of fuel consumption of the engine and the efficiency of the battery as a device for storing energy and delivering it when needed and in the quantity required, results in a low operating cost. Still another promising source of power for such small plants is the small water powers scattered throughout the country, many of which have been already developed but abandoned for mill purposes because it was found to be impossible to compete with larger mills. It is evident, therefore, that those not reached by reliable and low-priced electric service may still avail themselves of the electric current and obtain the many conveniences which it contributes, at a cost which should seldom exceed that of an equivalent service from a public-service electric plant. This, of course, will depend upon the design of such small isolated plants. Suitability to the requirements is more important in such plants than in larger ones where the load is more elastic and may be controlled to a considerable extent. Many small power plants have been abandoned as unsatisfactory and extravagant after a short period of operation or are being run at excessive cost with little satisfaction, for no other reason than that the apparatus installed is not well suited to the load. For this reason it is inadvisable to decide the question in an offhand way and leave the installation of the equipment to the contractor since, no matter how honest the latter may be, he is seldom capable of giving the little plant the engineering consideration which it should have. Frequently it is said that the cost of lighting by electricity, in spite of its cleanliness and convenience, is too great when compared with gas, but if the incidental expenses resulting from the use of gas are included in the estimates, it would not infrequently be found that the electric system is, on the whole, considerably cheaper. On the farm there is the greatest opportunity for a successful application of electricity, because in addition to the lighting which, if undertaken alone might not be successful, there are many opportunities for using the small electric motor. The author has himself been engaged in work of this kind for several years past and is convinced that electric power may often be applied profitably to such work. To illustrate his point he describes several installations, some of them on farms and in dairies and one of them at a large country home. Each case shows a surprising number of uses of the motor. The best arrangement is a gas or oil engine driving a generator charging a storage battery. The latter should be large enough to supply the lighting at night and light loads during the day. Such an equipment is not expensive and requires but little attention and that not of an experienced kind.—*Abstracted from the Journal of the Franklin Institute, Philadelphia, July.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Universal Electric Storage Battery.

The Universal Electric Storage Battery Company, 65 North Peoria street, Chicago, Ill., has developed an ignition battery in which especial attention has been paid to overcoming the mechanical defects which exist in so many types. This battery is sealed, so that the corrosive acid can not spill nor slop over even if the battery is violently shaken, the sealing compound being an especially



"UNIVERSAL" ELECTRIC STORAGE BATTERY.

strong, smooth and adherent mixture of the company's own discovery. The hardwood box protects the rubber jar containing the element from breakage from sudden shocks. The terminal posts are strong and entirely non-corrodible, being made of alloy and hard rubber, both of which are unaffected by acid.

The electrodes are of the most modern type, and very carefully constructed.

The standard six-volt, sixty-ampere-hour size is suited not only for ignition, but for all sorts of medical and surgical use, for running phonographs, exploding blasts, and lighting miniature lamps.

The New Helios Ignition Battery.

The Helios Manufacturing Company, Bridesburg, Philadelphia, Pa., has placed on the market a new ignition battery which is being received with a great deal of satisfaction by contractors in general. Quite a business is being built up furnishing these ignition batteries for automobile service and selling them in conjunction with small lighting units and for the operation of electrical toys, electrical pianos and other light work. The Helios battery consists of very few parts, and the company is able to produce the battery at a low cost.

The battery is equipped with a new type of rubber case, so constructed that it is strong enough to be used without any auxiliary support. It is supplied with soft-rubber rests and a guard band, relieving the battery from sudden jars in rough handling. It is furnished with terminals of an improved type that can

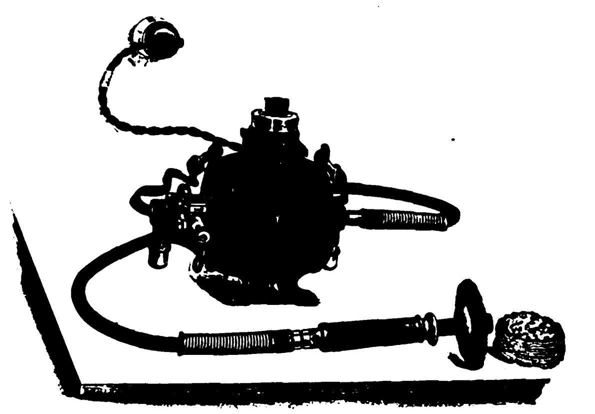
APPLE SIX-VOLT, SIXTY-AMPERE STORAGE BATTERY.

not become loose nor affected by the acid fumes. It is built in the following capacities: Four volts, thirty ampere-hours, twelve pounds; six volts, thirty ampere-hours, seventeen pounds; four volts, sixty ampere-hours, seventeen and one-half pounds; six volts, sixty ampere-hours, twenty-six pounds; four volts, eighty ampere-hours, twenty-three pounds; six volts, eighty ampere-hours, thirty-three pounds.

The Victor Portable Polishing Outfit and Air-Compressor.

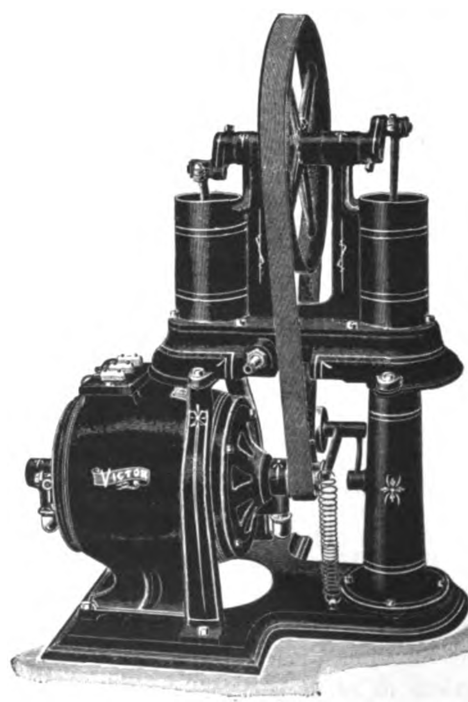
The Victor Electric Company, 55-61 Market street, Chicago, Ill., is the manufacturer of two electrical devices which meet many of the requirements of the contractor for shop and factory use and for executing orders in connection with the wiring and fitting up of residence installations. The Victor portable polishing outfit is neat and powerful, is used principally for cleaning and polishing, and is portable enough to be carried anywhere. It can even be swung from the back of the operator, carried on a carrying strap and belt. The flexible motor shaft enables the operator to reach everything within a number of feet of the motor, and a ten-foot cord attached to the nearest electric socket gives a wide radius of operation. With this outfit metal fixtures, signs, railing and parts of machinery can be easily cleaned and polished in a small fraction of the time necessary to do it properly by hand.

The motor develops one-eighth horsepower, and the entire outfit weighs less than twenty pounds. The buffer and brushes can be easily and quickly changed.



THE VICTOR PORTABLE POLISHING OUTFIT.

The air-compressor was designed to meet the demand for an outfit capable of



THE VICTOR AIR-COMPRESSOR.

supplying a moderately large volume of compressed air at a pressure up to seventy-five pounds. It is supplied with two pistons having two-inch bore by two-and-one-half-inch stroke, and can be safely operated at a speed of 275 revolutions per minute. The motor furnished with the direct-current outfit is capable of developing one-half horse-power, and the winding is calculated especially for this work.

The company manufactures several other types of air-compressors, particularly for dentists and physicians. The company also manufactures the compressor just described mounted on a truck with a pressure regulator and reservoir.

Some Dale Designs for Tungsten Lamps.

The Dale Company, Ninth avenue and Hudson street, New York city, has been at work for some time developing a line of fixtures adaptable to the use of the new high-efficiency lamps, and has produced several specialties adapted to take tungsten lamps. Particular attention is called to the new style shade-holder and adapter illustrated herewith. No adjustment of any kind is necessary with this two-and-one-quarter-inch holder, which goes on the socket easily and firmly and holds the shade rigidly.

New Style Dale Holder.

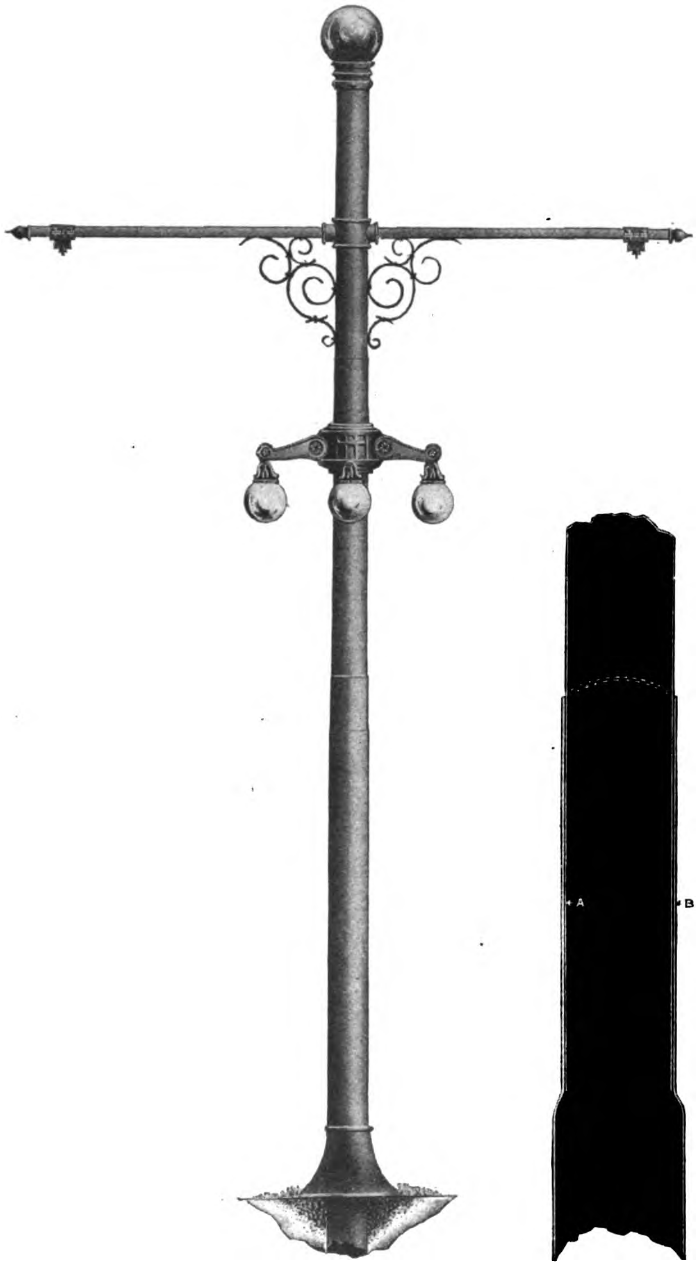
New Dale Tungsten Adapter.

The adapter for tungsten lamps is a simple device which can be used in clusters or fixtures where lamps are at an angle, making it unnecessary to reconstruct or rewire the fixture.

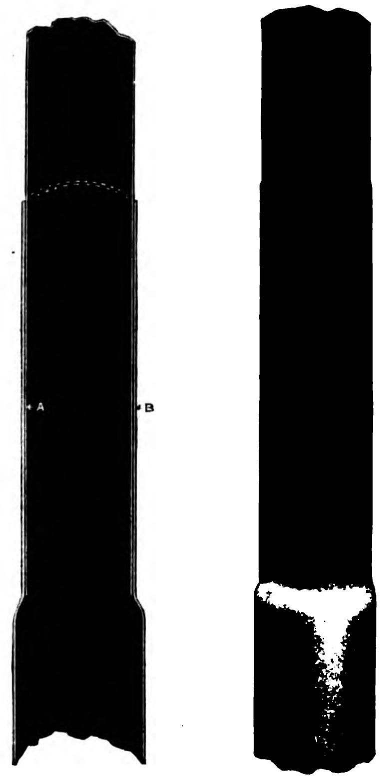
These devices have met with instant success and are being used by central stations, electrical contractors, jobbers and supply men all over the country. But devices are labor and money-savers and increase materially the opportunities for the use of electricity.

Tubular Steel and Iron Poles.

The Pittsburgh Pole and Forge Company, Pittsburg, Pa., is the manufacturer of steel poles and forgings of every description. The company is introducing a line of tubular iron poles, trolley poles, rail benders and car forgings. The accompanying illustrations show the style of pole made by this company, attention being particularly directed to the form of joint used. The tubular steel or iron pole for light and power plants has many advantages. The obstacle preventing the use of tubular iron poles for high-tension transmission work has been overcome by the Pittsburgh Pole and Forge Company by its patent hot process of making a solid swaged joint of the same diameter and thickness for the entire length of joint. It is impossible to telescope the pole either by overload or drop test. Under hydraulic pressure the pole will bend before the joint will give way. It is also stated that this joint is proof against corrosion by water.



Pittsburgh Standard Combination Span and Light Pole.



Pittsburgh Solid-Joint Tubular Pole.

Magnalium.

Magnalium is an aluminum alloy which promises to fulfil many of the expectations which have been based in the past on the utilization of aluminum. Magnalium can be cast in a liquid condition, and the castings machined with about the same facility as brass. The machined surfaces are mirror like and of a silvery color. Screw threads can be easily and perfectly cut, and bored holes are always sharp and clean. The metal does not clog even a very fine file.

When magnalium is cast in dry sand it usually has a tensile strength of 18,000 to 21,000 pounds per square inch, and shows a reduction area of three and one-quarter per cent. Cast in an iron chill, it has a tensile strength of 22,000 to 25,000 pounds per square inch, with a reduction of area of five per cent to eight per cent. The tensile strength of one quality of magnalium containing a somewhat smaller percentage of aluminum equals about 34,000 pounds per square inch. This can be increased to about 42,500 pounds per square inch by proper treatment.

Wire drawn from one quality of this alloy has a tensile strength of 41,000 pounds per square inch, with a reduction area of ten per cent. It will stand a tensile strain of 53,000 pounds if the raw material has been forged before drawing.

Magnalium shows almost no magnetic influences, but its electrical conductivity is about fifty-six per cent of that of pure copper.

Morris R. Machol, 32 Park Place, New York city, is the American agent for the magnalium process.

Electrical Equipment of the Southern Lumber Company's Plant at Bogalusa, La.

One of the most important electrical installations of recent times is that recently completed by the Great Southern Lumber Company, at Bogalusa, La. The importance arises not only from the fact that this is the first installation of this kind in that section of the country, but because it is the largest electrically equipped wood-working plant in the world.

The enormous capacity of this plant has made it necessary to cover a large area, consequently considerable of the wood-working machinery is located at such a distance from the main sawmill that the transmission of power would be almost impracticable through any other means than by the application of electric motors.

A practical mill man will readily understand that there are a large number of complications required where rope transmission is used and that such a system only multiplies the use of belts, pulleys, hangers, etc., as well as adds to the cost of help necessary to keep such apparatus in working order.

The electric drive, when properly installed, does away with long lines of shafting and multitudes of hangers, journal boxes, etc., which have to be continually looked after and kept in repair. It further does away with a great number of expensive belts, which frequently break and have to be renewed or retightened owing to various conditions which must be anticipated.

It is not possible to eliminate all belting in a wood-working plant where electric motors are used as, for example, the small machines in the filing room which may be grouped so that several operate from one motor, or the lumber sorters, blowers and stackers may require short lengths of belting, but even in this case long lines of shafting and gearing may be eliminated. The excellent arrangement and consequent economy of operation of this plant, secured by direct drive, is in a great part due to the efforts of G. U. Borde, of New Orleans, who acted as consulting engineer for this company.

The entire 1,500 horse-power for use about the mill is generated at a central point by General Electric generators and is distributed through cables to motors located at the machines to be driven. The three generators, direct-driven by slow-speed engines and delivering current to the line at 2,300 volts are excited by current from two direct-current marine-engine sets shown in the foreground of Fig. 2. The entire current is carried to the mill through cables in underground steel conduits. The heavy black line running to the left from the power-house in Fig. 1 shows the course of the underground conduit supplying the two planing mills, sorter and stacker and ending with the forty-two motors in the main planing mill.

The wood-working machinery, furnished by the Berlin Machine Company, as well as the auxiliary apparatus and sizes of motors, is listed in the following table:

PLANING MILL NO. 1.

13 16-inch No. 238 trim saws, each direct-coupled to five-horse-power, 1,200-revolutions-per-minute motor.
17 No. 94 planers and matchers, each direct-coupled to thirty-five-horse-power, 900-revolutions-per-minute motor.
2 No. 266 three-saw gang edgers, each belted to thirty-five-horse-power, 900-revolutions-per-minute motor.
1 64-inch No. 285 band rip saw, direct-coupled to fifty-five-horse-power, 514-revolutions-per-minute motor.
1 44-inch No. 283 band rip saw, direct-coupled to twenty-five-horse-power, 600-revolutions-per-minute motor.
1 44-inch No. 281 band rip saw, direct-coupled to twenty-five-horse-power 600-revolutions-per-minute motor.
1 30-inch No. 177 double surfacer, direct-coupled to thirty-five-horse-power, 900-revolutions-per-minute motor.
3 double 70-inch Sturtevant blowers, each direct-belted to 150-horse-power, 600-revolutions-per-minute motor.
All machinery in the filing room is connected with line shafting, belted to a ten-horse-power, 1,200-revolutions-per-minute motor.

PLANING MILL NO. 2.

8 No. 94 planers and matchers, each direct-coupled to thirty-five-horse-power, 900-revolutions-per-minute motor.
1 44-inch No. 281 band rip saw, direct-coupled to twenty-five-horse-power, 600-revolutions-per-minute motor.
4 16-inch No. 238 trim saws, each coupled to five-horse-power, 1,200-revolutions-per-minute motor.
1 double 70-inch Sturtevant blower, direct-coupled to 150-horse-power, 600-revolutions-per-minute motor.

PLANING MILL ON TIMBER DOCK.

1 30-inch by 20-inch No. 1 timber sizer, direct-coupled to eighty-five-horse-power, 900 revolutions-per-minute motor.

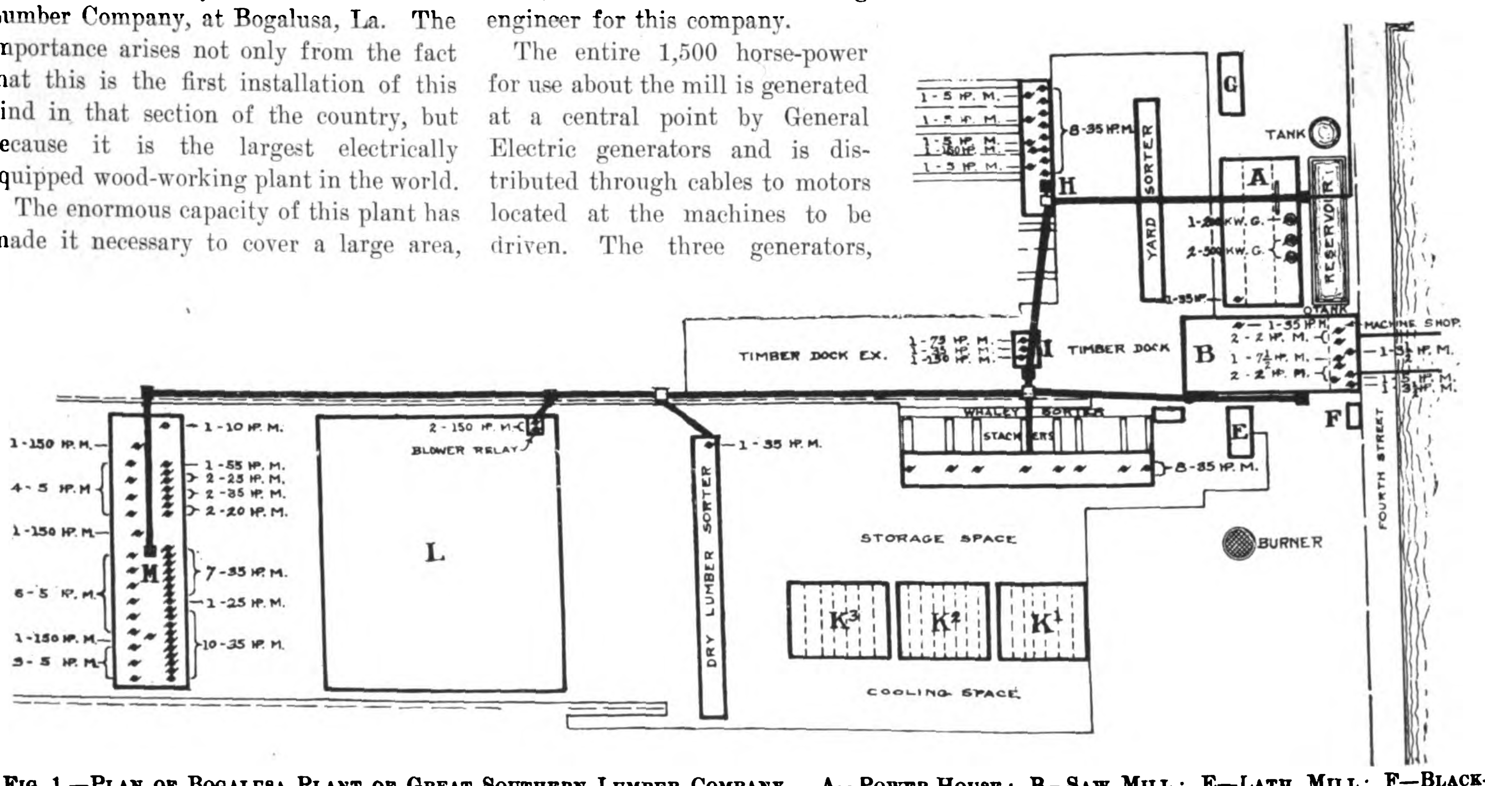


FIG. 1.—PLAN OF BOGALUSA PLANT OF GREAT SOUTHERN LUMBER COMPANY. A—POWER-HOUSE; B—SAW MILL; E—LATH MILL; F—BLACKSMITH SHOP; G—TURPENTINE PLANT; H—PLANING MILL; K—KILN BATTERIES; L—ROUGH LUMBER SHED; M—MAIN PLANING MILL.

1 No. 94 planer and matcher, direct-coupled to thirty-five-horse-power, 900-revolutions-per-minute motor.
1 double 60-inch Sturtevant blower, direct-coupled to 150-horse-power, 600-revolutions-per-minute motor.
1 seven-and-one-half-horse-power motor connected to planer.
1 two-horse-power motor connected to pipe machine.
1 two-horse-power motor connected to pipe machine.

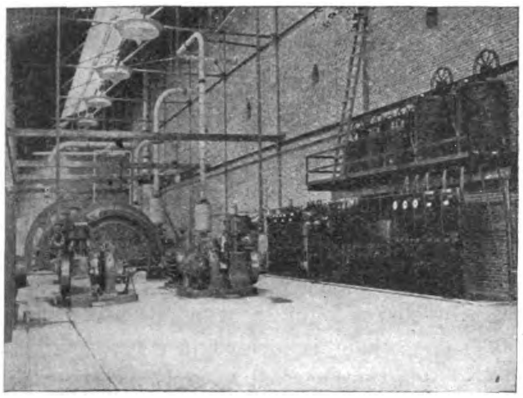


Fig. 2.—Power-House of Great Southern Lumber Company.

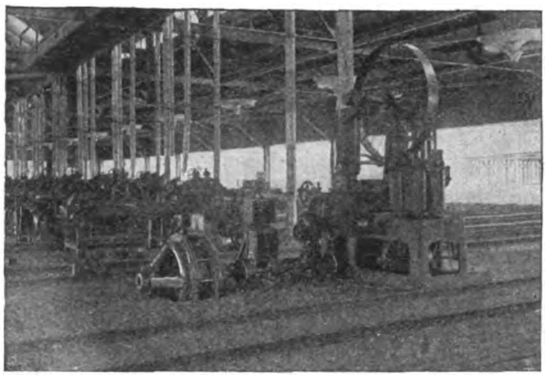


Fig. 3.—Berlin Band Resaw, Direct-Connected to General Electric Fifty-five-Horse-Power Induction Motor.

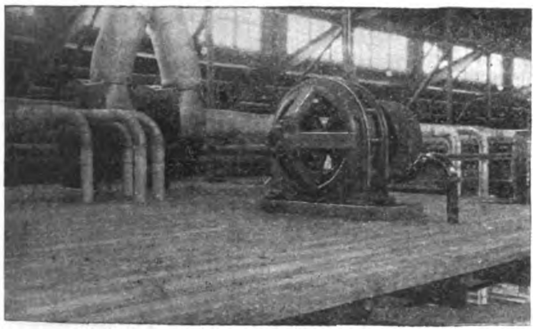


Fig. 4.—Sturtevant Blower, Belt-Connected to General Electric 150-Horse-Power Induction Motor.

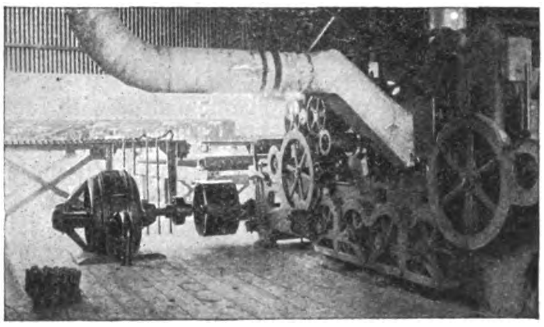


Fig. 5.—Timber Sizer, Direct-Connected to General Electric Eighty-five-Horse-Power Induction Motor.

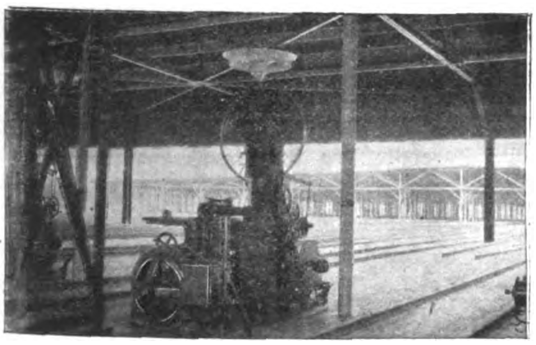


Fig. 6.—Berlin Band Resaw Showing Induction Motor and Motor Starter.

DRY LUMBER SORTER.

Dry lumber sorter, driven by one thirty-five-horse-power, 900-revolutions-per-minute belted motor.

LUMBER STACKERS.

8 lumber stackers, driven by eight twenty-five-horse-power, 600-revolutions-per-minute belted motors.

FUEL CONVEYERS.

2 fuel conveyers, driven by two thirty-five-horse-power, 900-revolutions-per-minute belted motors.

CENTRIFUGAL PUMPS.

2 14-inch centrifugal pumps for pumping into log ponds, each direct-coupled to eighty-five-horse-power, 720-revolutions-per-minute motor.

MACHINE SHOP.

1 two-horse-power motor connected to upright drill.
1 two-horse-power motor connected to bolt cutter.
1 three-and-one-half-horse-power motor connected to shaper.
1 five-horse-power motor connected to radial drill.
1 three-and-one-half-horse-power motor connected to machine lathe.

RELAY BLOWER STATIONS.

1 double 70-inch Sturtevant blower, belted to 150-horse-power, 600-revolutions-per-minute motor.

Transformers inside the mills reduce the pressure to 440 volts, at which pressure the motors driving the various mill machines are operated. All of the machines in the three mills of this plant are driven by the General Electric Company's form M induction motors which, on account of their extreme simplicity and sturdiness, are especially suited to this class of work. Moreover the electric motor of such sizes as are used in this work is essentially a high-speed, high-efficiency machine, making it not only possible but highly desirable to connect this direct to the shaft of the tool to be driven. This has been done in all except a few instances, as the higher efficiency obtained with the absence of long belts and lines of overhead shafting more than justifies the extra first cost for individual motors. Saws, shapers, joiners, are all connected direct to the driving motor. The good lighting and entire absence of belts are well shown in Fig. 3, which illustrates the direct motor drive to one of the Berlin band rip saws.

The dust, which is generally such an obstacle to the satisfactory operation of planing mills, is removed by electricity. Seven double blowers are driven by 150-horse-power motors drawing the dust up through a system of pipes. These blowers are distributed through the mill as follows:

One in each of the small planing mills H and I shown in the diagram, two in the rough lumber shed and three in the main planing mill. About eight ounces pressure is maintained by these, which not only carries away dust and fine shavings but also knots and large chips. One of these large blowers is shown in Fig. 4 and the arrangement of the pipes is well shown in Fig. 3.

Fig. 5, showing an eighty-five-horse-power motor connected to a timber sizer, gives a very good idea of the simplicity and compactness of this form of drive. This sizer is in the planing mill on the timber dock as shown in the diagram.

Each of the motors is supplied with a starting device and protecting fuses at the motor so that each machine is a plant in itself and practically independent of the other machines. Fig. 6 shows one of these starting compensators connected to a motor driving a band edger. The fuses at each machine protect that motor and its cable from internal injury, and as the cables are encased in iron conduits fire danger is eliminated.

The entire installation is one that exemplifies the best, the most economical methods of handling lumber, and the cleanliness and flexibility secured by the improved methods used are making the dusty sawmills of the past more and more uncommon.

The Electric Club of Chicago.

The Electric Club, of Chicago, Ill., is to be addressed at its August meeting by William D. Day, contract agent of the Sanitary District of Chicago, on the subject of disposing of the current generated at the hydroelectric development at Lockport.

Westinghouse Nernst Lamps.

Some interesting developments have been taking place in the laboratory of the Nernst Lamp Company, lately, and as a result, it is now only a question of the time required to perfect manufacturing detail, until the company will show some entirely new units.

The Nernst Lamp Company, it will be remembered, was the pioneer in bringing out a high-efficiency incandescent unit, when the original lamp was put on the market, and for some time thereafter it stood alone in the high-efficiency field. Then came in fast succession, the metallized filament, the tantalum and the tungsten. Undoubtedly, besides bringing about a reduction in lighting bills that opened up new fields for many central stations, the Nernst had its effect in stimulating the developments referred to above.

Its own further development in point of efficiency is a matter that has been looked forward to with considerable interest, for the Nernst system has many advocates.

One of the new units which is now ready for the market, it is stated, shows a mean hemispherical efficiency of 1.12 as against 1.65 shown by the corresponding old unit. This represents an improvement of thirty-two per cent and will make competition very close. When the circumstances are taken into consideration, this improvement not only does not seem extraordinary, but it indicates that a still higher efficiency may yet be reached. Just as the efficiency of a filament lamp depends upon the material of which the filament is made, so does the efficiency of the Nernst depend upon the glower material. This material is still in the development stage and there are so many different elements that may be used, offering so many different combinations that the present combination representing a thirty-two per cent increase, may be looked upon as only a step in its final development.

There are other features besides efficiency, however, that must be taken into consideration in selecting a lighting system. Maintenance is scarcely of less importance. In fact, maintenance must be added to efficiency to get the total operating cost per kilowatt-hour before a just comparison of systems can be made. The new single-glower units, of which there are four, *i. e.*, sixty-six, eighty-eight, 110 and 132-watts, respectively, are to be provided with screw base renewals; that is, the renewal part of the lamp will be screwed into place just as in ordinary incandescent-lamp practice. This represents a marked improvement in Nernst the debatable questions in connection with the Nernst system. Because it is an intermediate system between the ordinary incandescent and the arc, human nature naturally expects it to have all the advantages of the former and none of the disadvantages of the latter. As a matter of fact, its maintenance has shown up satisfactorily in large installations justifying an attendant and in small installations having a maintenance contract with the lamp company or a local lighting company. It is chiefly from isolated installations where some one unfamiliar with electricity undertakes to look after the lamps, that criticism has come. Such as these will find in the new renewals something that they can handle without doubt of obtaining satisfactory results.

A point to the advantage of the Nernst system is its wide range of units giving uniform illumination throughout an installation, including windows and the exterior, no matter how diverse the requirements. The new units with four different sizes in the single-glower, will further increase this range. Taste in illumination varies all the way from an entirely concealed system to myriads of small units peeping out from every point that will hold a lamp. The Nernst system is applicable to practically every effect except the latter extreme, which more properly comes under the head of decoration than of illumination.

Downward distribution remains a prominent characteristic of the system, rendering the use of reflectors entirely unnecessary.

When the Nernst system was first introduced it was badly handicapped by being suitable for alternating-current circuits only. A couple of years ago direct-current lamps were brought out and proved successful. The new units will operate equally well on either alternating or direct current, 110 or 220 volts.

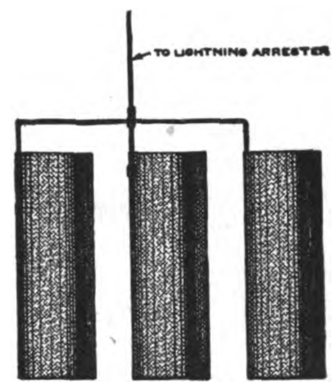
For Squealing Commutators.

The Joseph Dixon Crucible Company, Jersey City, N. J., reports that its graphite brushes, which are made in only one quality, are giving most excellent satisfaction. They frankly acknowledge in their literature that a one-quality brush is not adapted to all conditions, but do say where their brushes are adapted they give unexcelled service. Their use results in the commutator's taking on in a short time a highly polished surface, smooth and well rounded. They state that since the installation of their own electric plant some eight years ago, they have not had occasion to turn down their commutators, and reasonably attribute the condition of the commutator to the use of their graphite brushes.

The Federal Cartridge Ground Plate.

The Federal cartridge ground plate commends itself to all practical men who have wrestled with the problem of making satisfactory ground connections in either telephone, street railway or electric lighting work. By its use a practically perfect ground can be secured at a minimum of expense and trouble.

This device is gotten up in standard sizes with a specific area of plate and size of ground wire. The copper surface is completely covered with the proper grade of charcoal for securing the best ground. The whole is incased in a netting which holds the charcoal securely in place while handling, but breaks down when installed, allowing the earth to mix with the finely



TYPICAL MULTIPLE INSTALLATION CARTRIDGE GROUND PLATES. PATENTED.

divided charcoal. The netting is meant to disintegrate rapidly as soon as the cartridge has been buried in moist earth. The heavy copper ground wire is firmly secured to the copper plate through its entire length so that there is no chance for a break or loose connection.

Each complete plate is put up in a cylindrical cardboard case which is for transportation only and is, of course, removed when the plate is put in the ground. The hole can be made easily with a standard post-hole digger so that the labor of installing is light.

The manufacturers suggest that a piece of fibre conduit be used to protect the wire from the ground plate to a point well above the surface of the ground. A rope drain fitted on the post or wall will lead considerable rainwater into this fibre conduit and so direct to the ground plate, insuring moist earth around the plate.

This ground plate is manufactured by the Federal Electric Company, Lake and Desplaines streets, Chicago, Ill.

lamp practice and will not only reduce the cost of maintenance but will permit it to be done by any one.

Maintenance has always been one of

A NEW FORM OF DIRECT-CURRENT AMMETER AND VOLTMETER.

BY P. MAC GAHAN.

There exists a considerable demand for a line of small-size direct-current switchboard ammeters and voltmeters of the highest grade and accuracy, so constructed as to be low in price.

Recent improvements in factory methods and in design features by the Westinghouse Electric and Manufacturing Company have rendered possible the production of a small-sized switchboard instrument of the permanent-magnet type, at a price as low as that of the best moving iron instruments previously available. The result has been the instruments herein described, which possess unique features and advantages not previously obtained with any type of construction. These instruments are made as ammeters and voltmeters and are mounted in neat black Electrose cases, five inches in diameter, rear-connected, with circular beveled-glass front-plates.

Fig. 1.—Westinghouse Direct-Current Voltmeter.

The use of a case made from insulating material instead of metal gives a degree of insulation not usually found in small instruments. Owing to the peculiar self-shielding form of the permanent magnets, an iron case is not necessary for shielding against the effects of external fields.

The meters are supported by means of brass studs projecting from the rear of the case, serving at the same time as terminals.

The voltmeters are made self-contained, including resistance, in any capacity as high as 300 volts, and the ammeters are operated from external shunts, the shunts of the capacities up to and including seventy-five amperes being mounted directly on the meter studs.

The scale divisions are uniform and the total length is almost the same as that found in the usual seven-inch-diameter meters.

From a technical point of view the most interesting feature of these instruments is the "single-air-gap" type of construction, which differs considerably from the original D'Arsonval bipolar magnet with two cylindrical air-gaps in series.

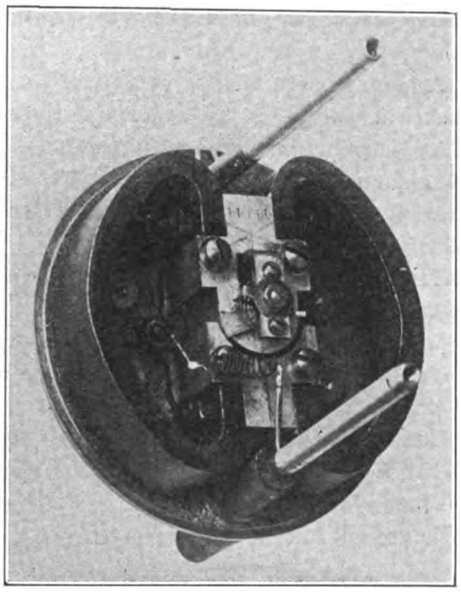


Fig. 2.—Internal View of Meter Mechanism.

The principal advantages of the single-air-gap construction in permanent magnet meters are as follows:

1. The possibility of removing the moving element from the magnetic structure without interfering with the magnets or removing their pole-pieces.

2. The coil balancing the weight of the pointer.

3. Single air-gap means that larger air-gap clearances may be used without making the total magnetic reluctance of the air-gap too high.

The removability of the permanent magnets is really of the greatest importance to the user who desires to do his own repair work on the premises.

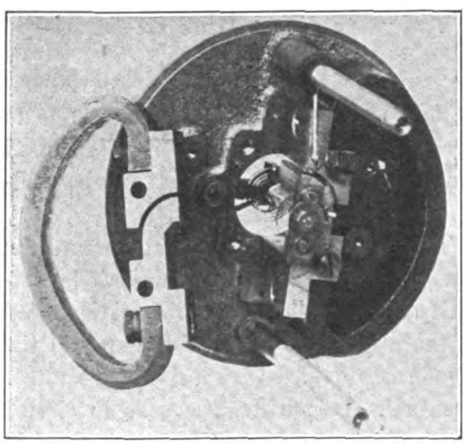


Fig. 3.—Method of Removing Permanent Magnet.

Fig. 2 shows an internal view of the meter mechanism with the case removed.

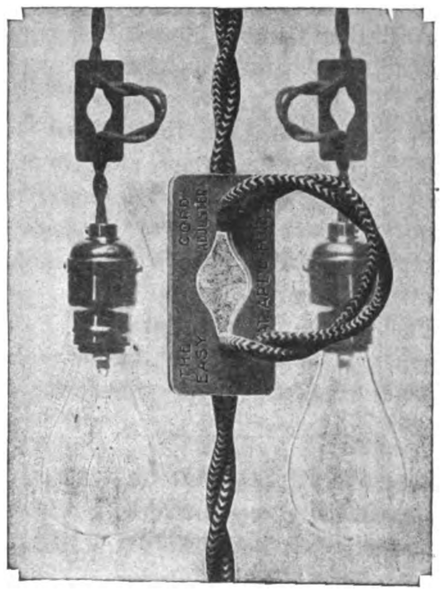
Fig. 3 shows the process of removing the permanent magnets when repairs become necessary.

The principal applications for this class of instrument will be for small panels, such as for rectifier outfits, battery charging, small isolated plants, small marine plants, or even on regular large switchboard work where a small-sized instrument is desirable.

The low price is due to the economic disposition of the material used, the light weight, and the fact that there are no hand operations used in manufacture, aside from the assembly. The parts are all machine-made in large quantities, with a highly organized and accurate tool equipment, the assembler merely attaching these parts together without further fitting.

The Easy Cord Adjuster.

One of those simple little things that anybody ought to have thought of is the "Easy" cord adjuster, the use, simplicity



The "Easy" Cord Adjuster.

and advantages of which are clearly shown in the accompanying illustration. This little specialty is made of the finest grade of red fibre. It will be seen that it contains a slot through the centre, running lengthwise. This slot is made considerably wider at the centre, which permits a double cord to be easily inserted and pulled through any desired length. The tapering ends of the slot hold the cord firmly and keep it from slipping. The dimensions of the "Easy" cord adjuster are two inches by one inch by one-sixteenth inch and one hundred weigh ten ounces. W. N. Matthews & Brother, of St. Louis, Mo., the manufacturers, state that they have sold thousands to contractors and jobbers all over the United States.

New Orders.

The General Electric Company announces that the following orders for new apparatus have been recently received:

Isthmian Canal Commission—Six vertical Curtis turbine units, 1,500 kilowatts, twenty-five cycles, 2,200 volts, each complete with individual base condenser, air and circulating pumps and necessary piping; electrical equipment for one twenty-ton traveling crane; four thirty-five-kilowatt, 125-volt, direct-current turbine-driven exciters; four 500-kilowatt, 600-volt, rotary converters, each complete with three air-blast type transformers; six 100-kilowatt, 2,200-6,600-volt, single-phase, oil-cooled transformers; six 110-kilowatt, air-blast type transformers; two switchboard equipments.

Mitsui & Company, Japan — Fifty GE-52 railway-motor equipments, also rotary converters, transformers, etc.; twenty GE-52 double-motor equipments, with headlights and spare parts; three 1,000-kilowatt alternating-current generators.

Australian General Electric Company—Seventy four-motor type M control equipments for GE-81 railway motors.

Santos Dock Company, Brazil—Six 3,000-kilowatt transformers and five fifty-light constant-current transformers; one motor-generator set; 628 arc lamps; one switchboard; miscellaneous small motors and transformers.

Pueblo Tramway Light and Power Company, Mexico — Ten water-cooled, 1,500-kilowatt, sixty-cycle transformers.

More Electrical Machinery for Guadalajara — Large Extension to Juanacatlan Plant.

The Compania de Transvias Luz y Fuerza de Guadalajara, South America, which company is the result of the combination of the two former electrical companies of that city, and operates not only the entire lighting system, but also the railway system of Guadalajara, have en route to Mexico a large order for additional electrical machinery which was bought from Messrs. G. & O. Braniff & Company, of Mexico City.

In order to meet the increasing demand for electrical power in Guadalajara, this company, finding that their power-generating stations at La Junta and Juanacatlan were insufficient, found it necessary to purchase a 750-kilovolt-ampere, modern, Westinghouse, three-phase, belted-type generator, which will be installed at Juanacatlan. This new generator is but one of the four which will be installed as needed.

The latter station was one of the first electric-power plants in the country; the original installation consisting of single-phase machines, which were added to from time to time by other machines of the same type as growth necessitated.

A more modern method of transmitting electrical energy is by means of three-phase current, on account of the saving of amount of copper required in the transmission line, and is now almost universally in use.

The Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., is supplying the new electrical machinery. This extension was necessitated not only by the operating of electrical railways in Guadalajara, which now have been in service for the last several months, but also by the additional power required from their present and new subscribers.

The "Patterson" Wireless Dry-Battery Holder.

Stanley & Patterson, 23 Murray street, New York city, have placed on the market a wireless dry-battery holder which presents many advantages for the user of dry batteries for any purpose. This holder eliminates binding-posts and wire connectors and is made to take from one to six cells. If more than six cells are used any combination of holders may be utilized to fit the requirements.

THE "PATTERSON" WIRELESS BATTERY HOLDER.

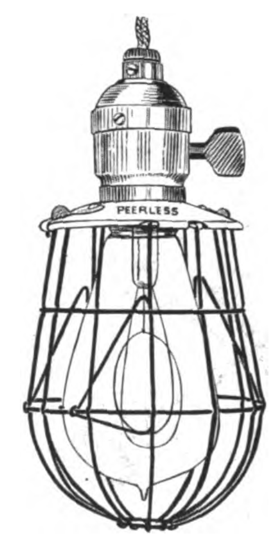
The cells used with this holder are the same as standard two and one-half by six-inch cells, except that a thread is rolled at the upper end of the zinc cup and the carbon is provided with a flat-butt contact terminal. In putting the cells in circuit all that is necessary is to screw the cell into one of the sockets the same as an incandescent lamp.

A feature of one form of the wireless battery holder is the automatic bridge, which comes into action, closing the circuit between the adjacent batteries, if it should be necessary to remove a dead or defective cell from circuit, and there was not another cell available at the moment. When a new cell is procured it is simply screwed into place, and the power of the new cell is added to those already connected up.

A New Lamp Guard.

The accompanying illustration shows one application of the "Peerless" lamp guard, manufactured by the Greenwood Manufacturing and Supply Company, 141 Milk street, Boston, Mass.

This lamp guard has a canopy-shaped, divided metal top, which is hinged to both sides of the cage and has a swivel catch, which fastens it rigidly to the sockets. The guard is made with tops to fit snugly to all styles of sockets, whether metal, porcelain, hard rubber or molded mica. It is made in one piece, and gives maximum rigidity with minimum obstruction to the light. The flat metal tops are nicely finished and nickel plated and the wire parts are coated with pure tin.



THE GREENWOOD "PEERLESS" LAMP GUARD.

Holophane Convention.

The fourth annual convention of sales, engineering and manufacturing departments of the Holophane Company was held at Hotel Sagamore, Lake George, July 12 to 18. The party, consisting of some forty salesmen, department heads and executive officers, in addition to whom were the wives of a half-dozen of the men and several invited guests, making a party of over fifty.

Conferences on matters of business and policy occupied the mornings, the men engaging in sports and pleasure jaunts in the afternoons. A number of very important matters were discussed and plans adopted which will greatly enlarge the scope of the Holophane Company's work in future. Announcements of these changes will be made shortly.

Current Electrical News

DOMESTIC AND EXPORT.

A MILLION-DOLLAR LIGHT AND POWER MERGER—Following a meeting of the directors of the People's Light, Heat and Power Company on July 23, it was announced that a merger of that company with the Home Light, Heat and Power Company, both of Springfield, Ohio, would be effected in the near future. The capital stock of the new company will be $1,000,000. Columbus, New York and Boston men are interested in the new company.

PORTLAND RAILWAY, LIGHT AND POWER COMPANY TO SPEND $1,000,000—The contract has been let by the Portland Railway, Light and Power Company for the building of an underground system of conduits and cables in the business district, as required by city ordinance. The contract amounts to over $1,000,000, and was awarded to the engineering firm of William S. Barstow & Company, of New York. With the installation of the new system, current service to consumers throughout the business district will be changed from a 500-volt direct and a 220-volt alternating-current to a 220-volt direct-current when the system is complete, which will mean the changing of all motors in the underground district now installed to 220 volts direct current.

BOSTON INDEPENDENT TELEPHONE COMPANY TO GET BUSY—The Metropolitan Home Telephone Company, which received a franchise from the city of Boston in December, 1906, is finally taking steps toward beginning construction of its independent telephone system. Under the terms of its franchise, the company must begin construction before January 1 next and have in operation before January 1, 1910, a telephone system adequate for the service of 20,000 subscribers. A system for 100,000 subscribers must ultimately be in operation. In consideration of the franchise, the company will furnish the city with free telephones in the ratio of one telephone for each 2,000 of population of the city, additional telephones to be paid for by the city at a discount of thirty-three and one-third per cent from the company's established rates.

OREGON TELEPHONE CONSOLIDATION—It is rumored that a consolidation of the Home Telephone Company and the Pacific Telephone and Telegraph Company is in prospect, and will take place as soon as certain details can be harmoniously arranged. This proposed combination of interests is reported to have been under serious consideration by the officials of the rival telephone companies since the first of the year, during the time negotiations were being carried on for consolidation of the systems of the Pacific Telephone and Telegraph Company and the Independent Telephone Company, at Seattle. Though greater obstacles will have to be overcome in Portland in operating the systems of the rival corporations than in Seattle, owing to franchise provisions and dissimilarity of apparatus, yet it is said that a practical plan has been formed.

ELECTRIC LIGHTING.

HEPPNER, ORE.—The electric plant at Heppner was destroyed by a cloudburst on July 13.

MUNNSVILLE, N. Y.—The city of Munnsville is to build an electric light plant and displace the present street oil lamps.

SALEM, OHIO—The Salem Electric Light and Power Company is completing plans for the construction of a new power-house.

LIMA, OHIO—At a meeting of the city council held on July 6 it was decided to employ an electrical engineer to prepare plans and estimates for the building of a city electric light plant.

ATKINS, ARK.—The town council of Atkins has granted a thirty-year electric light franchise to W. F. Turner, of Atkins, who will at once proceed to have an electric light and power plant installed and put in operation.

KEENE, N. H.—Stockholders of the Keene Gas and Electric Company and the Citizens' Electric Company have voted to consolidate the two properties. The former company is to issue $50,000 four per cent bonds to be exchanged share for share for the Citizens' company.

WEAVERVILLE, N. C.—The certificates of incorporation of the Weaverville Electric Company have been received. The charter is granted to R. S. Howland, John H. Carter and G. W. Eppes, all of Asheville. The powers granted in the charter are broad and inclusive.

BUTTE, MONT.—At the annual meeting of the stockholders of the Butte Electric and Power Company held in Jersey City, N. J., on July 15, the retiring board of directors was re-elected, with the exception that G. F. Panfield was elected in the place of Rudolph Kleybolte.

HATTIESBURG, MISS.—G. L. Hawkins, of the banking firm of F. W. Foote, is one of the leading interests in a company which has laid about nine miles of street railway in this city. The company has practically negotiated the sale of their bonds and will soon have the necessary money to buy cars and other equipment. New work will probably be started in thirty days.

PINE BLUFF, ARK.—Ralph L. Crump, of New York, representing the Equitable Security Company, has bought the property of the Pine Bluff Light and Water Company, including the gas, electric light and water plants, for $450,000. The sale was under authority of the United States Circuit Court, and was a matter of formality, Crump representing the company's bondholders.

WOONSOCKET, R. I.—The common council, on recommendation of the joint standing committee on street lights, comprising Councilmen Rhodes, Dulude and Cornell and Alderman Mullen, has adopted a resolution contracting with the Woonsocket Electric Machine and Power Company for arc lights for five years at $120 a year and for forty-candle-power incandescents at $30 a year.

CLINTON, MASS.—The first vote in connection with the purchase by the town of the Clinton Electric Light and Power Company was taken at a special town meeting on July 14, when the report of a special committee recommending an appropriation for further investigation into the matter was adopted. The vote was in favor of municipal ownership, being 223 to 27.

RALEIGH, N. C.—The state has authorized the Central Carolina Power Company, which built and operates the plant at Buckhorn Falls, on the Cape Fear River, to change its name to the Carolina Light and Power Company; to change its office from Fayetteville to Raleigh, and to increase its capital stock from $1,000,000 to $3,750,000. The Electric Bond and Share Company is the principal stockholder. James D. Mortimer, of New York city, is president.

TITUSVILLE, N. Y.—The plant of the Titusville Electric Light and Power Company, together with its bonded indebtedness and all of its other perquisites, has passed into the hands of John L. and J. C. McKinney, who have organized a company consisting of themselves, R. E. Dickinson and Fred Woodring. Mr. Dickinson will be secretary and treasurer and Mr. Woodring will act as superintendent, a position which he has held in the plant for the past three years. The purchase price was approximately $75,000.

NIAGARA FALLS, N. Y.—The Niagara Falls Power Company has let contracts for an addition to the transformer house of its Canadian Niagara Power Company across the river. It is expected that the plant will be ready for operation by October 1. A new set of dynamos will be installed, and the output of the plant, which is 20,000 horse-power, will be increased to 32,500 horse-power. The Niagara Falls Power Company is now stringing a new transmission line between Niagara Falls and Buffalo, to enter Buffalo just east of Ferry street.

TELEPHONE AND TELEGRAPH.

WEST CHESTER, PA.—The Millway & Rothsville Telephone Company has been organized, with Dr. H. Walter, of Rothsville, as president.

AZUSA, CAL.—The Covina Home Telephone Company has opened its branch exchange. It will serve about 400 patrons in Glendora and Azusa.

TACOMA, WASH.—Arrangements are being made for the construction of a telephone line from Ashford, in the Succotash Valley, to Longmire Springs, on the west slope of Mount Rainier.

PHOENIX, ARIZ.—The board of supervisors have granted the People's Independent Telephone Company a franchise, extending to every part of Maricopa County, for a period of fifty years. The company first asked for a perpetual franchise, but the board would not grant it.

LITTLE ROCK, ARK.—The North Louisiana Telephone Company is constructing a line from Ruston, La., to El Dorado and has a contract with the Rock Island to extend the line to Little Rock. It is said to be the intention to put in a copper circuit and operate a long-distance line from Ruston to Little Rock and intermediate points.

SNOHOMISH, WASH.—Acting under instructions from the Chamber of Commerce, a committee is circulating an agreement of incorporation for the purpose of organizing a home telephone company. For several weeks the independent company has been boycotted for cutting off free long-distance territory and giving it to Everett.

PEKIN, ILL.—The directors of the Farmers' Mutual Telephone Company will hold a meeting in Pekin on August 1 to discuss plans for the building of a new line, or perhaps purchasing the old independent line. At a meeting in Pekin recently the secretary-treasurer, Arthur Becker, was authorized to secure quarters in Tremont for the head office, also to collect up the subscriptions for stock.

BELLEVERNON, PA.—Application has been made for a state charter for the Westmoreland & Fayette Telephone Company. It is to be capitalized at $1,000, divided into forty shares. The stock is said to be oversubscribed. The intention is to build farmers' lines in this vicinity, also connecting the towns of Bellevernon, Fayette City, Perryopolis, West Newton, Smithton, Monessen and Webster.

ONEIDA, N. Y.—A new independent telephone company has asked for a franchise to construct lines and cables in this city. It is understood that a number of local capitalists are interested in the venture. It is understood that the new company, if it secures its franchise, will at once commence work and will open an office here for business, connecting with Syracuse and Utica and other places near here.

VANCOUVER, WASH.—The franchise of the Washington Home Telephone Company in this city has been sold to H. J. Roake, who, with several local business men, will at once begin the work of constructing the exchange. The new company will be formed with local officers. The construction money will be raised by Vancouver men, and no bonds will be sold. It is expected to have telephones in operation by January 1, 1909.

WHEELING, W. VA.—At a meeting of the directors of the Belmont Telephone Company final action was taken in regard to issuing $100,000 of new preferred stock to make extensive extensions of the system and to redeem the greater part of the outstanding bonds. The extensions of the company's system proposed will take in a good part of eastern Ohio, and all of Belmont County that is not already included in the circuits.

MULLEN, NEB.—The Hooker County Telephone Company has elected the following officers: Dr. D. A. Walker, Mullen, president; F. A. Meidell, Seneca, vice-president; Charles Rodgers, Mullen, treasurer; A. L. Dawson, Seneca, secretary; Ross Fleming, Theron E. Evans and M. R. Fessenden, of Seneca, directors. A new $140 switchboard has been placed in Mullen and gives this line free exchange with the lines running to Brownlee.

SALTILLO, MEXICO—General Geronimo Treviño has been granted a telephone concession by the government of Coahuila. The concession exempts from either state or municipal taxation the capital that will be invested in the installation of a telephone line from the hacienda La Bahia to the town of Muzquiz, Coahuila. He has also been granted permission to use the streets and roads to place the poles and in return agrees to transmit free of charge all official communications.

CHESTNUT MOUND, TENN.—A new enterprise, to be known as the Chestnut Mound Home Telephone Company, has been launched. A meeting of the stockholders has been held, perfecting an organization, electing the following temporary officers: L. C. Thompson, president; A. H. King, vice-president; J. P. Elrod, secretary; F. C. Hargis, treasurer. This is a home institution and connections will be made with all the nearby towns and on to Nashville by way of Gordonsville will be the outcome.

NEWCASTLE, PA.—Plans to merge a number of small independent telephone companies in this locality may result in the formation of a central company, to be known as the Inter-State Telephone Company. If the project is consummated the central company will have $100,000 capital and will control about 3,500 telephones. The companies located in Plaingrove, New Wilmington, Mt. Air, Blacktown, Slippery Rock, Harrisville and New Bedford in this state and Beaver and North Jackson in Ohio, are to be included in the merger.

LANCASTER, PA.—The Landisville Telephone Company has been granted a charter. Residents of Landisville and the surrounding country, objecting to the prevailing toll charges, decided to construct their own line, a large portion of which has already been erected. In addition to Landisville, it will reach Rohrerstown, Bamford, Silver Spring, Garber's Mill, Salunga, East Petersburg and Mechanicsville. The directors of the company are: J. M. Trout, H. H. Koser, P. W. Baker, Ezra Miller, J. L. Minnich, D. R. Stauffer, C. C. Greider, J. W. Kreider, H. W. Minnich, S. N. Root, H. B. Stauffer, F. H. Shenk and A. H. Hoffman.

HARRISBURG, ARK.—The Going Telephone Company was organized recently at Harrisburg. The officers elected were: L. C. Going, president; W. N. Harris, vice-president and general manager; May E. Hart, secretary and treasurer; J. C. Mitchell, auditor. The company is capitalized at $50,000, of which $35,000 has been subscribed. It is expected that within the next six months about $25,000 will be expended in the building and acquisition of telephone exchanges and long-distance lines in and to the towns in eastern Arkansas. The new corporation takes over the Harrisburg Telephone Company's system and franchises. The headquarters of the company will be maintained at Harrisburg.

NAPA, CAL.—The Clear Lake Telephone and Telegraph Company, a new competing line, has been organized and articles of incorporation filed in the office of the county clerk. The company intends to construct and operate new telephone lines in Napa, Sonoma, Mendocino and Lake counties, principally between the following points: From Lakeport to Calistoga, from Lakeport to Cloverdale *via* Highland Springs and Pieta, from Lakeport to Kelseyville and from Pieta to Hopland. The company has a capital stock of $50,000, and the board of directors consists of A. H. Spurr, of Lakeport; H. S. Johnson and F. L. Wright, of Santa Rosa. L. J. Shuman and M. S. Sayre, of Lake County, are also largely interested in the new company.

ANACONDA, MONT.—The directors of the Montana Independent Telephone company have elected the following officers: Harry A. Gallwey, Butte, president; Dr. W. H. Hall, Butte, vice-president; Charles J. Kelly, Butte, secretary and treasurer; Thaddeus S. Lane, Butte, managing director. Patrick Wall, general manager of the East Butte Mining Company, was added to the board of directors, the board now being composed as follows: H. A. Gallwey, M. S. Largey, Patrick Wall, W. H. Hall, H. D. Brown, Thaddeus S. Lane, L. O. Evans, Con F. Kelley, J. T. O'Brien and Charles F. Kelly, of Butte; W. G. Conrad and Thamos Couch, Jr., of Great Falls; Frank H. Clinton, of Anaconda. The Anaconda exchange will be open for business some time in the latter part of July. The eastern extension has been completed to the Nine Mile House, nine miles southeast of Butte. Material has been ordered for the further extension to Logan, Mont., where connections will be made with the Bozeman independent company's lines, and all other independent lines in eastern Montana. This extension will be completed during the summer.

PERSONAL MENTION.

MR. T. G. SEIXAS, of New York, has been appointed general manager of the Pacific Traction Company, of Tacoma, Wash.

MR. R. B. BENJAMIN, president of the Benjamin Electric Manufacturing Company, Chicago, Ill., has gone to London, England, for the purpose of establishing a branch office and factory for manufacturing and handling the company's wireless clusters and lighting specialties abroad. He is accompanied by Mr. B. J. Grigsby, of the engineering department, who will be left in charge upon Mr. Benjamin's return. A stay of from four to five weeks is contemplated.

MR. WILLIAM W. COLE, for many years the able manager of the Elmira Water, Light and Railway Company, has resigned to become associated with the firm of Dodge & Day. Mr. Cole was presented with a handsome diamond ring by Roy H. Smith, secretary of the Chamber of Commerce, on behalf of the railroad employés of the company. The gas and electrical departments also presented Mr. Cole with a diamond scarf pin as a token of their esteem and affection. Mr. Cole is succeeded by Samuel J. Dill.

MR. JAMES F. HEYWARD, who has been appointed general manager of the Maryland Electric Railways Company, with headquarters in Baltimore, was presented with a handsome silk umbrella by the employés of the Citizens' Traction Company, of Pittsburg, when he resigned on July 23 as general manager. The Franklin & Oil City Street Car Men's Union made the presentation and declared that they were sorry to see him leave. Mr. Heyward is not unknown in Baltimore, having been long connected with the local street railway service before the general consolidation. He was the right-hand man of the late Nelson Perin and was the general manager of the City & Suburban line before the merger.

MR. V. R. LANSINGH sailed for Europe on Saturday, July 25, to be gone for six weeks. He will spend the greater part of this time in studying recent European developments in the science of illumination and in going over the situation there as regards Holophane specialties. It is not generally known that Holophane globes were first brought out in Belgium, England and France and that the American company was in the beginning looked upon as a precarious enterprise. The Yankee glassmaker, however, is far in advance of the foreign artisan. Globes produced in America are considered superior to those of European manufacture and are also cheaper, so that the company of which Mr. Lansingh is the head is to-day successful both technically and commercially. It is expected that certain of the styles developed abroad will be acceptable to this market and it is to arrange for an interchange of ideas and experience that Mr. Lansingh is making this trip.

MAJOR E. L. ZALINSKI, U. S. A., retired, has assumed the presidency of the Bureau of Illuminating Engineering, New York city. Major Zalinski, who is naturally of a scientific mind, devoted a great number of years in military research, particularly that of artillery, and is the inventor of a number of devices of war. Major Zalinski is, perhaps, best known in the elctrical field for his work on the diffusing reflector which he, a short time ago, perfected and brought to the fore, and also through the medium of various articles which he has contributed to the advancement of science and art of illuminating engineering. In these he paid particular attention to the diffusion of artificial light. The Zalinski type of diffusing reflectors are now generally accepted and used throughout this and other countries. After perfecting these reflectors Major Zalinski turned over to a well-known company their commercial development. He is now devoting his entire time to the Bureau of Illuminating Engineering, which is prepared to undertake any problems pertaining to the use of artificial light, and has at its command practical, as well as scientific facilities for solving the most intricate propositions. Inasmuch as the bureau affords independent advice to architects and general users of artificial light, it has readily been accepted and is meeting with immediate success.

ELECTRICAL SECURITIES.

There was a broadening of speculation last week, with increased activity, and a number of smart advances, with a number of securities reaching new high levels for the year. For several days there appeared to be a genuine feeling of confidence and buoyancy. The reversal of the judgment of the trial court in the Standard Oil case indicated to many the outer defense which investments may be sure of in the courts of last resort, and notwithstanding the Executive order for action looking to an immediate retrial, there was decided stimulus felt over the present outcome of the case. The favorable turn taken in the affairs of the Westinghouse Electric and Manufacturing Company gave these shares a good impetus upward which was shared by other electrical securities. Reports of a slow betterment in industry in general are widely current. Dividends have been declared on the following electrical securities: Connecticut Railway and Light Company; regular quarterly dividends of 1 per cent on the common and preferred stocks, payable August 15. Books close July 31 and reopen August 17. Montreal Light, Heat and Power Company; regular quarterly dividend of 1½ per cent, payable August 15 to stock of record July 31.

ELECTRICAL SECURITIES FOR THE WEEK ENDED JULY 25.

New York:	*Closing.*
Allis-Chalmers common	11½
Allis-Chalmers preferred	33¾
Brooklyn Rapid Transit	52¼
Consolidated Gas	140½
General Electric	145¾
Interborough-Metropolitan common	8
Interborough-Metropolitan preferred	22½
Kings County Electric	110
Mackay Companies (Postal Telegraph and Cables) common	67½
Mackay Companies (Postal Telegraph and Cables) preferred	68½
Manhattan Elevated	138⅜
Metropolitan Street Railway	30
New York & New Jersey Telephone	110
Western Union	56
Westinghouse Manufacturing Company	78½

In the fiscal year ended February 29, 1908, the Mackay Companies, in their telegraph department, had five months of normal and seven months of poor business. It seems probable that this experience will be directly reversed during the current year. In the past five months telegraph earnings have been more slowly improving, particularly since the first of June. For the remaining seven months it is practically certain that the telegraph business will be much larger than it was a year ago. The cable business of the Commercial Cable Company has been very satisfactory, and it is understood that June business was actually in excess of June a year ago. This result was in a measure made possible, of course, by the fact that the New York-Havana direct cable is now in service, and is proving a large money earner.

The report of the Kings County Electric Light and Power Company, including the Edison Electric Illuminating Company, for the six months ended June 30, shows gross earnings of $1,776,722, compared with $1,672,835 in 1907; operating and general expenses, $824,660; net, $952,062, an increase of $125,304 over the same period a year ago. Replacements and depreciation, $194,998; fixed charges, $303,280, leaving a balance after dividends of $400,000, of $53,784, an increase of $44,818.

Boston:	*Closing.*
American Telephone and Telegraph	122
Edison Electric Illuminating	216
Massachusetts Electric	47
New England Telephone	113
Western Telephone and Telegraph preferred	70

On June 27 last the New England Telephone Company had a total of 233,731 stations of its own, an increase of 5,870 since the first of the year. Including the Southern Massachusetts Company and sublicensees, the company had on June 27 a total of 296,226 stations connected with its lines. Directors of the New England Telephone Company have declared the regular quarterly dividend of 1½ per cent, payable August 15 to stock of record July 31. Books close August 1 and reopen August 14.

Philadelphia:	*Closing.*
Electric Company of America	10
Electric Storage Battery common	30
Electric Storage Battery preferred	35
Philadelphia Electric	9⅝
Philadelphia Rapid Transit	15¼
United Gas Improvement	87½

Chicago:	*Closing.*
Chicago Telephone	138½
Commonwealth Edison	103
Metropolitan Elevated preferred	47
National Carbon common	68
National Carbon preferred	111

ELECTRIC RAILWAYS.

NEW CASTLE, PA.—A new street railway from Beaver to New Castle is planned by the New Castle & Beaver Falls Electric Street Railways Company. Charles Strohecker, of Zelienople, is president.

PALESTINE, TEX.—The Union Central Railway Company has announced its acceptance of the proposition of the citizens of Palestine offering inducements for the road to build into this city. The citizens have pledged the company $25,000 bonus, ten acres for depot facilities and a right of way through the city and county.

ROCHESTER, N. Y.—The Rochester, Charlotte & Manitou Railroad, a trolley line, was sold at auction on July 21 for $12,000 to Kendall B. Castle, a local lawyer, on a foreclosure action brought by bondholders. It is generally supposed that behind the attorney is the Mohawk Valley Company, a branch of the New York Central system.

PHILADELPHIA, PA.—To the accompanying cheers of nearly 500 workmen, the first train of two cars was operated on July 16 in the eastern section of the Market street subway between Fifteenth street station and the station at Second street. Aboard the train, the cars of which were of the steel type used on the elevated section, were President John B. Parsons, P. A. B. Widener, a director; W. S. Twining, chief engineer, and several other officers of the engineering and operating departments of the traction company.

WATERVILLE, WASH.—James Fullerton, of Seattle, has appeared before the county commissioners in behalf of a franchise for an electric line which he proposes to run from a point on the Columbia up the Grand Coulee, with a branch to Waterville. The franchise has not been granted on account of some defects in publishing the notices. Mr. Fullerton said he had secured the right of way the entire length of the line with the exception of three farmers who were holding out and that he did not want to deal with them until after the franchise had been granted.

TACOMA, WASH.—Lucian F. Cook, Henry L. Gray, Charles E. Cutter, C. A. Tonneson and Fred S. Cook have filed articles of incorporation of the Narrows Terminal Belt Railway Company. The company has a capital stock of $250,000. It will construct a trolley line from the end of Center street to Belmarlow Beach. The company also intends the construction of a power plant near American Lake, and a water right allowing it to take 2,000 feet of water per second from the lake has been filed. It is intended to conduct the water from the lake to the Sound, which is 250 feet lower than the lake, in flumes.

GRAND FORKS, N. D.—An ordinance granting to five Grand Forks men a franchise to construct a street railway system in Grand Forks has been given its final reading and passed unanimously by the city council. This means that a stock company will be formed and a street railway built in Grand Forks at an early date. The city already has a line running to the University of North Dakota. This line will be taken over and made part of the new system. The plan is to have a system that will include East Grand Forks. If possible the rails will be laid before the business section of the city is repaved.

LEE'S SUMMIT, MO.—H. W. Gibson, representing the Kansas City Southeastern Traction Company, has been granted a franchise to construct and operate an electric railway on the streets through the city of Lee's Summit. In the granting of the franchise the traction company agrees to begin actual construction of the road inside of one year and to have the road in operation inside of three years, or forfeit the franchise with the city. This line is the proposed line running from Kansas City *via* Leeds, Raytown, Lee's Summit, Lone Jack, thence to Warrensburg, Sedalia and Jefferson City, where they connect with a similar proposed line from St. Louis, which will, when completed, connect Kansas City and St. Louis.

OBITUARY NOTE.

MR. H. G. SHALER, secretary of the Doubleday-Hill Electric Company, Pittsburg, Pa., died in Pittsburg on July 18. Mr. Shaler was a native of Pittsburg and was well known in electrical circles. He was a man of a fine, gentle and generous nature and will be mourned by a host of friends and acquaintances. He is survived by his wife and two children.

NEW MANUFACTURING COMPANIES.

ST. LOUIS, MO.—Grant Electric Company. $3,000. Incorporators: Adolph L. Zuest, Jr.; Fred J. Mayer and Erle R. Jackson. To manufacture and deal in electrical appliances.

BOSTON, MASS.—The National Electric Equipment Company, of Boston, has been incorporated with a capital of $50,000. The president is Charles H. Sprague, of Newton, Mass.

SAN FRANCISCO, CAL.—The Union Electrical Manufacturing Company has been incorporated to do business in San Francisco. It has a capital stock of 50,000 shares at a par value of $1 a share.

NEW YORK, N. Y.—The Kosmos Electric Runabout Company, Manhattan, has been incorporated to manufacture electric vehicles, etc. $100,000. Incorporators: J. H. Kahrs, E. Giovannoni and D. B. Turner, New York city.

READING, PA.—The Reading Chandelier Works is the name of a new concern which is about to engage in the manufacture of electrical and gas fixtures at 440 Woodward street. The plant will occupy the entire three floors and a basement.

SPRINGFIELD, ILL.—The Elgin Electrical Manufacturing Company, of Elgin, has been incorporated to manufacture electrical devices with a capital of $10,000. The incorporators are M. E. Hepburn, L. B. Hamlin, Jr., and C. C. Heywood.

NEW YORK, N. Y.—The Power Equipment Company, of Manhattan, has been incorporated to manufacture engines, boilers, machinery, etc., electrical work. $25,000. Incorporators: L. A. Camacho, New Brighton; G. A. Conover, Bayonne, N. J., and A. M. Mayer, New York city.

LOUISVILLE, KY.—The Ohio Falls Construction Company has been incorporated with a capital of $2,000, to be divided in 200 shares of $10 each, to manufacture electrical supplies. The incorporators are C. A. Duckwall, Theodore Allen, Clifton Brennan and Harry B. White.

INDIANAPOLIS, IND.—Columbia Meter Company, Indianapolis. $10,000. To manufacture electric and other meters. Directors: Gustave A. Schaffer, William H. Pugh and Thomas G. Lee. This company, which has been in business in this city for two years, is incorporated to effect a reorganization.

SALT LAKE CITY, UTAH—The Capital Electric Company has filed articles of incorporation with the county clerk, with $400,000 capital stock, at $1 per share. The officers are: President, R. W. Nicol; vice-president, A. L. Woodhouse; secretary and treasurer, C. W. Corfield. The company takes over the stock of other companies as follows: Butte Electric Supply Company, Electric Fixture and Supply Company, Boisé; Pocatello Electric Supply Company, Idaho Falls Electric Supply Company, Electric Supply and Fixture Company, of Ogden; Salt Lake Electric Supply Company, Electric Manufacturing and Repair Works, Salt Lake; Citizens' Electric Company, Salt Lake; interest in the Utah Electric Company, and now the Capital Electric Company. Of the new stock 174,000 shares will be owned by Mr. Nicol. Twenty thousand shares will be owned by employés of the company, managers, superintendents and the like. The value of the real estate acquired amounts to $173,748.

DATES AHEAD.

Michigan Electric Association. Annual meeting, Grand Rapids, Mich., August 18-21.

International Association of Municipal Electricians. Annual convention, Detroit, Mich., August 19-21.

Ohio Electric Light Association. Annual convention, Put-in-Bay, Ohio, August 25-27.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Old Time Telegraphers' and Historical Association, and Reunion of Military Telegraphers, Niagara Falls, N. Y., September 16-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 6-7.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

INDUSTRIAL ITEMS.

THE AJAX LINE MATERIAL COMPANY, Chicago, Ill., states that under date of July 10 the examiner in interferences announces that "it is adjudged that the Ajax Line Material Company is the owner of the trade-mark and is entitled to the registration." This is in reference to the trade-mark "Ajax."

THE SPRAGUE ELECTRIC COMPANY, New York, N. Y., has recently opened another branch office on the Pacific Coast. The San Francisco office is now supplemented by one in the Colman Building, Seattle, Wash., in charge of W. R. Hendrey, who is well known in the electrical field on the coast.

W. R. OSTRANDER & COMPANY, 22 Dey street, New York, N. Y., has published the fifteenth edition of their 690-page catalogue and discount sheet. This is one of the most complete listings of electrical apparatus published. The value of the catalogue is enhanced by the careful and comprehensive index, making reference easy.

THE F. BISSELL COMPANY, Toledo, Ohio, has added another postal card to its series of "Bissell Frog" souvenirs, showing the enthusiastic batrachian fishing for orders—and getting them. The company is also distributing some interesting literature devoted, respectively, to Wagner measuring instruments, Perkins snap switches, "Security" conduit rods, and Bryant "New Wrinkle" sockets and Bryant "Chapman" receptacles.

THE HOYT ELECTRICAL INSTRUMENT WORKS, Penacook, N. H., is distributing several bulletins devoted to the Hoyt voltammeter for ignition testing, the Hoyt voltmeters and ammeters for direct current, the Hoyt battery power gauge for ignition batteries, type 35 Hoyt voltmeters and ammeters for direct current for portable and switchboard use, and the Hoyt voltammeter for testing ignition batteries. The company has commenced the publication of a monthly bulletin in which may be found items of particular interest to the automobilist and the user of ignition apparatus.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing an attractive folder entitled "'Tis of the Home We Speak," the circular being devoted to a well-written description of its new lighting fixtures, manufactured by the Price-McKinlock Company, Boston, Mass. The circular should be found of considerable interest to architects, or those contemplating the installation of attractive lighting fixtures. Especial attention is called to the new studios at 264-270 Fifth avenue, Chicago, where a large number of original designs in lighting fixtures are shown.

THE LORD ELECTRIC COMPANY, 213 West Fortieth street, New York, N. Y., has ready for distribution bulletin H, devoted to lightning protective devices. This bulletin gives a brief discussion of lightning phenomena and describes in detail the principles and mechanical and operating features of the Shaw lightning arrester. Several models are illustrated. The bulletin also describes and illustrates the ground points, plates and contacts which it has developed, and considerable valuable data are given concerning the auto-discharge choke-coil, the vertical-unit choke-coil, the laminar-unit choke-coil, and high-tension disconnecting switches.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., in bulletin No. 4603, describes and illustrates an arc lamp especially suited to the illumination of mills and factories, where the vibration caused by machinery and the variation in line voltage resulting from the use of motors for machine drive have made imperative the design of a lamp of this character. This is a multiple lamp, to operate on 220 volts, direct current. Bulletin No. 4600 describes various types of controllers for use with both alternating-current and direct-current motors, on electric cars, locomotives, automobiles, launches, elevators, trains, hoists, etc., and also in rolling mills, machine shops, printing plants and pumping stations. The bulletin describes the controller most suitable for a specific purpose, and contains general data and dimensions which will be found of value to any one contemplating the installation of motor drive.

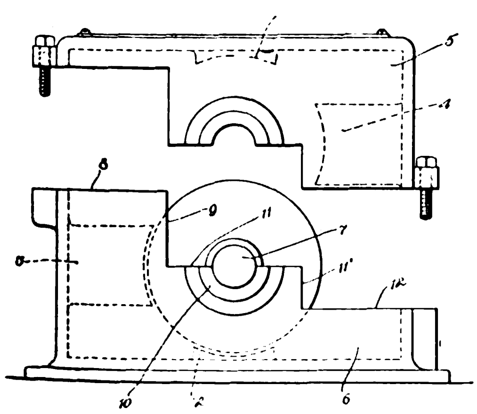
Record of Electrical Patents.

Week of July 21.

893,606. MAGNETIC SEPARATOR. Charles G. Buchanan, Brooklyn, N. Y. The ore is moved by a conveyor through a uniform magnetic field for part of the travel, the exciting magnets being short-circuited during the remainder of the time.

893,618. ELECTRIC TRANSFORMER-FURNACE. Otto Frick, Stockholm, Sweden. A rotatable induction furnace.

893,681. DYNAMO-ELECTRIC MACHINE. William L. Waters, Milwaukee, Wis., assignor to National Brake and Electric Company, Milwaukee, Wis. A dynamo casing separated into two parts along three horizontal and two vertical planes.



893,681.—DYNAMO-ELECTRIC MACHINE.

893,701. MACHINE FOR EXTRUDING METALS. George H. Benjamin, New York, N. Y., assignor to the Coe Brass Manufacturing Company. The metal to be extruded is maintained molten by an electric heater.

893,711. FIELD MAGNET FOR DYNAMOELECTRIC MACHINES. Abe L. Cushman, Concord, N. H. The pole-pieces are provided with removable flaring tips forming substantially V-shaped lateral notches for concentrating the flux.

893,730. RAILROAD-SWITCH SIGNAL. William H. Harris, Stark, Mont. The signaling circuits are closed by means of a knife-edge actuated by bell crank.

893,731. ELECTRIC SIGNAL FOR RAILWAYS. William H. Harris, Stark, Mont. The track is divided alternately into long and short blocks, each of the former being connected in circuit with a succeeding short block.

893,742. LIGHTNING ARRESTER. Ralph D. Mershon, New York, N. Y., assignor to the Westinghouse Electric and Manufacturing Company. A series of grounded discharge paths are connected in multiple and are arranged to have successively higher striking potentials.

893,783. ELECTRIC HEATER FOR SHOE-OPERATIVES' KNIVES. Edwin N. Chandler, Brockton, Mass., assignor to Simplex Electric Heating Company, Boston, Mass. A plate heated electrically against which the knife blades are held by a clip.

893,811. ELECTRICAL CONDENSER. Greenleaf W. Pickard, Amesbury, Mass. The condenser coatings are attached to the glass base by a silicate binder.

893,814. DEVICE FOR PRODUCING ELECTROLYTIC METAL-PLATING. Albert Schmitz, Brussels, Belgium. The metal plate is passed continuously through the plating bath, sliding contacts being provided for collecting the current.

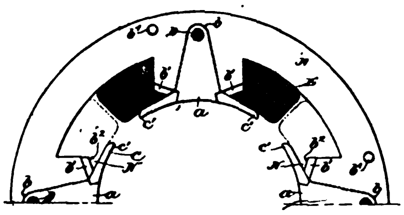
893,816. STARTING DEVICE FOR MERCURY-VAPOR APPARATUS. George Schwarz and Josef Amon, New York, N. Y. The starting device is a plunger in a branch circuit controlled thermally.

893,820. INTERCOMMUNICATING TELEPHONES. Henry C. Thomson, Boston, Mass., assignor to Electric Goods Manufacturing Company, Boston, Mass. A casing for mounting an intercommunicating telephone instrument.

893,835. FIELD-MAGNET FOR DYNAMOELECTRIC MACHINES. Abe L. Cushman, Concord, N. H. The poles have a longitudinal recess extending throughout the length of the pole-piece into which a removable section is inserted.

893,857. FLEXIBLE CONDUIT. George A. Lutz, New York, N. Y., and Clarence C. Sibley, Perth Amboy, N. J., assignors to American Circular Loom Company, Portland, Me. The lining of the conduit has series of rows of perforations at distances apart, the rows being at an angle to the length of the conduit.

893,880. SWIVEL-JOINT FOR ELECTRIC CURRENTS. Augustus B. Smith, Wilkinsburg, Pa. Both portions of the joint are provided with terminals, a rolling current-transmitting device being placed between.



893,711.—Field-Magnet for Dynamo-Electric Machine.

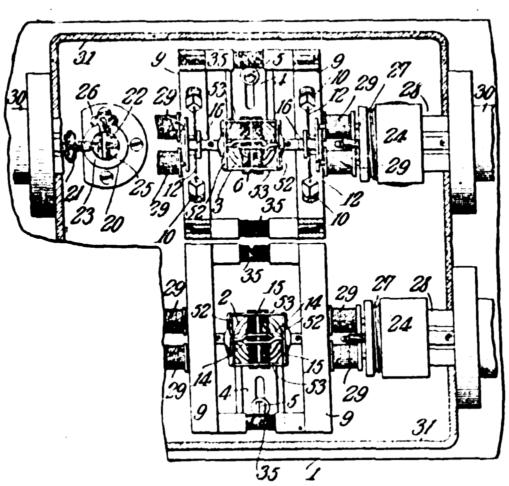
893,891. HAND TELEPHONE SET. George F. Atwood, East Orange, N. J., assignor to Western Electric Company, Chicago, Ill. A waterproof hand telephone, the talking switch being entirely enclosed.

893,902. ELECTRICAL PERMUTATION-LOCK SYSTEM. Henry T. Cleary, St. Louis, Mo. A lock controlled by a number of electric circuits.

893,918. THERMOSTAT. William F. Gossick and Arthur R. Van Valkenburgh, Chicago, Ill. A two-part thermostat, the part containing the heat-responding device being removable.

893,936. ELECTRIC REGULATION. Morris Moskowitz, New York, N. Y., assignor to the United States Light and Heating Company, New York, N. Y. A regulating system for controlling a generator when charging a storage battery.

893,953. TELEPHONE RELAY. Charles W. Underwood, Crowley, La. A relay consisting of two telephone-receiver magnets in series with a telephonic transmitter, and an armature in operative relation to each magnet.



893,953.—Telephone Relay.

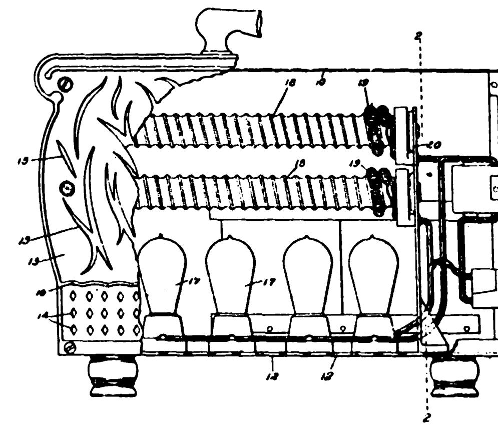
893,979. DYNAMOELECTRIC MACHINE. James Burke, Erie, Pa., assignor to Burke Electric Company. The armature has two windings, one consisting of twice as many turns as the other.

893,994. ILLUMINATED ELECTRIC HEATER. Francis C. Green, New York, N. Y., assignor to Consolidated Car-Heating Company, Albany, N. Y. The heating casing is perforated so as to imitate a flaming fuel bed.

893,997. DISTURBANCE-OPERATED CIRCUIT-BREAKER. Leo D. Haas and Edwin G. Derbidge, San Jose, Cal. The actuating magnet circuit is closed by a pendulum switch whenever the device is disturbed.

894,142. TELEGRAPH TRANSMITTING INSTRUMENT. Frederick H. W. Higgins, London, England. A type-printing telegraph.

894,143. PERFORATING PUNCHING MACHINE, ETC. Frederick H. W. Higgins, London, England. A perforating machine for a type-printing telegraph system.



893,994.—Illuminated Electric Heater.

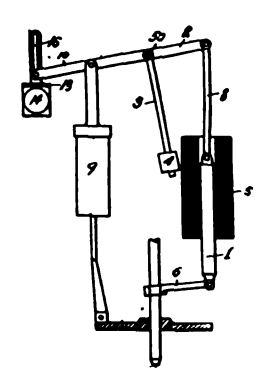
894,144. ROTOR FOR DYNAMOS AND ELECTROMOTORS. Jack Hissink, Berlin, Germany. The end turns of the rotor conductor are enclosed in separate supporting rings.

894,150. LIGHTNING ARRESTER FOR ELECTRICAL CIRCUITS. Ralph B. Ingram, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A series of spark-gaps which are shunted by successively decreasing amounts of ohmic resistance.

894,157. PROCESS FOR OPERATING ELECTRIC-ARC LAMPS IN SERIES. Frank M. Lewis, Brighton, England, assignor to General Electric Company. The lamps are controlled by series-regulating coils only.

894,158. ELECTRIC ARC LAMP. Frank M. Lewis, Brighton, England, assignor to General Electric Company. An arc lamp for constant-potential series circuits, which is controlled by a series magnet only.

894,166. MEANS FOR PRODUCING AND UTILIZING RAYS OF LIGHT FOR THERAPEUTIC PURPOSES. Corydon E. Rogers, Seattle, Wash., assignor, by mesne assignments, to the Rogers Therapeutic Lamp Company, Phoenix, Ariz. A reflector for an incandescent lamp.



894,158.—Electric Lamp.

894,167. KEYBOARD. Adolph H. F. Shaar, San Francisco, Cal., assignor to United States Wireless Printing Telegraph Company, Los Angeles, Cal. A plurality of contact levers for telegraphic purposes.

894,170. TELEPHONE REPEATER SYSTEM. Nathaniel G. Warth, Columbus, Ohio. A telephone relay composed of two induction coils and two transmitting devices, the latter being controlled by independent electromagnetic means.

ELECTRICAL REVIEW

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CONTENTS

ELECTRIC POWER IN THE MINE.

In order to keep the mining industry on a par with others, the old and crude methods which employed hand labor largely have necessarily been abandoned. Here, as elsewhere, free use of mechanical power has been the means of cheapening the cost of production and increasing the output of the mines. We first saw the steam engine applied to pumping and later to hoisting, and in recent years compressed air and electricity have been adapted to driving drills and cutting machinery, while the electric motor has largely displaced the old hand-pushed or mule-drawn cars. The interest at the present time centres, therefore, not simply in the extension of the use of power in the mine, but in the kind of power most suitable for all mining purposes. We find the steam engine applied to hoisting, the use of steam-driven pumps for drainage, the application of compressed air for operating drills and other cutting machines—all of which has been done most successfully; and, what is more interesting to us, we have seen the gradual adaptation of electrical means, not merely to supplement the older methods, but actually to replace them.

The first use of electricity was, of course, for lighting, and the advantages of the incandescent system were appreciated. Then came the electric mine locomotive, which soon proved superior to the compressed-air tractor. Next the motor was applied to driving the drills and cutting machines, and here also it seems to be conquering the entire field, for when there is some old device possessing a peculiarly advantageous feature, this may almost always be incorporated in an electrically driven machine which is more easily supplied with power and transported from point to point with less difficulty.

The most recent noteworthy application of electricity in the mine has been its use for driving winding drums. Its superiority for such constant work as driving drainage pumps has long been recognized, and where electric power is available the motor-driven pump is usually selected, but for such irregular work as the driving of hoisting drums, it was thought that the older direct-connected steam engine was unquestionably the better. Even here we have seen the electric motor, when arranged to handle irregular loads economically, displace the simple engine drive and show such excellent results that the method promises rapidly to become standard practice. This last triumph of the motor leaves little work in the mine which can not be performed by some application of electrical energy. The problem of supplying power to the mine is thus greatly simplified, since all the power-generating apparatus may be concentrated in one economically operated station and the energy may be easily distributed with slight loss to any point in the mine. We have here the ideal solution, and one which has long been looked forward to. Nevertheless, it is really surprising to note how rapidly the mines are being converted to the electric drive. An excellent idea of this is given by the mining exhibition which was held recently at London, England, at which a good deal of attention was given to the application of electric power for mining purposes. Fifteen years ago this method was not considered for anything except lighting and signaling. Now it will be but a short time before it has become the standard method in the mine.

THE BRUSIO HYDROELECTRIC PLANT.

Switzerland, a country blessed with great resources of water power, has always been a leader in the development of such sources of power. In later years, the introduction of electrical transmission of energy has added greatly to the value of the waterfalls. Thus it follows naturally that the Swiss engineers should also become leaders in this new branch of engineering. Switzerland possesses no coal mines, and hence was forced to turn to the waterfalls as a substitute for steam or gas power.

The development of electrical transmission has been particularly advantageous for Switzerland, because in that country there are many small industries as well as large. There are not only the silk mills, railways and other lines of work making large demands for power; but a system of home industries is wide-spread, and it can readily be imagined how beneficial to the whole community the distribution of power by means of electricity may be, when it is realized that frequently the demand for power does not exceed one-eighth or one-quarter of a horse-power. Much of this small power is used in the homes for making small parts of clocks, watches, etc., and it is interesting to point out that no other system of power distribution could meet these requirements. Electrical energy is, however, easily and conveniently delivered at any point, in large or small quantities, as desired, and is easily converted into mechanical power at the point required, in a small motor. This is the only method we have to-day of replacing foot-power and enabling the workman to devote his entire attention and energy to directing the operations of his machine. Such consumers are naturally widely distributed, a matter of little moment with the electrical supply company, but prohibitive to distribution of power by any other means. Nor are the large consumers of energy in that country always collected in groups. For these reasons the development of electrical transmission of energy has been a great factor in the building up of the Swiss industries.

In another field of electrical application Switzerland has also gone ahead. During recent years a number of different types of electric railway systems have been installed, including direct-current, single-phase and three-phase equipments, as well as high-potential, direct-current systems. One advantage of this tendency in Switzerland is the avoidance of smoke from factory chimneys or locomotive stacks, a feature of particular value over there where the tourists expect the air to be clear and clean, and where the least trace of smoke would bring forth criticism. And in another way electric traction systems have been of advantage in Switzerland, as they are excellently adapted to operate the many adhesion and inclined railways found throughout the mountains.

In the southern part of Switzerland, as well as in the northern part of Italy, there are many large silk and other mills, many of which formerly were driven by their own steam plants. Practically all of these to-day are supplied from large central hydroelectric stations. Italy unfortunately has few coal mines and comparatively few water powers, hence she is coming to depend upon her neighbor to the north, and draws upon the latter for electrical energy in large quantities.

In view of these conditions in Switzerland the article appearing elsewhere in this issue, in which Mr. Frank Koester describes the Brusio hydroelectric power development and its 50,000-volt Swiss-Italian transmission line, will be read with particular interest. There are a number of notable features about this plant, one of these being the high head of the water—1,300 feet. This drives direct-connected 7,000-volt, three-phase, alternating-current generators, at which potential the current is transmitted across the frontier into Italy. There it is stepped up to 50,000 volts, and transmitted eight and one-half miles to the step-down transformer stations, where it is distributed at different pressures to the various consumers.

Other interesting features of this station are the syphoning system at Lake Poschiavo; the individual switchboard for each generating unit, with its central controlling switchboard or column; the system of reinforced concrete cells for the various high-tension devices; the arrangement of the high-tension busbars, which are not, as in American practice, placed in compartments, but are only separated by reinforced concrete shelves; the complete double-line transmission system; the unique arrangement of the transformer station; and the precautionary measures adopted for protecting the plant against atmospheric disturbances, which are so frequent in this mountainous country. This transmission system may be considered the most notable one in Europe. Owing to the importance of reliability two distinct lines and two step-down transformer substations have been provided. The system as a whole may be taken as an excellent example of modern Swiss engineering.

THE VALUE OF WOOD PRESERVATION.

The electrical transmission systems and the electrical railways are among those industries which use large quantities of timber, and they are naturally feeling severely the rapid increase in the price of ties and poles, which has taken place in the past five years. It is true that both of these industries are looking for a substitute for wood, but even at the present prices there are many places where wood is cheaper than steel. As yet a satisfactory steel or concrete cross-tie does not seem to be available. Such a tie must, of course, be satisfactory in price as well as in its mechanical features. Hence it is of great importance to these industries to prevent, as far as possible, a still more rapid increase in the cost of timber. This can be done if some method of treatment is adopted which will give to the ordinary pole a much longer life than it would have untreated, or which will make it possible to utilize woods which to-day are not satisfactory because they do not resist decay. There is nothing new in this suggestion, as it has been made many times before, and has even been actually put into practice to a limited extent; but it is evident that the true value of such treatment is not yet fully realized, otherwise it would be much more frequently resorted to. In the current issue of the *Engineering Magazine* this feature of the problem is considered by Mr. C. P. Winslow. His discussion is not limited to the value of this process for the electrical industry alone, for he takes the matter up in a broader way. He does, however, point out how the cost of timber may be reduced by a proper treatment, and makes particular reference to the effect that this would have upon the tie problem and the cost of poles for transmission and distribution purposes.

The application of any preservative treatment can not, of course, reduce the cost of the piece of timber, except by making it permissible to employ a cheaper grade of stock. But even in this event it is likely that the cost of the treated piece would be nearly, if not quite, as great as that of an untreated piece of better material; but when one takes into consideration the increased life which the treatment gives, thus saving the first cost of a new piece, at an increased price and the cost of putting it in place, the value of the treatment is evident.

There is also a broader aspect which recently received considerable attention, and that is the preservation of our forests, so that they may supply the needs of future generations, and the avoidance of further destruction of our water powers. Unless the consumption of timber can be reduced we will soon be at the end of our supply, and there can be little doubt that the preservation of timber from decay will become one of the important means of decreasing the drain on our supplies.

As an illustration of the economy of preservative treatment one or two of Mr. Winslow's figures may be quoted, and it should be understood that his contention is not that such a treatment may become profitable in the future, but that the treatment is profitable to-day, since at the slight increase in the cost of the material, the annual charge for ties or poles, as the case may be, is reduced. For example: A thirty-five-foot pole for an electric line, of either loblolly or old-field pine, may be had for about $5 at its origin of growth; such a pole if not treated in any way will last about five years; hence allowing interest at five per cent the annual charge will be $1.15. Treating the butt of the pole with creosote will give it a life of about twenty years, at an increased cost of only about one dollar, so that the annual charge is reduced to forty-eight cents; and, of course, the further from the source of supply the higher the price of the pole and the more profitable will the treatment be. In the same way Mr. Winslow shows that the annual charge for a railway tie may be reduced from 16.8 cents to 10.7 cents by a proper treatment. The untreated tie is assumed to cost seventy-five cents, and to last five years; the treated tie is assumed to last ten years. But even should it last only six years it would still show an annual saving of two-tenths of a cent.

This phase of the problem, the actual saving in the yearly cost of maintenance, is one which will appeal to the constructing and operating engineer, and should lead to a much wider use of preservative treatment than is at present made. One difficulty to-day is the comparatively few places where such treatment may be given; but this is a lack which should be quickly supplied. The preservative treatment has been used in Europe for years past, and its value has been unquestioned, and there is little reason for holding off any longer against it in this country.

ELECTRICITY IN AGRICULTURE.

On another page of this issue we publish a statement by Sir Oliver Lodge of the results which have so far been obtained from the experimental application of electrical stimulation to growing plants. We have already referred to these experiments, which were first made at Bitton, near Bristol, England, and then on a larger scale at Gloucester. There is no information of the results of these latest tests, as, of course, the effect of this year's experiments has not yet been determined.

As we have pointed out before the apparent effect of electrical stimulation is so great, and the energy required so trifling, that practically the only cost of applying this treatment is that of installing the system. This should be very small compared with the increased value of the crops. In several cases an increased yield of thirty to forty per cent was obtained, while the grain from the electrically treated plot was said to be better and brought a better price than that from the untreated neighboring plot. In some cases where an increase in the weight of the harvest was not found there was an increase in its value. This was the case with beets, which contained several per cent more sugar than did those from the control plot. The experiments were repeated again this year, and a little later we will probably have some new facts which may throw additional light on the problem.

It is much to be desired that similar tests be conducted elsewhere, on a scale at least as large as that in England, where altogether about twenty acres are used in the experiments. It would be well also to have tests conducted in as many different parts of the world as possible, because the value of the treatment might be much greater in northern latitudes, for example, where there is less sunlight, than nearer the tropics. In some climates and on certain soils it might have little or no value; indeed it might, perhaps, be detrimental. It might even be found that an electrical treatment would take the place of fertilizers, as some agriculturalists contend that the chief value of the manures is to render the plant food contained in the soil more available. The vigorous growth produced by electrical stimulation may possibly enable the plant to secure its food without other assistance. It is true that we now have one or two methods of preparing artificial fertilizers from atmospheric nitrogen, and if these live up to their present promises, the fertilizer situation may be somewhat relieved, if not saved; but these fertilizers are necessarily expensive, and the cost of using them would be much more than that of electrical stimulation. The problem as presented is interesting, and well worthy of careful study and investigation.

Record-Breaking Telegraph Sending and Receiving.

During the recent Democratic National Convention at Denver, the chief telegraph operator of the New York *Sun,* George W. Conkling, performed a feat in telegraph sending which is unparalleled for speed, accuracy and endurance, even in this branch of engineering where heroic work is by no means the exception.

Working over a wire that stretched more than half way across the continent, about 2,500 miles, Mr. Conkling attained the high speed of 3,136.20 words an hour, or 52.27 words to the minute, a record which has never before been equaled anywhere.

Furthermore, Mr. Conkling in just twenty-eight working hours sent over this wire to his paper bv the Morse system and using the Phillips code a total of 73,000 words, an average of 2,607.14 an hour, or 43.45 words a minute.

Much of this matter was sent from a seat in front of the speakers' stand in the convention hall while pandemonium was being raised.

The wire worked by Mr. Conkling was a duplex circuit. It really was four wires joined together by the Western Union company for this emergency. It ran from Denver to Kansas City, thence to St. Louis, thence to Pittsburg and thence to New York.

It is impossible to transmit over such a distance without the aid of repeaters, or automatic relays. These were at Kansas City, St. Louis and Pittsburg.

At each of these men were stationed at the direction of Mr. Conkling to "refine" the wire, as the operators say. Their duty was to keep readjusting the repeaters and make sure that the circuit was just right in spite of weather conditions and other things.

To send an average of 2,600 words an hour it is absolutely necessary that every letter should be distinct, otherwise the man receiving will have to break in and have it repeated. The man at the receiving end of the wire from Denver, H. R. Clark, did not break in on Mr. Conkling once in three hours, a record in itself.

In the long session of Thursday night, at which Mr. Bryan was nominated at 3.45 A. M., Denver time, words were flashed from Denver right into the New York office at the rate of fifty-two a minute and were taken by Mr. Clark on a typewriter without a break, the ticks of the instrument in the office being as distinct as if the wire ran to Harlem instead of to the Rockies. Besides being a record for speed it was also one for endurance.

On July 7, the first day of the convention, Mr. Conkling sent 14,750 words in five hours and twenty-three minutes, an average of 2,789 words an hour. On July 8 he increased the average to 2,949 words an hour, sending 8,100 words in two hours and forty-five minutes, and on the day following the record was 5,750 words in one hour and fifty minutes, or 3,136 words an hour.

The last day of the convention Mr. Conkling sent 10,370 words in three hours and twenty minutes, or 3,111 words in an hour, which was only a shade under his record of the previous day.

Not only is this put down as a record as long-distance work goes, but there is nothing in the archives to show that it has ever been done over short lines.

Mr. Conkling, in 1903, won a silver loving cup as the most perfect sender with a Morse key.

Mr. Clark, some years ago, received and wrote on a typewriter a president's message containing 22,000 words in ten hours without misplacing a single letter or "breaking in" on the sending operator.

Electrical Engineering in the Backwoods.

To the Editor of the Electrical Review:

"We were sitting around the stove in the bar of a little hotel in a Maine town," said an electrical salesman, "when the electric lights flickered and went out.

"From the darkness came a solemn voice that said:

"'Electric lights all out, b'gosh, and yet it ain't blowin' hard either. Something's happened to the dynamo, maybe.'

"I had been selling electrical supplies to the little lighting companies for several months but I had never heard this particular idea expressed before.

"I laughed long and loud, and was all the more amused when no one joined me.

"After they had lighted a big kerosene lamp, I proceeded to explain to the crowd that incandescent lamps can't be blown out by the wind. When I had finished, the old rube who had commented on the lights said:

"'Look here, young man, if you knew a little somethin' about local conditions and about your own business, you'd know that the wires in this township are hung up slack on the poles in some places and that they get to slatting in a good stiff breeze. When they do, there's a short-circuit that puts the line out of business.'"

R. G.

Regulate Stocks Now.

To the Editor of the Electrical Review:

The men who have their fingers on the pulse of our commercial life, and whose statistics measure the beats of the great arteries of business, are advising us that conditions are improving; the pulse is quickening, and a normal tone is becoming more of a surety.

This is as it should be. We have had time to adjust business to a great degree to the conditions brought upon us by the calamities of a few months ago. Manufacturers have curtailed their orders for raw material, and also their output, and have used up surplus stocks they had on hand. Wholesalers and jobbers have likewise reduced their stocks to the minimum, and so down the line from mine to finished product, from raw material to consumer, the closest scrutiny has been exercised to prevent congestion and loss.

Manufacturers, dealers and consumers of electrical machinery and supplies were among the first to be affected by the tidal wave of disaster, and they have made strenuous efforts to adjust themselves to the new conditions imposed.

Now that a more healthy tone is evident, it is the part of wisdom for the electrical manufacturer and dealer to foresee the conditions and meet them as they appear. Unless this is done, there will be greater difficulty than has been heretofore experienced in meeting the demands of consumers.

We have climbed the hill of prosperity and know how inadequate has been the ability of our jobbers, wholesalers and manufacturers to supply promptly the contractor, the central station and the public with the material they required; and when such material was obtainable, such was the congestion on the lines of transportation that long delays were the rule.

Now is the time when every dealer of apparatus and supplies should look over his stock and figure his probable requirements; and then order all he can safely handle. This will assist the manufacturer in his estimates of what he is likely to require in the matter of raw material and skilled labor in order to produce the finished product. Every item that can be safely ordered now will assist just that much in overcoming the difficulties that are sure to come on us both in production and transportation if orders are held up until material must be used. Prices now are right, and advantage should be taken of them and of the general conditions. To do this is to "take time by the forelock."

J. E. Perego.

Chicago, Ill., August 1.

BOOK REVIEWS.

"How to Become a Competent Motorman." V. B. Livermore and J. R. Williams. New York. D. Van Nostrand Company. Cloth. 248 pages. Illustrated. 5 by 6½ inches. Furnished by the ELECTRICAL REVIEW for $1.

The authors of this book have endeavored to prepare a guide for the motorman which, without confusing his mind with undigested scientific principles, will explain to him the use of the different devices which go to make up the equipment of the modern electric vehicle. The different types of controllers are described and the effect of each movement of the controller handle is explained. Wiring diagrams are given for these systems. The troubles likely to happen to the different parts of the equipment are explained, the symptoms of each being pointed out and advice suitable for each emergency is given. The concluding portion of the hand-book deals with the different air-brake systems and tells how they should be taken care of. There is also a short chapter dealing with signals and signaling.

"Dynamo-electric Machinery." Francis B. Crocker. Chicago. American School of Correspondence. Cloth. 236 pages. Illustrated. 6½ by 9½ inches. Furnished by the ELECTRICAL REVIEW for $1.50.

This is one of the series of practical working guides which is being brought out by the American School of Correspondence. The object of the book is to give a simple and at the same time authoritative discussion of the theory, construction and design of dynamo-electric machinery. The general arrangement of the subject is that usually found in such books. The elementary theory of electromagnetic induction is first explained and it is shown how this is applied in the production of the electromotive force in the dynamo. The reactions produced by the load on the dynamo are then explained and the means adopted to minimize them are described. Part two deals with the characteristics of dynamos of different types and shows how these may be predetermined. The calculation of the magnetic circuit is taken up, followed by a discussion of methods of winding and some useful hints for the mechanical design are given. Part three deals with the construction of continuous-current machines and describes in some detail the different types of designs which have been found successful. In this section some tables of dimensions and speeds, which should be useful to designers, are given. The problem of treating in a satisfactory way the whole subject of continuous-current machines without writing a large book is not easy, but Professor Crocker has solved it here very successfully, his plan being to dwell upon the essential features, and pass over those not so important.

"Telephone Law." A. H. McMillan. New York. McGraw Publishing Company. Cloth. 332 pages. 6 by 8½ inches. Furnished by the ELECTRICAL REVIEW for $3.

The object the author of this book had in mind was to place in compact and concise form such legal information as would be of value to the practical telephone man. The book was not intended for practising lawyers. For this reason it is not exhaustive. A good deal of matter presented is of local interest, as must necessarily be the case where there are so many state governments; and it is, of course, impossible to cover every phase of this complex subject. However, what is here given will be of considerable assistance to the telephone man.

"Notes on Hydroelectric Developments." Preston Player. New York. McGraw Publishing Company. Cloth. 68 pages. 3 diagrams. 5 by 7½ inches. Furnished by the ELECTRICAL REVIEW for $1.

This little treatise has been prepared to assist investors in reaching a reliable understanding of the possibilities of any proposed hydroelectric development. The author purposely avoids discussing the engineering features of such developments, and refers to them only so far as is necessary to give a clear understanding of the power that can be obtained at any site and of the possible means of producing it. In Chapter i he gives a list of matters which should first be looked into. These include the general physical conditions of the site, records of past floods, and the possible markets for power. In Chapter ii a method of procedure for obtaining this information is suggested. In Chapter iii he explains the kind of engineering examination that should be made. In Chapter iv the market for power is considered, with the possible competitors of the power plant. Chapters v and vi deal with the cost of producing energy, and central station economics; Chapter viii with the sale of energy; Chapter ix takes up the problem of producing secondary power, and the concluding chapter of the book deals with the effect of capital cost upon the selling price of energy. The book seems to be admirably adapted to its purpose, as a technical education is not necessary to follow the argument. It should enable any business man to reach a satisfactory conclusion respecting the value of any power site, provided, of course, he follows the plan here laid out.

To Reorganize Virginia Traction Companies.

The reorganization of the Virginia Passenger and Power Company, the Richmond Passenger and Power Company, the Richmond Traction Company and controlled lines has been undertaken by a committee consisting of Douglas Robinson, of New York, chairman; Frank J. Gould, of New York; Charles S. Whelan, of New York; Percy M. Chandler, Philadelphia; R. Lancaster Williams, of Baltimore, and Fritz Sitterding, of Richmond, Va., with John D. Dickinson, Jr., secretary, and Henry W. Anderson, counsel, and Carter, Ledyard & Milburn, consulting counsel.

The committee has prepared a plan of reorganization which has been deposited with the Bowling Green Trust Company as depositary and requests the holders of the various securities affected by the reorganization to obtain the same and deposit their securities under it before September 3. The protective committee of the Richmond Passenger and Power Company consolidated bondholders and a similar protective committee representing the South Side Railway and Development Company's bondholders have endorsed the plan of reorganization.

Examination for Inspector of Mechanical and Electrical Engineering.

The United States Civil Service Commission announces an examination on September 2 and 3 to secure eligibles from which to make certification to fill a vacancy in the position of inspector of mechanical and electrical engineering, at $2,190 per annum, in the office of the supervising architect, Treasury Department, and vacancies as they may occur in any branch of the service requiring similar qualifications. The duties of the specific position consist of inspecting and testing mechanical and electrical equipment entering into the modern government or office building, requiring high-class education and extensive experience in all branches of enginering embracing this class of work. Applicants should apply at once to the United States Civil Service Commission, Washington, D. C., for application form 1,312. No application will be accepted unless filed with the commission in complete form prior to the hour of closing business on Saturday, August 22. In applying for this examination the exact title as given in the heading of this announcement should be used.

"A.C." ACCUMULATOR SUBSTATIONS; AND THE USE OF ACCUMULATORS FOR PEAK LOADS.[1]

BY A. M. TAYLOR.

Many causes have conspired to delay the introduction of accumulators into central stations in this country for the purpose of supplying energy for light and power during the time of peak load.

The non-fulfilment of the great expectations raised some twenty years ago has had its reaction, and numerous failures in actual practice have caused central station engineers to lose confidence in all cells of every make for light and power supply as a substitute for generating plant.

Even when one succeeds in convincing an engineer that a battery will pay for itself if it only lasts as short a period as, say, five years, and that, therefore, there can not be much risk in installing it (as guarantees for much longer periods of maintenance can be had, at reasonable rates, and from responsible parties), the said engineer will hesitate to put it in directly it is brought home to him that, in order to insure its paying under these conditions, it must be relied on as a real, and not merely a nominal, substitute for generating plant.

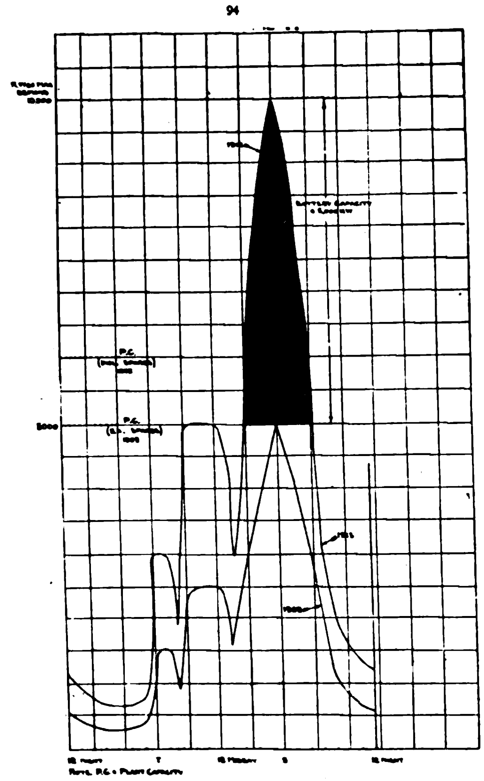


FIG. 1.—TYPICAL LOAD CURVE FOR STATION HAVING PRESENT MAXIMUM DEMAND OF 5,000 KILOWATTS. FURTHER EXTENSIONS ARE ASSUMED TO BE CARRIED OUT WITH BATTERIES.

ENERGY LOSSES.

It requires to be realized by engineers that, if cells are installed exclusively to take the peak of the load, and are not discharged unnecessarily, the value of the energy wasted in the cells and accessories is only of the order of one to two per cent of the value of the revenue introduced by said cells. Consequently their inefficiency is not nearly so serious a matter as most people imagine.

Consider Fig. 1, the lower half of which shows a typical load-curve for a station having a present maximum demand of 5,000 kilowatts. All further extensions are assumed to be carried out with batteries until, in 1913, the maximum demand reaches 10,000 kilowatts.

Neglecting changes in the load-factor, we may assume that, say, 5,000,000 units are sent out in 1908, and 10,000,000 units in 1913. The battery has thus introduced a revenue of, say, $156,000 per annum (taking three cents as an all-round price for light and power and neglecting losses in transmission in each case). What are the losses due to the inefficiency of the battery and adjuncts?

The lower curve in Fig. 2 has been compiled from figures published for the maximum demands at Neptune Bank by Merz and McLellan in April, 1904, as a rough approximation to the relative periods of time which the station was working during the year on different loads.

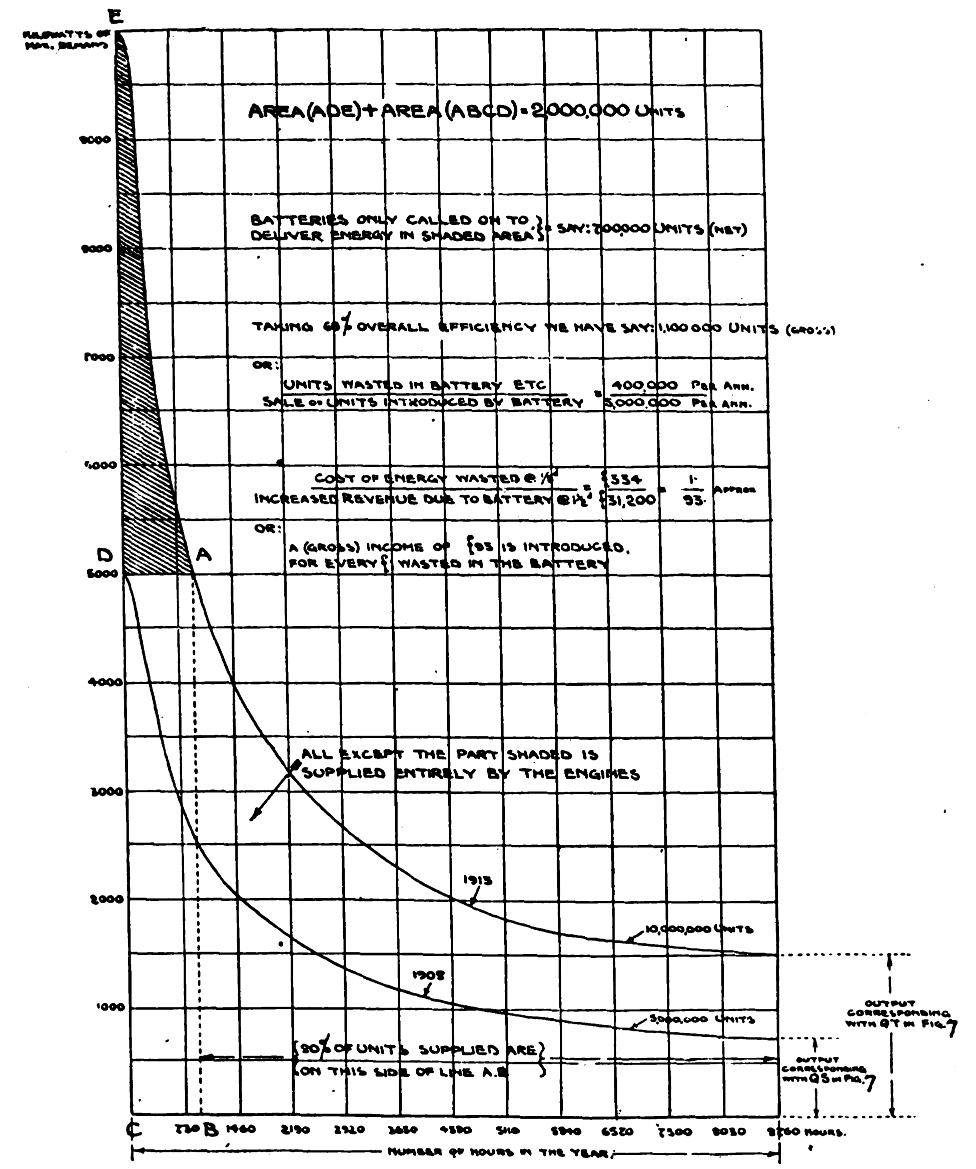


FIG. 2.—ANALYSIS OF PROPORTION OF WORK CARRIED BY ENGINE AND BATTERIES.

Referring to the upper curve of Fig. 2, which embraces the extra 5,000,000 units "introduced" by the battery, it will be noticed that the batteries are only called upon to deliver energy when the peak exceeds 5,000 kilowatts. They are, of course, charged when the load is small and the engines and boilers inefficiently loaded.

To simplify the question, the author, in the notes accompanying Fig. 2, has

[1] Abstract of a paper read before the Incorporated Municipal Electrical Association, Nottingham (England), June 30 to July 3

only considered the employment of the battery in the winter, and for discharging at the heaviest peaks; the extra losses involved in the occasional charges and discharges required during the summer are not serious.

lowed. The cost of 400,000 units at two-fifths cent (or $1,600) is, then, the sum which we must set off against the revenue of $156,000, introduced by the cells, on account of the "wasted" units in the battery.

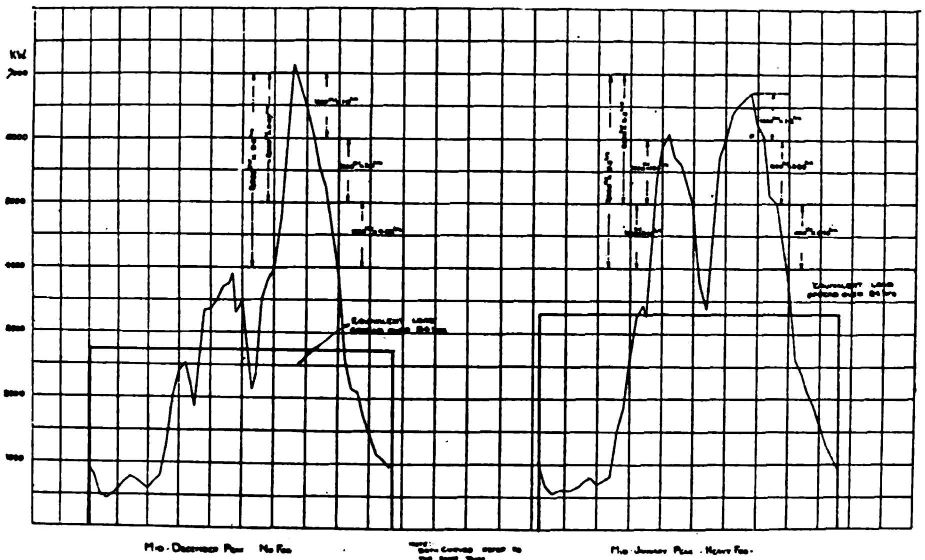


FIG. 3.—TYPICAL STATION LOAD CURVES, SHOWING DURATION AND EXTENT OF BATTERY DISCHARGE.

Referring to the notes accompanying Fig. 2, it will be noticed that some 1,100,000 units are put into the battery; of which some 700,000 are reclaimed as "useful" work. In the figures for the increment in fixed charges due to the introduction of the battery (considered later in discussing Fig. 6), the author debits the "extra" units introduced by the battery with the whole of the increment in the fixed charges of the station, as well as with the capital charges on account of the cells; consequently it is unnecessary to debit the 400,000 "wasted" units with anything beyond the coal, water and petty stores consumed. These items are sufficiently covered by the two-fifths cent allowed.

PROPORTION OF PEAK TAKEN UP.

The capital cost of the cells depends, of course, very largely on the proportion of the peak which is taken up by them, each successive kilowatt so taken up requiring a longer period of discharge. This will be evident from Fig. 3, the left-hand diagram of which shows the peak load of a station in a large industrial town, and may be taken as a typical case. Referring to this figure it will be noticed that the first thousand kilowatts taken up require only an average duration of discharge of 1.15 hours, the second thousand kilowatts require three hours, and the third thousand kilowatts 4.26 hours. The average duration of discharge for 3,000 kilowatts taken up is as shown, 2.8 hours, and for 2,000 kilowatts it is 2.07 hours.

On the right-hand side of Fig. 3 is given a peak load-curve for the same station during an exceedingly heavy fog, and the corresponding hours of duration for each successive thousand kilowatts on either of the two humps of this peak are given in horizontal figures, the equivalent hours of duration for the joint load of the two peaks being given in vertical figures; the notes at the top of the figure show the capital cost, per kilowatt of maximum demand taken up by the cells, for different proportions of the peak, both for the left-hand and for the right-hand diagrams. It will be noted that the cost for taking up $\frac{2000}{7000}$ of the peak in the right-hand diagram is very little in excess of that of taking up $\frac{3000}{7000}$ of the peak in the left-hand diagram.

In the comparison which will now be made between the cost of generating plant and batteries, it is assumed that no provision is made for dealing with fog loads, there being numerous towns in the country where such loads are not materially felt. Even where the contrary is the case, the battery can still hold its own, provided that a lesser proportion of the peak is taken up.

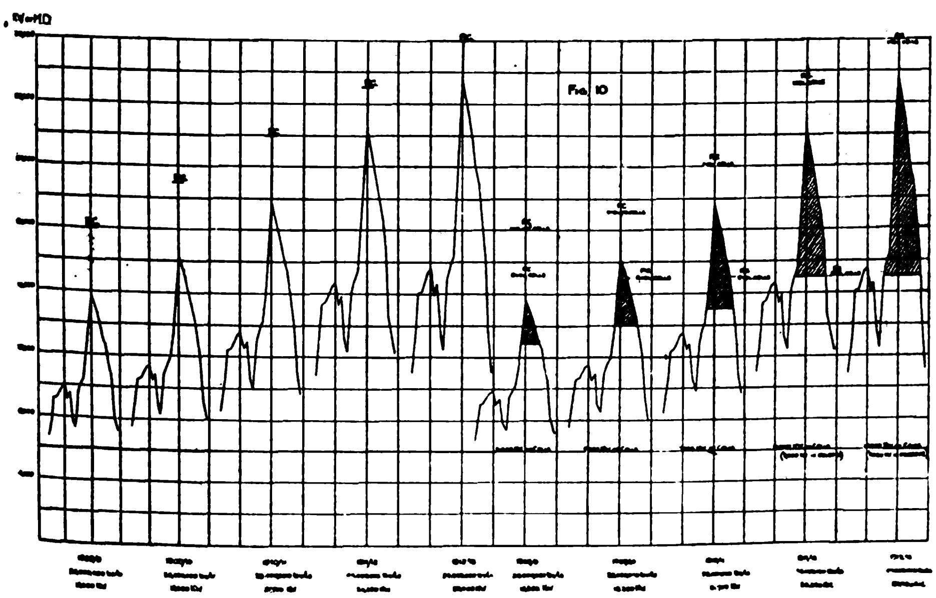


FIG. 4.—ASSUMED ANNUAL DEVELOPMENT OF STATION PEAK LOAD COMPARED WITH SAME DEVELOPMENT ASSISTED BY STORAGE-BATTERY INSTALLATION.

CELLS v. GENERATING PLANT.

In order to obtain a clear idea of the various economies, both in capital cost and running expenses, which may be effected by the introduction of cells to take the peak of the load for light and power work, a typical station has been selected, in which the annual development is assumed to progress at a healthy rate, and the effect is noted of installing accumulators to deal with the peak of the load in place of generating plant, and the annual expenses are estimated in the two cases over a number of years.

On the left-hand side of Fig. 4 is shown the assumed annual development of the peak of the load for a large steam-power station, and the plant capacity allowed (including spares) to meet same.

On the right-hand side of Fig. 4 is similarly shown the same station carried over the same term of years by means of cells added to the existing generating plant, no further generating plant being put down. In both cases only sufficient spare plant has been allowed to cover the chance of a breakdown of one of the generating units. This may be criticized as insufficient, but owing to the large capacity of the battery for short-period discharges, the comparison would undoubtedly show still more favorably to the latter if a larger margin of spare-plant capacity were allowed. In Fig. 5 is given the estimated figures for the development of a steam station whose demands are shown by Fig. 4, no battery being considered, and in Fig. 6, the corresponding expenses, with the accumulators considered in Fig. 4 are similarly expressed. It will be noted in the latter figure (6) that the steam expenses incurred in the year 1907-8 are taken as the basis, and it is assumed that since no further generating plant is added, the fixed charges, and interest and sinking fund charges, will remain constant.

To the total of the steam-plant charges incurred in the year 1907-8 is added a sum representing twelve per cent on the cost of the cells added during the year 1908, and the total so obtained is plotted as the cost for the year ending in March, 1909. The capital cost of the cells and their accessories inclusive of building has been put in at £15 ($75) per kilowatt throughout. In the years 1910 to 1911, 1911 to 1912 and 1912 to 1913, a small sum (£1,000) has been added to cover the cost of extra wages for attending to the cells and apparatus.

With reference to the twelve per cent taken on the cost of the cells in the above figures, it may be explained that interest charges on the cells are taken at three per cent and depreciation and maintenance charges at nine per cent.

It will be noted that in Fig. 6 the savings introduced by the cells, as against steam plant, are £12,000 ($60,000), £24,000 ($120,000), £37,000 ($185,000), £46,000 ($230,000) and £64,000 ($320,000), respectively, in the five years following 1907-8; a total saving of £183,000 ($915,000).

Taking the increments which each year show over 1907-8 in annual expense, and dividing these by the corresponding increments in units sold, shows that for the steam plant the costs of each extra unit sold are 2.18 cents, 1.8 cents, 1.82 cents, 1.72 cents and 1.70 cents, whereas with the combined steam and accumulator plant the corresponding costs are found to be 1.24 cents, 0.88 cent, 0.8 cent, 0.84 cent and 0.78 cent, with the result as already stated that the total net saving in five years is $915,000 after providing for the payment of interest, depreciation and maintenance on the accumulators, representing an average saving of $183,000 per annum.

It may be pointed out that the £64,000 ($320,000) saving in 1912-13, would pay an additional ten and one-half per cent interest on the total investment in cells and accessories, including that of 1912-13.

As a further illustration of the relative costs of the cells and of the steam plant, the author has resolved the cost into curves, connecting load-factor and price per unit, which are shown in Fig. 7. In this figure the cost for the battery itself and the increment in fixed charges introduced by it is shown by the curve AB, the corresponding curve for the increment in the generating plant (excluding distribution) being marked CD on the above figure. It is to be noted that in these two curves (Fig. 7), we have a comparison between the cost of introducing to an already large generating station the necessary steam plant, of the most modern reciprocating type and in large units, in order to deal with a stated increment in the maximum demand of the station; and on the other hand, the corresponding costs for accumulator plant capable of dealing with the same increment in the maximum demand. We are not, therefore, comparing merely the total capital and other costs per kilowatt, incurred to date (which figure would be handicapped by the amount of capital that had been spent in past years on obsolete or inefficient plant), but are considering the relative merits of the two systems under absolutely identical conditions. To show the difference that would be obtained in favor of the electric accumulator system, were we to compare its added costs with the existing costs of the steam system (as we might do if the station had reached its limit of exten-

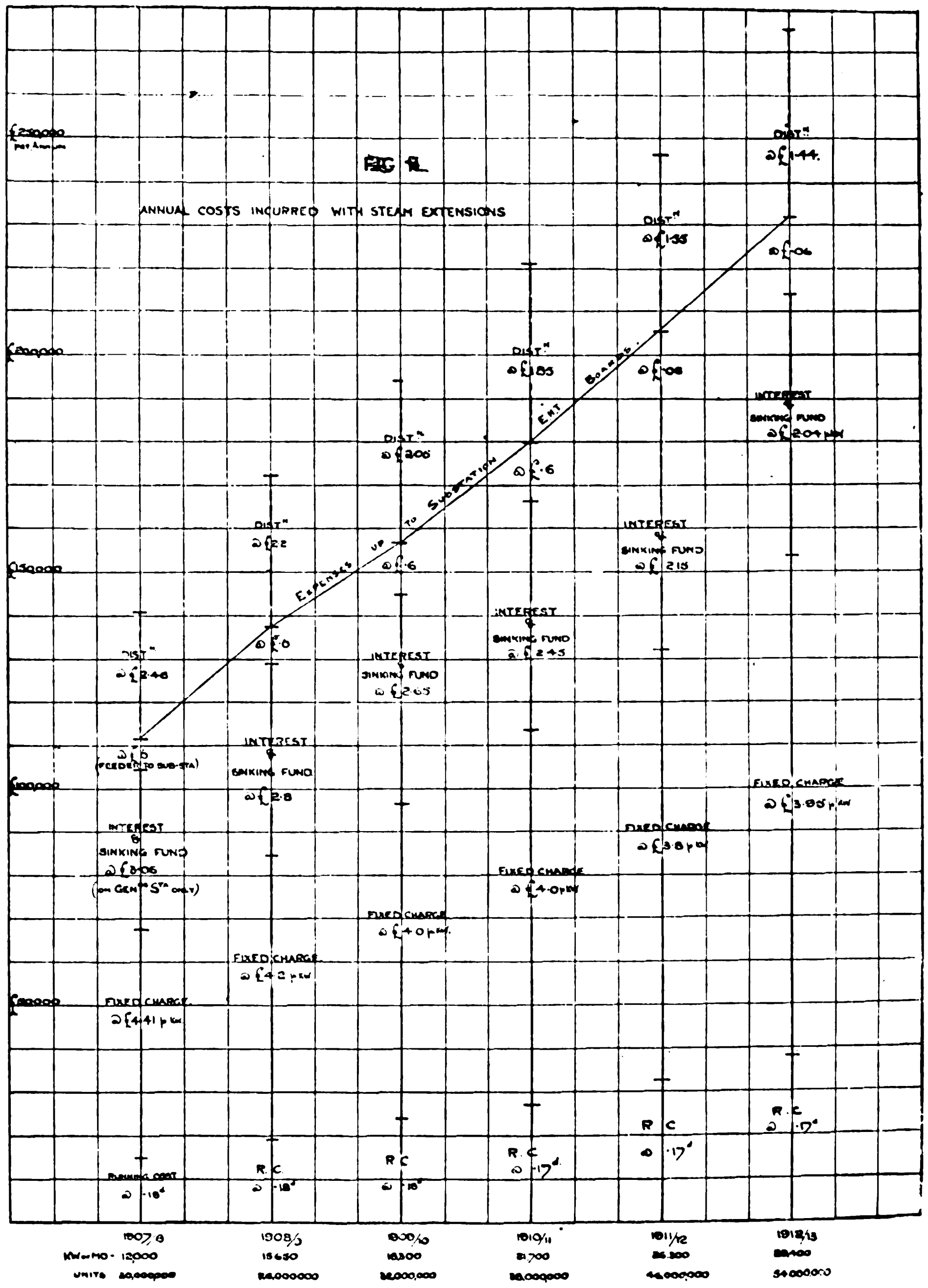


Fig. 5.—Estimated Figures for Development of Steam Station, No Battery Being Considered.

sion), we have only to compare curve AB with curve EF (the latter representing the costs for 1907-8, for any load-factor, as deduced from the ordinate plotted for a particular load-factor in Fig. 5). The author submits that in estimating the saving introduced by putting down accumulators, it is not in certain cases unfair to take the difference in costs between the curves EF and AB as representing the saving, since the station is at the present time charging the consumer on the basis of the curve EF, while the added cost for each unit sold with the accumulators is only that represented by the curve AB.

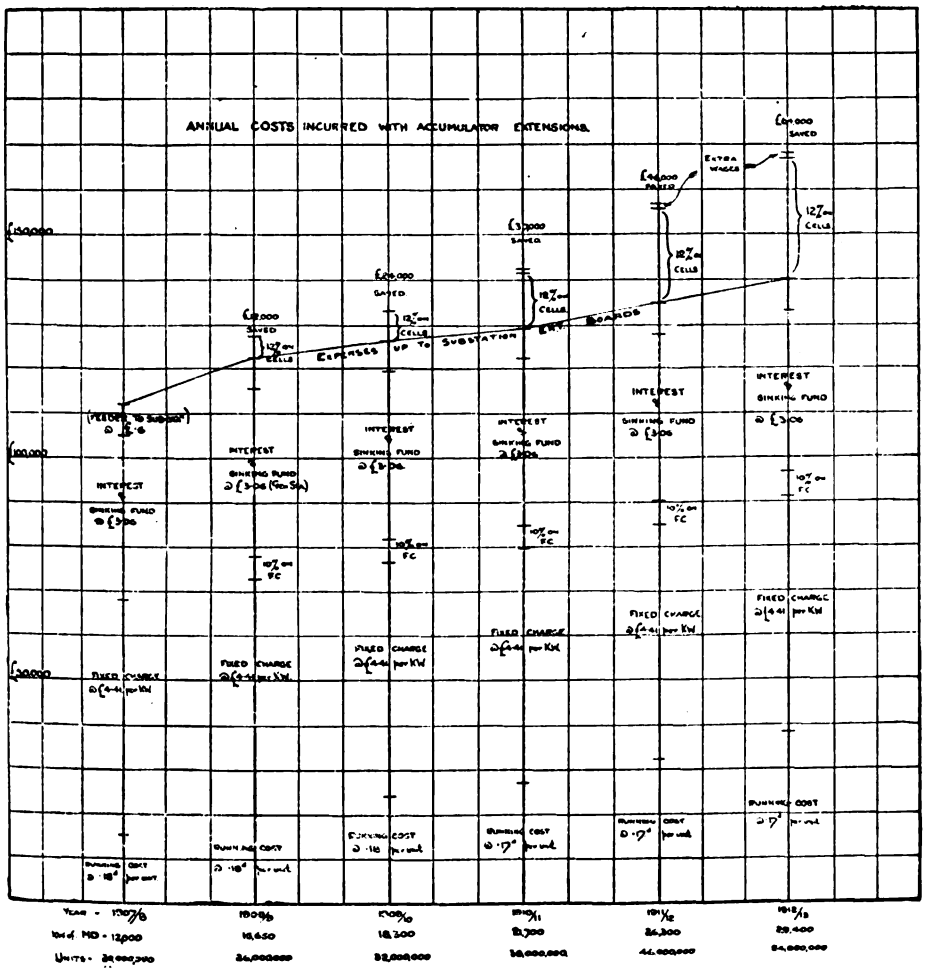


Fig. 6.—Estimated Figures for Development of Steam Station, with Storage Battery Considered.

Each extra unit sold (due to the growth of the load) would therefore bring in, if present prices remained unaltered, a net profit represented by the difference between these two curves; or say 1.9 cents per unit on a sixteen per cent load-factor.

ALTERNATING-CURRENT SUBSTATIONS.

The author trusts that, in the examination of the energy losses incurred by the accumulator system it will be conceded that the cost of the energy used in charging the cells is so very low that the inefficiency of the cells and accessories is much more than compensated by the gain in coal economy on the "interest-paying" units. The result of calculations which he has made in conjunction with the employment of substations has satisfied him that there is a future for such a scheme, (particularly in connection with long-distance transmission of power), the batteries being put down here, rather than at the generating station.

The limits of the present paper do not allow of going into details but, from inquiries made of accumulator companies, it is found that, where cells of very large individual capacity can be installed, it is possible to obtain a discharge representing six kilowatts (on a three-hour basis) for every square yard of floor space, for a single tier of batteries; and where there are two tiers this would be raised to twelve kilowatts, or if three tiers, eighteen kilowatts per square yard of ground space. These figures do not include any space for the rotary converters, or the boosters or auxiliary apparatus; but where the units are of moderate size, the extra floor space required for these is not at all serious. Assuming for the moment that a separate building were erected for the cells, of a cheap construction, it would be quite possible to erect such a building, where the cells were on a single floor only, for something under $1.87 per kilowatt, and even where the cells were arranged on two floors, or even three floors, the cost of such a building need not exceed, say, $3.75 to $5 per kilowatt, and, of course, the cost of maintenance of such a building is trifling compared with that of the cells.

As regards the cost of land, this, in the vicinity of substations, could, generally speaking, be obtained at a rate not materially in excess of $3 per square yard, which, for a single-story battery, works out at fifty cents per kilowatt, which is really quite negligible compared with the cost of the battery. It is, however, of course, often a matter of the greatest difficulty to get the land just where it is required, and hence it is highly desirable to adopt any means whereby the floor space required for the accumulators can be greatly reduced. In the smaller sizes of substations, such as would be employed for prospecting purposes, and in fact up to 2,000 kilowatts, the author believes that his low-voltage system of accumulators will be found very useful in reducing floor space (as well as capital cost), and he has taken advantage of the facilities which the employment of alternating currents offers for stepping down the voltage to produce a scheme which is at once cheap, flexible and easily extensible with the growth of the load in the substation. By this means it is possible to use the batteries to deliver alternating current of high pressure into the line at times of peak load, while at the same time delivering direct current of suitable pressure to the bus-bars of the substation, and the author believes that this and other combinations will be found to be valuable as a means of relieving the main generating station at the time of peak load, as well as the feeders. The efficiency to be obtained on discharge, as between battery terminals and extra high-tension alternating-current bus-bars, will, in a large substation, be found to be of the order of ninety-three per cent, and that between the battery and the substation direct-current bus-bars of the order of eighty-seven per cent, and even in a small substation these figures would not be materially less than ninety per cent and eighty-two per cent, respectively. It is further suggested that such a system may be found very helpful on long high-pressure lines, such as those on the outskirts of a power company, the accumulator in this case enabling a given amount of maximum demand to be met at a subcentre for a very much less expenditure in extra high-tension cables than would otherwise be incurred; or, to put it in another form, it would be possible to supply a given maximum demand at much greater distances from the main generating station with economy than has hitherto been the case. Indeed, if the savings introduced in the generating plant by the adoption, in this way, of accumulators at the substations were utilized for the purpose of extending the lengths of the extra high-tension feeders, it might be possible to carry the transmission several times as far as is now considered practicable, without incurring any greater charges than would

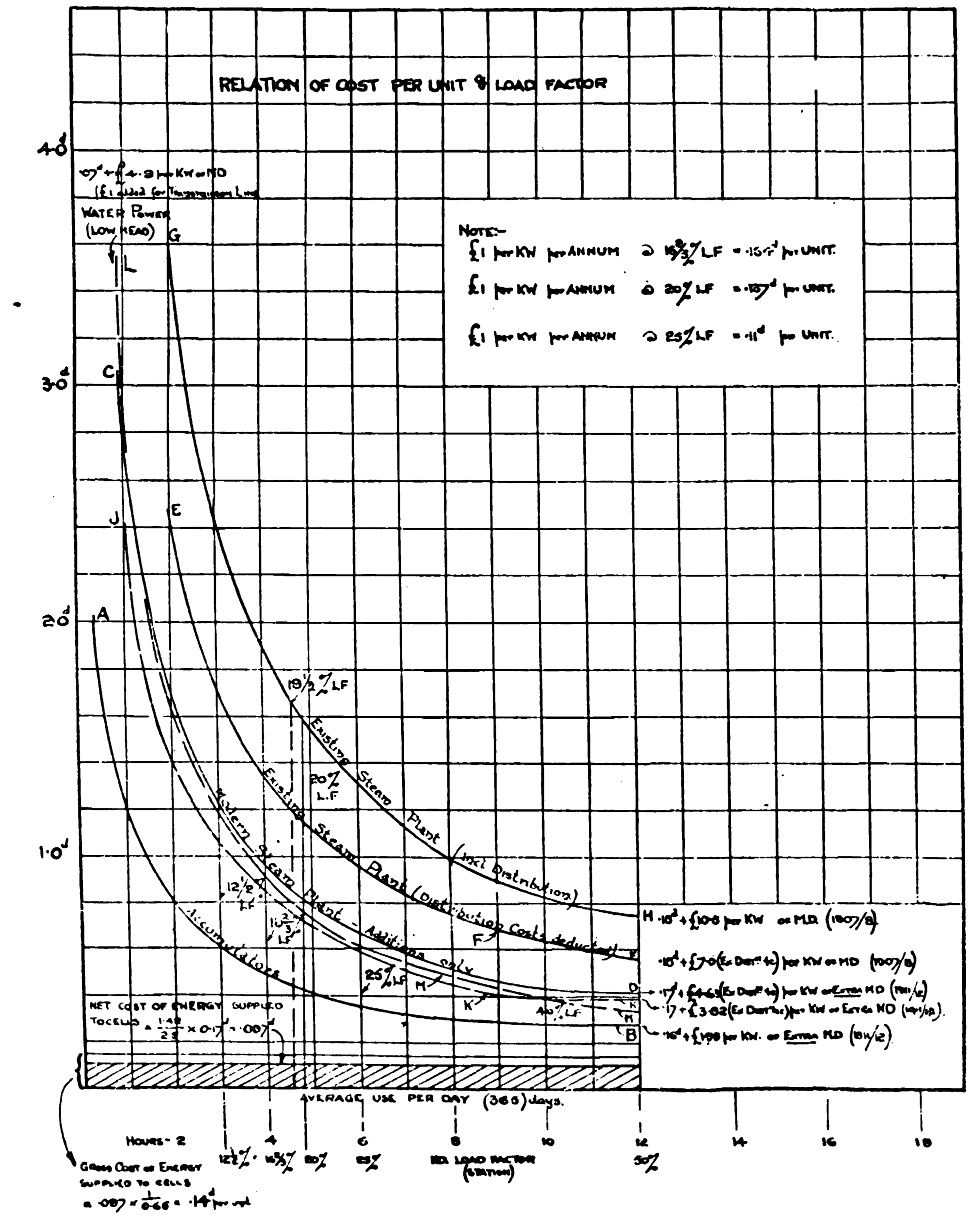


FIG. 7.—NET EFFECT OF USING CELLS ON THE COST OF EXTRA UNITS AND STATION LOAD FACTOR.

be incurred by the continuance of the use of steam plant for extensions, coupled with the employment of the shorter feeders.

CONCLUSIONS.

In the present paper the author's investigations have been confined to the consideration of the introduction of cells in connection with a large modern station, with ample station and street accommodation for extensions in all feeders to substations, and on the further assumption that there is land adjoining the station to accommodate additional steam plant. Where any, or all, of these facilities do not exist, especially if the limit of the station development has been reached, there is a strong case for accumulators.

By their means it is quite possible to postpone the erection of a new station for some years and thus to obtain the advantage of the latest and best experience in the selection and performance of plant.

As regards the introduction of accumulators into the smaller stations, the author ventures to express the opinion that the causes of high coal consumption in these stations are due, not altogether to the smallness of the engine and boiler units, or even to their being of somewhat obsolete type, but rather to the greater proportion which the stand-by losses and the fixed charges bear to the total cost of operation. The use of cells would introduce great economies here; and in many cases would enable the existing small units to be replaced by large and more economical units with the certainty of being able to find a suitable load for the latter, even where the load-factor of the station happens to be a poor one; thus avoiding, in many cases, the immediate building of a new station.

The author suggests that Fig. 7 will be found helpful as showing at a glance and in a single diagram the net effects of using cells on the cost per (extra) unit for different (station) load-factors. It also shows in a clear way the pronounced saving introduced by using cells, as against modern steam plant; and that, too, of the largest sizes likely to be available in the majority of cases.

The capital costs taken for the increment of steam plant (including building and land) range from $200 to $100 per kilowatt of plant capacity added. It may here be mentioned that in the costs plotted in Fig. 5 the cost of the feeders on the extensions to the substation where the battery is placed is also debited to the steam extensions, an allowance of $3 per kilowatt of maximum demand per annum being taken. In Fig. 7, however, this is reduced to $1.50 per kilowatt of maximum demand.

The figure of $75 per kilowatt of maximum demand for the batteries similarly includes building and land, but no spare battery capacity; there being 100 per cent overload capacity in the battery for one hour, and the chance of interruption with a properly designed battery plant being so much more remote than with running machinery, or even steam boilers and accessories.

As regards the transmission of power over long distances, such as from water-power centres, the author suggests that the facilities for increasing the radius of transmission (for a given limitation in electromotive force) which the storage system offers, combined with the great advantage of having the reserve of power at the point where it is wanted, should be considerations of moment in introducing cells for such work. There are many large water-power transmissions on which he believes it will be found that the curves connecting load-factor and cost per unit will consist of a much smaller element of "running cost" and an equally large, or larger, element of "fixed charges" than in the steam station shown in Fig. 7 (especially when transmission line costs are included), and on all such there should be an excellent opening for alternating-current substations.

Coal-Mining Reports.

According to the figures prepared by the United States Geological Survey, in 1907 Ohio produced 32,142,419 short tons of coal, having a spot value of $35,324,746. Early in 1908 George Harrison, chief inspector of mines for Ohio, estimated that the total production of the state in 1907 had been about 30,000,000 tons, which would have been equivalent to an increase of somewhat less than ten per cent over the output of 1906. The complete statistics for 1907, which will soon be published by the United States Geological Survey, show that Mr. Harrison's estimate was conservative, as the actual increase in production was more than 2,000,000 short tons in excess of his estimate. The production for the year showed an increase of 4,410,779 short tons, or 15.91 per cent, in quantity and of $4,978,166, or 16.4 per cent, in value over that of 1906. In 1907 the coal-mining industry in Ohio was not greatly affected by labor troubles or strikes, the car supply was more nearly adequate than in some other states, and the average prices were satisfactory to the operators.

The total production of coal in Oklahoma in 1907 was 3,642,658 short tons, having a spot value of $7,433,914, according to the Geological Survey's annual report on mineral resources of the United States for 1907.

Since the Survey's report for 1906 was published the area included within the territory of Oklahoma and the Indian Territory has been organized and admitted into the Union as the state of Oklahoma. As, however, the entire coal-producing district is included in what was Indian Territory, the production of the state of Oklahoma is co-ordinate with the production of Indian Territory.

The new state began its history of coal production with a noteworthy increase over that of Indian Territory in 1906, when the output amounted to 2,860,200 short tons, valued at $5,482,366. Compared with this the production of 1907 showed an increase of 782,458 tons, or 27.36 per cent, in quantity, and of $1,951,548, or 35.6 per cent, in value. Only three states exceeded Oklahoma in percentage of increase in 1907 over 1906. These were Michigan, whose production increased fifty-one per cent; Arkansas, which had an increase of 43.3 per cent, and New Mexico, with an increase of 33.8 per cent.

The total production of coal in Oregon in 1907 was 70,981 short tons, having a spot value of $166,304.

The Coos Bay field is the only productive coal field in Oregon. It is situated in the southwestern part of the state, in Coos County, and occupies a total area of about 250 square miles, its length north and south being about thirty miles and its maximum breadth at the middle about eleven miles. Among the other coal fields that have been prospected in the state are the Upper Nehalem field, in Columbia County; the Lower Nehalem field, in Clatsop and Tillamook counties; the Yaquina field, in Lincoln County; the Eckley and Shasta Costa fields, in Curry County; the Eden field, in Coos County, and the Rogue River Valley field, in Jackson County—all west of the Cascade Range. None of these fields has been developed to the point of production. Another field lies in the basin of John Day River, east of the Cascade Range, but little is known concerning it. All the fields west of the range, except the Coos Bay, are of rather small area, the largest being the Upper Nehalem, which has an area of less than twenty square miles. The coal of all these fields is lignitic. Its transportation is confined exclusively to Coos Bay and the Pacific Ocean, and San Francisco is the principal market. The Coos Bay field is divided by its structure into six portions—four basins and two arches. The basins are known as the Newport, the Beaver Slough, the Coquille, and the South Slough, and are separated by the Westport and Pulaski arches.

The output of the Tennessee coal mines in 1907 amounted to 6,810,243 short tons, having a spot value of $8,490,334, showing an increase of 550,968 short tons, or 8.8 per cent in quantity, and of $822,919, or 10.73 per cent, in value, over the production in 1906. The average price per ton advanced from $1.22 in 1906 to $1.25 in 1907. About forty per cent of the output of the Tennessee mines is used for railroad fuel, 15 per cent is taken by the comparatively restricted local market of the eastern part of the state, and the rest of the product is marketed in competition with coals from Alabama and southern Kentucky. That the industry did not show greater gain in 1907 was due in part to the exceptionally mild weather in November and December, which caused decrease in the demand for coal for domestic purposes, and in part to added competition from many of the large mines in Virginia, Alabama, West Virginia and Tennessee, forced by the condition of the iron industry to market for steam coal much of their product that would otherwise have been coked. Notwithstanding these adverse conditions, however, the output of the state was the largest ever recorded.

The production of coal in Texas in 1907 was greater by 25.53 per cent, in quantity, and 27.53 per cent, in value, than that of 1906, according to E. W. Parker, of the United States Geological Survey, amounting to 1,648,069 short tons, having a spot value of $2,778,811.

This increase in the coal output is largely the result of the condition of the petroleum industry in the state in the last two years. In 1906 the output of petroleum was sixty per cent less than in 1905 and the coal output showed an increase of 112,189 short tons. In 1907 the production of petroleum was about the same as in 1906, the decrease being insignificant, but the advance in the price of fuel oil in the state was so decided that a number of railroads returned to coal for locomotive use, and the effect on the coal industry is shown by the figures given above.

Coal or lignite was produced in sixteen counties of Texas in 1907, or three more than in 1906. The counties reporting production of bituminous coal—Erath, McCullough, Maverick, Palo Pinto, Parker, Webb and Wise—were the same as in 1906; of the lignite-producing counties—Bastrop, Fayette, Hopkins, Houston, Leon, Medina, Milam, Robertson and Wood—three (Fayette, Lyon and Robertson) were new.

The bituminous and lignite mines in these counties gave employment to 4,227 men in 1907 for an average of 242 days, as compared with 3,048 men for an average of 227 days in 1906. Of the total number, 3,137 men were employed in the bituminous mines for an average of 255 days, and 1,090 in the lignite mines for an average of 204 days. The average production per man per day in the bituminous mines was 1.18 tons, and in the lignite mines 3.18 tons. The average production per man for the year was 300 tons in the bituminous mines and 649.3 in the lignite mines, the average for the state being 390 tons. In most of the bituminous mines the men worked eight hours a day, but in the lignite mines the ten-hour day is the rule. One mine employing sixty men reported nine hours as the length of the working day. Mining machines were used in three mines in 1907, and the product amounted to 36,100 short tons mined with thirteen machines; in 1906 the use of twelve machines resulted in 22,682 short tons of coal.

The total production of coal in Idaho in 1907 was 6,508 short tons, having a spot value of $26,494. Lignite beds occur in several areas in Idaho, but little mining has been done until within the last five or six years. The producing districts are the Horseshoe Bend and the Jerusalem, occupying the lower portion of a ridge between Boisé and Payette Rivers; an area near Salmon City, in Lemhi County, and one at the eastern edge of the state, in Bingham and Fremont counties, where the Sublette field of Wyoming extends across the state line. The principal production in 1905 and 1906 was in the Salmon district, in Lemhi County, 4,380 tons having been mined there in 1905, and 4,285 tons out of a total of 5,365 in 1906. In 1907 Fremont County was credited with a production of 2,884 tons and 3,500 tons were produced in Lemhi County. Bingham County also produced a small quantity of coal in 1907.

The total production in the state in 1907 showed an increase of 1,143 tons, or 21.3 per cent, in quantity and of $7,956, or 42.92 per cent, in value.

Reception to Farman by the Aero Club.

The Aero Club of America tendered a reception to Henry Farman, the French aeronaut, on the evening of July 30, at the Hotel Astor, New York city. Madame Farman and Mrs. Paul LaCroix received, and the guests were introduced to Mr. Farman by Augustus C. Post. Charles Jerome Edwards welcomed the guest of honor in a speech in which he told of the interest of Americans in Mr. Farman's aeroplane flights. Addresses were also made by several others eminent in aeronautics, the closing address being delivered by Charles J. Glidden, who is widely known in the electrical field and who is an enthusiastic automobilist and aeronaut.

Mr. Farman made a short address, expressing his pleasure at meeting with his brother aeronauts and so many men prominent in social and engineering life, and stated that he had complete confidence that the dirigible aeroplane was a certainty.

One of the interesting features of the evening was the brief address made by Homer W. Hedge, who talked very enthusiastically of the possibilities of the dirigible balloon and explained the formation of the Aero Club of America.

There were a great many electrical men present at this gathering, giving it the aspect of a meeting of one of the electrical engineering societies with which electrical men are so familiar.

Mr. Farman is scheduled to make a series of flights at the Brighton Beach Race Track, Brighton Beach, Brooklyn, N. Y., from August 1 to August 9.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

MONTREAL STREET RAILWAY COMPANY.

The report of earnings of the Montreal Street Railway Company for the nine months ended June 30, 1908, shows that the company did not earn the seven and one-half per cent dividends paid by it during the period. The earnings report indicates that the company either will have to reduce its dividend from the two and one-half per cent quarterly rate during the last quarter of the year or else show a large amount paid out of profit and loss surplus for the year.

The earnings for the nine months ended June 30 show as follows: Gross, $2,672,763; expenses, $1,651,707; net, $1,021,056; charges, $150,876; surplus, $570,180.

During the company's fiscal year ended September 30, 1907, it earned 9.65 per cent on the total $9,000,000 capital stock then authorized. Since the beginning of the current year the authorized capital stock has been increased to $10,000,000. The bonded indebtedness has also been increased by $2,000,000.

UNITED RAILWAYS OF ST. LOUIS.

The gross earnings of the United Railways of St. Louis for the six months ended June 20, 1908, showed a decrease equal to 2.34 per cent, but decreases in expenses and charges brought about an increase equal to 9.39 per cent in net income. The earnings for the six months' period for 1908 are: Gross, $5,163,555; expenses, $3,367,509; net, $1,796,046; charges, $1,385,547; net income $410,499; preferred dividend, $124,580; balance, $14,081.

TOLEDO RAILWAYS AND LIGHT COMPANY.

The report of the Toledo Railways and Light Company for the month of June and six months ended June 30 shows June gross of $201,766; expenses, $107,458; June net, $94,308; other income, $8; total income, $94,316; charges and taxes, $71,762; June surplus, $22,554. Six months' gross, $1,230,375; expenses, $682,388; six months' net, $547,987; other income, $2,783; total income, $550,770; charges and taxes, $420,136; six months' surplus, $130,634.

SEATTLE ELECTRIC COMPANY.

The report of the Seattle Electric Company for the month of May and twelve months ended May 31 shows May gross of $386,961; expenses, $216,858; May net, $170,103; charges, taxes and sinking fund, $87,431; May surplus, $82,672. Twelve months' gross, $4,365,709; expenses, $2,593,833; twelve months' net, $1,771,876; charges, taxes and sinking fund, $1,001,398. Twelve months' surplus, $770,478, a decrease of $38,159 as compared with the same period a year ago.

NORFOLK & PORTSMOUTH TRACTION.

The report of the Norfolk & Portsmouth Traction Company for the month of June and six months ended June 30 shows June gross of $164,526; expenses, $98,622; June net, $65,904; six months' gross, $875,619; expenses, $574,535; six months' net, $328,084.

BOSTON & WORCESTER STREET RAILWAY.

The gross earnings of the Boston & Worcester Street Railway Company for June were $54,500, the largest in the current fiscal year, and 3.6 per cent larger than in the corresponding month a year ago. The gross earnings on the main line last month showed an increase of seven per cent, but the business on the branch lines, which is local in character and in mill towns, showed a decrease, compared with a year ago, owing to the industrial depression.

MICHIGAN STATE TELEPHONE COMPANY.

The Michigan State Telephone Company's report for the six months ended June 30 shows gross earnings of $1,648,984; expenses, $1,211,252; net earnings, $437,732; interest, $208,935; balance, $228,797; dividend on preferred stock (six per cent), $68,498; surplus, $160,299.

NASHVILLE RAILWAY AND LIGHT COMPANY.

The report of the Nashville Railway and Light Company, Nashville, Tenn., for the month of June and six months ended June 30 shows June gross of $130,994; expenses and taxes, $73,622; interest charges, $32,069; reserve and sinking fund, $3,921; surplus, $12,623. Six months' gross, $760,050; expenses and taxes, $464,183; interest charges, $188,061; reserve and emergency fund, $22,670; six months' surplus, $85,136.

AMERICAN LIGHT AND TRACTION COMPANY.

The report of the American Light and Traction Company for the six months ended June 30 shows net earnings of $2,499,257, an increase of $186,292, and a final surplus after allowing for dividends and reconstruction reserve of $538,853, an increase of $116,597. The total surplus now stands at $3,196,257.

MEMPHIS STREET RAILWAY COMPANY.

The Memphis Street Railway Company, of Memphis, Tenn., for the month of

June and six months ended June 30 shows June gross of $140,882; expenses and taxes, $87,092; interest charges, $34,876; reserve and emergency fund, $2,500; June net surplus, $16,414. Six months' gross, $775,067; expenses and taxes, $494,-401; interest charges, $208,439; reserve and emergency fund, $15,000; six months' net surplus, $57,227.

CUMBERLAND TELEPHONE AND TELEGRAPH.

The report of the Cumberland Telephone and Telegraph Company for the month of June and six months ended June 30 shows June gross, $504,364; expenses, $292,209; June net, $212,155; charges and taxes, $35,374; June surplus, $176,781. Six months' gross, $3,056,978; expenses, $1,782,208; six months' net, $1,-274,770; charges and taxes, $223,018; six months' surplus, $1,051,760.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

The comparative statement of earnings and expenses of the American Telephone and Telegraph Company for the month of June and six months is as follows:

Month of June—

	1908.	1907.
Interest and other revenue	$815,351	$603,243
Telephone traffic (net)	326,237	283,161
Real estate	13,156	12,814
Other sources	40,296	42,399
Total	$1,195,040	$941,617
Expenses	203,590	181,974
Net earnings	$991,450	$759,643
Interest	647,540	579,346
Balance	$343,910	$180,297

January 1 to June 30—

	1908.	1907.
Dividends	$6,443,344	$5,685,089
Interest and other revenue	4,951,788	3,813,182
Telephone traffic (net)	1,995,864	1,832,114
Real estate	55,735	37,541
Other sources	341,658	200,845
Total earnings	$13,785,391	$11,568,772
Expenses	1,073,770	1,032,569
Net	$12,714,621	$10,536,203
Interest	3,871,675	3,439,791
Surplus	$8,842,945	$7,096,411
Dividends April-July	6,120,092	5,262,056
Net surplus	$2,722,853	$1,834,355

DENVER CITY TRAMWAY COMPANY.

A meeting of the stockholders of the Denver City Tramway will be held August 27 to authorize an issue of $25,000,000 five per cent thirty-year mortgage bonds, to be used for the following purposes: To refund the present outstanding indebtedness; to acquire all or any part of the property and assets of the Denver & Northwestern Railway Company and the Denver Tramway Power Company and to pay off or exchange for the outstanding bonds of these two companies, as well as to provide funds for future extensions, additions and improvements to the company's lines.

DETROIT UNITED RAILWAY COMPANY.

During the six months ended June 30, 1908, the Detroit United Railway earned an amount equal to 3.12 per cent on its $12,500,000 outstanding capital stock. This compares with an amount equal to 3.52 per cent earned during the first six months of 1907.

The reason for the less favorable showing this year is found in the heavy increase in charges, the increase being equal to 5.71 per cent. This increase was the principal cause for a decrease equal to the 11.37 per cent in the surplus after charges.

Below are shown the earnings for the six-month periods for both 1908 and 1907:

	1908.	1907.
Gross	$3,285,428	$3,286,869
Expenses	2,110,307	2,105,239
Net	1,175,121	1,181,630
Other income	28,609	28,239
Total income	1,203,730	1,209,869
Charges	812,973	769,078
Surplus	390,757	440,791

As the company's best months are those of July, August and September, a better showing for the last half of the year can be expected. During the year ended December 31, 1907, the company earned 8.88 per cent on its $12,500,000 capital stock. The amount available for dividends was equal to 6.71 per cent after the deduction of depreciation charges.

UNION TRACTION OF INDIANA.

Secretary William H. Forse, Jr., of the Union Traction Company of Indiana, in a circular to stockholders states that, owing to general business depression and a strike of a portion of the company's employés during January and February, gross earnings of the Indiana Union Traction Company for the year ended June 30, 1908, from all properties except those leased after June 15, 1904, do not amount to $1,850,000, and therefore no rental, based on gross earnings for such period, will be payable.

MASSACHUSETTS ELECTRIC COMPANIES.

The report of the Massachusetts Electric Companies for the quarter ended June 30 shows gross receipts of $5,328,088, an increase of $162,613 over the corresponding period last year. Net earnings after fixed charges show a gain in gross of $117,887, or 65.2 per cent. For the nine months operating expenses absorbed 68.7 per cent gross, compared with 71.4 per cent for the same three quarters of 1907.

PHILADELPHIA RAPID TRANSIT COMPANY.

While the annual report for the fiscal year ended June 30 of the Philadelphia Rapid Transit Company has not been made public, it is understood that the company carried 512,869,053 passengers during the year, an increase of 20,732,015. With the completion of the new elevated and subway line through the centre of the city it is estimated that traffic next year will show a much larger increase. Gross earnings were $18,288,000. Operating costs were a trifle higher, and the company will show a deficit for the year of approximately $92,000, as compared with last year's deficit of $364,048. With the payment of the remaining $7.50 due on September 7, the stock will be full paid and non-assessable. The payment of this assessment of $4,500,000 will clean up existing loans of $3,000,000 or more, and all payments on construction work.

TWIN CITY RAPID TRANSIT COMPANY.

The report of the Twin City Rapid Transit Company for the six months ended June 30 shows gross earnings of $2,982,849; expenses, $1,535,589; net earnings, $1,447,260; charges and taxes, $644,427; surplus for dividends, $802,-833; preferred dividend, $105,000; balance for common stock, $697,833.

LITTLE ROCK RAILWAY AND ELECTRIC COMPANY.

The Little Rock Railway and Electric Company reports for the month of June and six months ended June 30 as follows: June gross, $54,046; expenses and taxes, $30,270; interest and sinking fund, $10,-205; reserve and emergency fund, $3,000; net surplus, $10,570. Six months' gross, $330,732; expenses and taxes, $168,622; interest and sinking fund, $58,000; reserve and emergency fund, $18,000; six months' net surplus, $86,110.

BIRMINGHAM RAILWAY, LIGHT AND POWER COMPANY.

The Birmingham Railway, Light and Power Company, of Birmingham, Ala., reports for the month of June and six months ended June 30, June gross of $194,293; expenses and taxes, $118,647; interest and sinking fund, $43,846; June surplus, $31,800. Six months' gross, $1,064,825; expenses and taxes, $682,777; interest and sinking fund, $263,295; six months' surplus, $118,753.

KNOXVILLE RAILWAY AND LIGHT COMPANY.

The Knoxville Railway and Light Company, Knoxville, Tenn., reports for the month of June and six months ended June 30, June gross of $18,977; expenses and taxes, $24,933; interest charges, $11,421; surplus, $12,623. Six months' gross, $272,099; expenses and taxes, $144,697; interest charges, $68,677; surplus, $58,725.

ELECTRICITY IN AGRICULTURE.[1]

BY SIR OLIVER LODGE.

Some thirty years ago a Swedish professor named Lemström sought to elucidate the aurora borealis by trying to imitate its appearance by electrical experiments. For this purpose he produced high-tension discharges of various kinds, and sent them through vacuum tubes until he got an appearance very like those of the northern lights. Some of these experiments he conducted in his greenhouse, and he noticed incidentally that the plants seemed to thrive under the treatment, and that the electrification thus produced in their neighborhood appeared to do them good. He also noticed, as remarkable, the flourishing development of plants in arctic regions, where the sunlight was very weak, and he attributed part of this growth to the influence of electric discharges.

He says that when the plants in the north of Norway, Spitzbergen and Finnish Lapland have resisted the frequently destructive night frosts they show a degree of development which greatly surpasses that of plants in more southern regions, where the climatic conditions are more advantageous. This rich development appears principally in the fresh and clear colors of the flowers, in their strong perfume, in the rapid development of the leaves on the trees, and their scent, but particularly in the rich harvest which different seeds—such as rye, oats and barley—will produce when, as before stated, they are not destroyed by the frosts. From a bushel of rye sown they will often produce forty bushels, and from barley twenty bushels, and so forth. It is the same with grass. These results are attained although the people cultivate their soil very imperfectly, using only plows and harrows of wood.

He pursued the matter by careful observation, taking test plants in pairs or groups, electrifying one group—that is to say, discharging some electricity into the air above them—and keeping a similar group away from the electricity, in order to be able to compare them. Then he photographed the two groups side by side, and found in nearly all cases a marked improvement as the result of the electrical treatment. He concluded that the needle-like shape of the leaves in fir trees, and the beard on the ears of most cereals, had the discharge of electricity as their function, and found that they did act in this way.

It can hardly be doubted that the electrification of the air has some effect on growing plants. For it is found that, under the influence of sunshine, electrified plants can give off electricity into the air from the leaves, and the fact that the air is electrified relatively to the soil requires that the plants shall be electrified too, so that in all probability they are in a constant state of slow electrical discharge, which becomes more rapid when the sun is up. In what way this discharge of electricity from their growing tips and hair, and surface generally, really acts must be studied and reported on by physiological botanists; but it is natural to suppose that it can not be without influence and reasonable to think that that influence must be beneficial—a hypothesis which direct experiment confirms.

When, after some preliminary experiments at Bittin, J. E. Newman, of Gloucester, acting in conjunction with R. Bomford, of Salford Priors, determined to try the phenomenon on a really large scale, and came to me to see if I could help them electrically, and enable them to maintain a continuous high-tension discharge for hours together each day over ten or eleven acres by means of power furnished by an oil engine and dynamo, I very willingly assented and set my son, Lionel Lodge, upon the job.

The method is to stretch over the field to be treated a number of wires on poles, high enough for loaded wagons and all the usual farming operations to go on underneath the wires without let or hindrance. The wires are supported on the posts by elaborate high-tension insulators and they extend over all the acreage under experiment, a control plot of similar land under similar conditions being, of course, left without any wires.

The system of conductors is then connected at one post with a generator supplying positive electricity at a potential of something like 100,000 volts and with sufficient power to maintain a constant supply of electricity at this kind of potential.

Leakage immediately begins, and the charge fizzes off from the wires with a sound which is sometimes audible, and with a glow which is visible in the dark. Any one walking about below the wires can sometimes feel the effect on the hair of the head, as of a cobweb on the face. They are then feeling the stimulating action of the electrification.

The electrification is maintained for some hours each day, but is shut off at night; it is probably only necessary to supply it during the early morning hours in summer time, and in spring time or in cold cloudy weather for the whole day, or during the time of the plant's greatest activity. But at what stages of the growth of a plant the stimulus is most effective has still to be made out. However, in the case of wheat, both the ear and the straw are valuable, and the electrification is accordingly applied for a time each day during the whole period of growth until stooling begins.

The power required to generate the electricity is very small, for although the potential is high the quantity is insignificant, and the energy is accordingly comparatively trivial. It is known that even when natural atmospheric electricity has accumulated intensely, and has become a thunderstorm, the quantity even then is quite small, though the potential or tension is so enormous that the flashes are of astonishing violence and power while they last.

The electricity can be generated in more than one way. It can be generated by the revolving glass plates of a static influence machine, usually known in this country as a Wimshurst machine, or it can be generated by transforming up to high tension and rectifying to one direction the current of the revolving magnetic generator called a dynamo. The first is in many respects the simplest and was used in the early and small-scale experiments, but it can hardly be regarded as an engineering method adapted to continuous or rough use. The latter is the one which in the trials now to be described we have adopted.

The power is generated by a two-horse oil engine driving a small dynamo in an outhouse of the farm. Thence the current (three amperes at 220 volts) is taken by ordinary overhead wires to the field where they enter a suitable weather-tight hut which contains the transforming and rectifying apparatus. The only moving part here is the "break" and if the original dynamo had been an alternator even this might have been dispensed with. The transformer is a large induction coil specially made to stand continuous use and its current is rectified by means of vacuum valves in accordance with a patented device of my own.

The negative electricity is conveyed direct to earth, while high-tension electricity, all of positive sign, is led by a specially insulated conductor out of the shed to the nearest post of the overhead insulated wires, which are thereby maintained at continuous high positive potential.

The overhead system of wires covered

[1] Abstract.

about nineteen and one-half acres of ground. The wires were mounted on insulators placed upon larch poles some fifteen feet high, which were placed in rows, the rows being separated by a distance of 102 yards and the poles in a row being seventy-one yards apart. Stout telegraph wire carried the current down each row, while thin galvanized-iron wires, placed some twelve yards apart, were stretched between the rows, and acted as the discharge wires. In this way twenty-two poles were sufficient to support the wire over the nineteen acres. Roughly, only one pole per acre is required, therefore the inconvenience is practically *nil*.

Owing to the flexible suspension, risk of breakage to the wires is very small. During the two years the wires have been up at Bevington, apart from a few wires broken at harvest time by catching the top of an extra high wagon load, only one wire has fallen.

The acreage was spread over two different fields: In one field some eleven acres of wheat were under treatment; in the other six and one-half acres of barley and a half-acre plot planted with potatoes, mangolds, etc.

The wheat field was of eighteen and one-half acres extent, the remaining seven acres were sown with English (White Queen) wheat, one and one-half acres, and Canadian (Red Fife) on five and one-half acres. In the electrified part Canadian wheat occupied two and one-half acres, English wheat nine acres.

The results on the barley field, including the small plot, had to be neglected owing to the great local variations produced by the very irregular manuring the field had previously undergone; the wheat field, however, as far as one could judge, had been very uniformly treated previously.

In the wheat, a difference was noticeable at an early stage, the young blades on the electrified part being, in the opinion of many observers, of a darker green.

The crop was judged as considerably heavier by several practical observers, and the straw was, on an average, from four inches to eight inches higher. Both experimental and control plots came into ear at about the same time, but the Canadian wheat under treatment was ready for cutting some three or four days before the control area.

The following is a very brief summary of returns and information supplied to me by Mr. Newman and Mr. Bomford, showing the results from the electrified as compared with the control unelectrified plots.

SUMMARIZED RESULTS OF THE 1906 EXPERIMENTS.

Bushels of wheat per acre.

(Estimated corresponding increase in straw not measured.)

	From the Electrified Plot.	From the Unelectrified Plot.	Increase. Per Cent.
Canadian (Red Fife)...	35½	25½	40
English (White Queen).	40	31	30

Moreover, the electrified wheat sold at prices some seven and one-half per cent higher, several millers in baking tests finding that it produced a better baking flour.

The increase appears to be mainly due to better stooling. No marked difference was observable in the development of ears.

J. Kirkland, of the National School of Bakery, Borough Polytechnic, found the evidence from baking tests supported by the average of dry glutens from all his tests thus:

	Per Cent.
In the electrified	11.15
In the unelectrified	10.85

The somewhat poor yield of wheat obtained from the unelectrified portion of the field is probably explained by a deficiency in lime, which has now been rectified. Further, the wheat was spring sown, and red fife, under this condition, does not usually yield good crops. The experiments are being repeated upon wheat during the present season, and strawberries are also under treatment once more.

In 1907 wheat was grown again in the 1906 wheat field. Current was cut off from most of the barley field, which was down to clover and rye grass; eight and one-quarter acres in an adjoining field were planted with strawberries (Stirling Castle) in March, approximately two and three-quarters acres having a wire network erected over them. Mangolds were planted between the strawberry rows.

The wheat field during the early spring was given a dressing of lime, ten hundredweight to the acre, four hundredweight to the acre, bone meal drilled in; the unelectrified part was given one and one-half hundredweight sulphate of ammonia, and the electrified part three-quarters hundredweight. Barley had been grown on the strawberry field in 1906, and this was given ten tons to the acre of farmyard manure, which was plowed in.

RESULTS OF CROPS, 1907.

WHEAT.

(Variety—Red Fife, Spring Sown.)

Seven and one-half acres unelectrified gave 239 bushels thirty-eight pounds head wheat, fifteen bushels one pound tail.

Eleven acres electrified gave 455 bushels fifty pounds head wheat, seventeen bushels twenty-seven pounds tail.

Or, summarizing as follows:

BUSHELS PER ACRE (HEAD WHEAT).

Electrified, 41.4; unelectrified, 32; increase 29 per cent.

Electrified wheat brighter and a better sample. Increase due to better stooling and also better filling out of ears.

HOURS PLANT RUNNING.

1906, March 16 to July 10, inclusive; 621¾ on ninety days. Average electrical pressure corresponded to a three-quarters-inch spark.

1907, March 28 to July 27, 1,014 hours on 115 days. Average pressure corresponded to a one-half-inch spark.

STRAWBERRIES.

This being the first year, the crop was necessarily very small, and was picked chiefly to see if any increase had been obtained. The result showed a thirty-five per cent increase. Earlier ripening was also observed.

Mangolds—It was found impossible to weigh either the whole or a part of this crop. Estimated increase (from number of cartloads removed) twenty-five per cent. Analysis showed an increase in the sugar where electrified, but the results varied considerably.

Small plots of raspberry canes showed a marked improvement in growth. A curious point about the raspberries was that the foliage and fruit on the old canes showed no difference, but that the new growth, particularly after the old wood was cut back, showed an enormous difference in favor of the electrified. The manurial treatment was exactly similar.

Small plots of tomatoes also showed a large increase in the crop.

Those interested in the experiments are much indebted to the enthusiastic co-operation of Mr. Bomford. It may be interesting to note that it was at a farm belonging to Mr. Bomford's father that the first steam plowing in England was done.

Professor Lemström is undoubtedly the pioneer in this sort of work; though circumstances connected with the natural electrification of the atmosphere and with the discharge of electricity from various surfaces have been pertinaciously examined by Professors Elster and Geitel.

Professor Lemström published his results with full details and illustrations, both of the apparatus used and of the appearance of some of the resulting crops, in a small book called "Electricity in Agriculture and Horticulture," published in English by the Electrician Company, in 1904, and is well worth referring to.

The Abbé Berthelon, in 1783, raised a head of metallic points in the air, in the manner of a lightning conductor, and made it terminate in a series of discharge points just over the plants. He states that the use of this apparatus was invariably accompanied by an improvement in the appearance of the vegetation and by an increase in the fertility of the plants.

An opposite or control experiment was made by Grandeau in 1879 when he protected a plant from atmospheric electricity by means of a wire cage, and showed that its development was greatly retarded.

Other experimenters have done the same thing and made careful measurements of the results, which are all in the same direction.

Professor Berthelot compared the growth at the top of a twenty-eight-metre tower with that of plants growing at the foot, and considered that the greater growth at the higher level was largely due to the potential gradient in the atmosphere.

Dr. Cook, of Bristol, likewise obtained an increase in the rate of growth by the use of an overhead discharge on a small scale.

During the winter of 1904 Mr. J. E. Newman installed a small trial apparatus, consisting of a small influence machine of the Wimshurst type and overhead discharge wires, at the Golden Valley Nurseries at Bitton, near Bristol. The wires ran about sixteen inches above the tops of the plants, or above the rows of tomatoes in the glass houses, and short pieces of fine wire, with the free ends pointing downward, acted as discharge points.

From March 7 to July 26 the machine was running during 108 days for a period of 9.3 hours daily, principally at night.

In all cases control plots were provided, which, as far as practicable, were under identical conditions, and the very favorable results obtained led to the experiments on a larger scale above described.

The Annual Convention of the Brilliant Electric Company.

The annual convention of the officers, sales managers and representatives of the Brilliant Electric Company was held at Cleveland, Ohio, July 18, 19 and 20, headquarters being established at the Colonial Hotel. The three days' convention included business sessions and excursions to various points of interest for rest and recreation. On the morning of July 18 the representatives made a visit to the engineering department of the National Electric Lamp Association, where an address was delivered by Chief Engineer S. E. Doane. Later in the morning a trip was made on special cars to the Gates Mills, where luncheon was served, after which a baseball game was played between the jobbers and the salesmen. In the evening dinner was served at the Colonial Hotel, and addresses made as follows: "The Brilliant Electric Company," by M. H. Nason, vice-president of the company; "The Brilliant Lamp from a Jobber's Standpoint," C. K. Crossan, president of the Sweeten-Crossan Electric Company; "The Tungstolier," Milton Hartman, manager of the Tungstolier department; "Co-operation with the Jobber," by F. B. Galloway, of Cleveland; "The Diagnosis of a Lamp Man," by E. V. Hennecke, of Cleveland; "Modern High-Efficiency Illuminants," Herman Akhurst, of Cleveland; "Personality as a Business-Getter," D. W. Hopper, of Cleveland. The evening session was closed with an address by E. J. Kulas, secretary and general manager of the company.

On Sunday, July 19, the party made a trip on the steamer Eastland to Cedar Point.

On Monday, July 20, breakfast and luncheon were served at the Breakers Hotel, Cedar Point. In the afternoon the party left Cedar Point, and dinner was served at the Colonial Hotel, in Cleveland. At 9 P. M. there was a farewell supper at the Hofbrau, most of the members of the party leaving for Buffalo, where the jobbers' meeting was held.

Among those present were the following:

Herman Akhurst, Brilliant Electric Company, Cleveland, Ohio.

F. C. Barrington, Columbian Electrical Company, St. Joseph, Mo.

F. M. Bernardin, B-R Electric and Telephone Manufacturing Company, Kansas City, Mo.

M. G. Campbell, B-R Electric and Telephone Manufacturing Company, Kansas City, Mo.

E. E. Chase, Brilliant Electric Company, Cleveland, Ohio. Tungstolier department.

Thomas M. Cluley, Union Electric Company, Pittsburg, Pa.

Thomas Creaghead, Creaghead Engineering Company, Cincinnati, Ohio.

C. K. Crossan, Sweeten-Crossan Electric Company, Philadelphia, Pa.

H. H. Cudmore, Ambos-Cudmore Company, Cleveland, Ohio.

H. C. Downing, Downing Electric Company, Fort Dodge, Iowa.

G. O. D'Urfae, Brilliant Electric Company, Cleveland, Ohio.

F. B. Galloway, Brilliant Electric Company, Cleveland, Ohio. Tungstolier department.

L. Grieser, Cleveland Electrical Supply Company, Cleveland, Ohio.

Milton Hartman, Brilliant Electric Company, Cleveland, Ohio. Tungstolier department.

W. J. Hartwig, W. J. Hartwig Company, Detroit, Mich.

E. V. Hennecke, Brilliant Electric Company, Cleveland, Ohio.

H. B. Hewett, Cooper-Hewett Company, Louisville, Ky.

D. W. Hopper, Brilliant Electric Company, Cleveland, Ohio.

J. H. Hughes, E. B. Latham & Company, New York city.

W. C. Jones, Union Electric Company, Pittsburg, Pa.

L. H. Keller, Union Electric Company, Pittsburg, Pa.

E. P. Kinney, Capitol Electrical Engineering Company, Lansing, Mich.

A. C. Knight, Brilliant Electric Company, Cleveland, Ohio. Tungstolier department.

G. A. Knoche, Dunham, Carrigan & Hayden Company, San Francisco, Cal.

C. F. Koepge, Brilliant Electric Company, Cleveland, Ohio.

E. J. Kulas, Brilliant Electric Company, Cleveland, Ohio.

C. E. Ludovici, E. B. Latham & Company, New York city.

M. McGraw and representative, Interstate Supply Company, Sioux City, Iowa.

F. C. Maxheimer, Cleveland Gas and Electric Fixture Company, Conneaut, Ohio.

M. H. Nason, Cleveland, Ohio.

G. W. Provost, Union Electric Company, Pittsburg, Pa.

J. P. Provost, Union Electric Company, Pittsburg, Pa.

W. S. Reynolds, Brilliant Electric Company, Cleveland, Ohio. Tungstolier department.

Mark Simonton, Electric Supply and Construction Company, Columbus, Ohio.

F. D. Sweeten, Sweeten-Crossan Electric Company, Philadelphia, Pa.

R. H. Westbrook, Westbrook Brothers & Company, Greensboro, N. C.

One of the interesting features of the convention was the issue of "Daily Doings," published each day during the meeting. This contained the official programme and a great deal of interesting matter, personal and otherwise. The bulletin was edited by Milton Hartman, of the Tungstolier department, and contributed greatly to the success and enjoyment of the meetings.

THE TEST-METER METHOD OF TESTING SERVICE METERS—I.

BY JOSEPH B. BAKER.

The testing of meters at their places of installation by the use of indicating instruments is accurate, but is slow and correspondingly expensive.

The most serious disadvantage of the indicating-instrument and stop-watch method is the great amount of computation which is involved. The two sets of factors entering into the calculation—the disc constant of the meter and the number of seconds required for the disc to make a given number of revolutions, and the amperes and volts as read by the indicating instruments—must be reduced to watts in order to make them comparable. This operation may be summarized briefly as follows: The disc revolutions are multiplied by the meter's disc constant to obtain watt-hours, and this again multiplied by 3,600 to reduce to watt-seconds. This product is then divided by the number of seconds recorded on the stop-watch to obtain the watts recorded by the meter, which is then compared with the true watts, found by multiplying together the instrument amperes and volts. The computation is usually performed on a slide rule and occupies two or three minutes.

In order to facilitate the making of routine tests, *i. e.*, shorten the time and lessen the labor required to make the house-to-house tests without sacrifice of accuracy, standard rotating wattmeters have been employed instead of indicating instruments. In this method of testing as formerly practiced a carefully calibrated meter of the same capacity and disc speed as the consumer's meter is connected in circuit with the latter and the number of revolutions made by the two meters in a given time observed on a stop-watch; the test load being either the consumer's regular load or a determined load given by a lamp bank or rheostat. The portable standard was usually suspended from the consumer's meter by adjustable chains.

In the early method of comparison and calibration the main fields of the "standard meter" were connected immediately in series with the main fields of the consumer's meter and its potential circuit in parallel with that of the consumer's meter, so that one meter (A) was next to the mains and the other meter between A and the load. After throwing on the load (usually the consumer's regular load) the two discs, previously held still, were allowed to start at the same instant, and the "gain" of one over the other as the discs revolved was readily observed by sighting on marks on the edges of the two discs. After a few revolutions it became apparent whether the meter under test was "fast" or "slow," and the necessary cleaning of the consumer's meter, replacing of its jewel, adjustment, or what not, was done until the two discs ran in synchronism. Allowance was made, of course, for the lower registration of the meter which was next the load, due to the watts lost in the other meter. This method of testing was regarded as especially convincing to the customer whose meter was being tested, since the method was more comprehensible to him than a test by indicating instruments; but it was deemed advisable to connect his meter between the standard meter and the load, rather than the other way about, in order that he should not observe his meter to be running faster than the standard, when it was declared by the tester to be adjusted properly!

The time required to test a consumer's meter by this method is short compared to the time required to test with indicating instruments; and the procedure is simple, inasmuch as no error is introduced by variation of either load or potential (as on a motor load, for example), and there are no swinging instrument pointers to make readings difficult. On the other hand, a disadvantage of the method for routine testing as originally practiced was that it necessitated the daily checking and transportation of as many test meters as there were different capacities of customers' meters to be tested; since otherwise the tester must reduce the revolutions of the standard meter to an equivalent number on the meter under test, by slide-rule or pencil computations.

Sources of Error—Following are the principal sources of error in the use of a rotating wattmeter for testing, in the order of their importance. The sources of error, as stated, apply more particularly to direct-current meters of the commutator type:

(1) Differences in friction and vibration, especially when the test meter is running on light load. The uncertainty, as to accuracy on light load, of the portable standard—which was, of course, inherently quite as great as in the consumer's meter, under ordinary conditions, due to the magnitudes of the possible change in commutator and jewel friction as compared with the torque—was one of the two main disadvantages of its use for testing; the other being the need of having as many portable standards as there were sizes of consumers' meters installed. Changes in commutator friction may change the accuracy on one-tenth load as much as ten per cent in one day, and any heavy vibration, such as that caused during the test by a passing truck or trolley car, may change the accuracy for the time being to a very serious extent.

(2) Using the test meter before the potential circuit has had time to warm up to normal operating temperature, corresponding to the temperature of the consumer's meter. The test meter runs fast when first connected to the circuit, due to the fact that it is disconnected for a relatively long time, and thus has time to cool down, between the tests made at successively visited installations.

(3) Connecting the test meter on the wrong polarity, thereby causing error, especially on light loads, due to the stray fields from the braking magnets.

(4) Heat radiated by the series fields of the test meter when carrying a heavy load for a considerable length of time. This heat increases the resistance of the armature, causing it to run slightly slower.

It will be noted that the test-meter method possesses decided points of merit, while its disadvantages are mechanical and external, rather than inherent in the testing principle involved; so that if the disadvantages could be removed, the method, consisting as it does of a direct comparison of the consumer's meter with a standardized apparatus of identical type, would become an almost ideal way—accurate, quick and inexpensive—of testing a large number of consumers' meters in succession.

MODERN COMMERCIAL TEST METERS.

The manufacturers of the commercial test meters of the present day have sought to realize the advantages and eliminate the sources of error above described, by working along the following two separate and distinct lines:

A. The composite field construction and method exemplified in the Mowbray, Thomson and Fort Wayne test meters.

B. The method of employing a rotating standard meter of the same type and adjustable to the same capacity as the service meter to be tested, as exemplified in the Westinghouse multiple field rotating standard. An account of these three commercial test meters will be given in subsequent articles.

The Extension of the Telegraph.

From statistics made public by the German Government the following data have been compiled comparing the extent and cost of telegraph service in the various countries of greatest importance in the year 1906:

The United Kingdom leads in the number of messages sent—94,000,000; the United States has, however, the greatest number of miles of line—1,155,480; France has the lowest average cost of message—twelve cents.

	No. of Messages in Millions.	Average Cost per Message.	Total Receipts.	Miles of Line.
United States....	65.5	$0.42	$27,985,000	1,155,480
United Kingdom.	94.0	.16	15,247,000	384,109
France...........	58.0	.12	7,331,000	389,002
Germany.........	52.5	.15	8,290,000	458,358
Austria..........	19.0	.14	2,702,000	133,549
Italy..............	16.0	.21	8,472,000	128,582
Spain.............	5.0	.32	1,640,500	47,923

Statistics of Russia, Japan and other countries are incomplete.

The Brusio Hydroelectric Plant and Its 50,000-Volt Swiss-Italian Transmission System.

By Frank Koester.

THE largest and most recent hydroelectric installation in continental Europe is that at Brusio in the southeastern corner of Switzerland. Some 3,155 feet above sea level, bordered by the slopes of the Bernina Mountains, lies the lake of Poschiavo. This lake receives, among others, the waters of the River Poschiavino and its tributaries as well as those of the River Cavagliasco, which in turn collects the waters of the glaciers Cambrena and Palü. The total drainage area which feeds this lake is seventy-seven square miles. The area of the lake is 0.77 square mile and its greatest depth is 260 feet.

Owing to the high altitude of the lake the water supply in the winter time will be considerably less than during other seasons, consequently the equipment of the plant with proper regulating devices became very essential. Therefore one of the foremost requirements consisted in damming the lake at its outlet, where the River Poschiavino continues, so that the water level of the lake may be raised 3.3 feet above the normal and lowered by siphoning as much as 24.3 feet below the normal level, thus providing a natural reservoir giving a reserve water supply of 520,000,000 cubic feet.

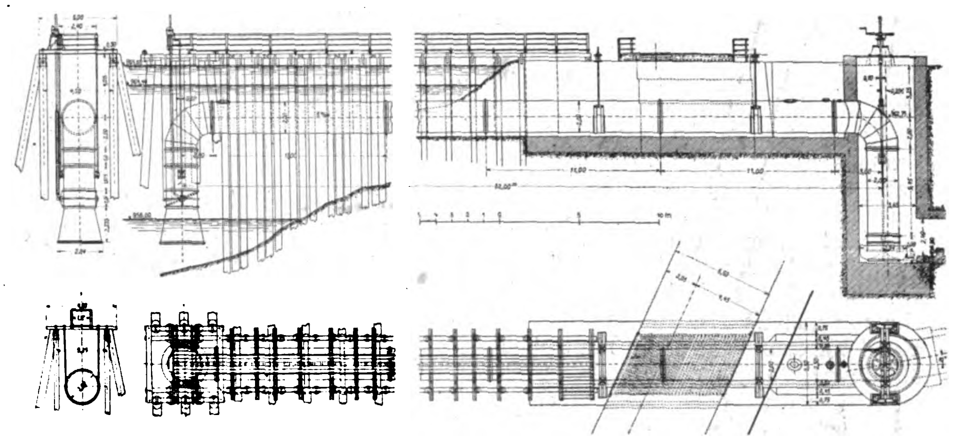


FIG. 1.—SIPHON SYSTEM AT LAKE POSCHIAVO POWER PLANT, BRUSIO, SWITZERLAND.

The headrace leading from the lake is carried to Monte Scala, a distance of 3.25 miles, by a tunnel through the mountain at a considerable depth, where a collecting basin is provided. The power plant is located at Campocologna, receiving the water through penstocks from the collecting basin under a head of 1,300 feet.

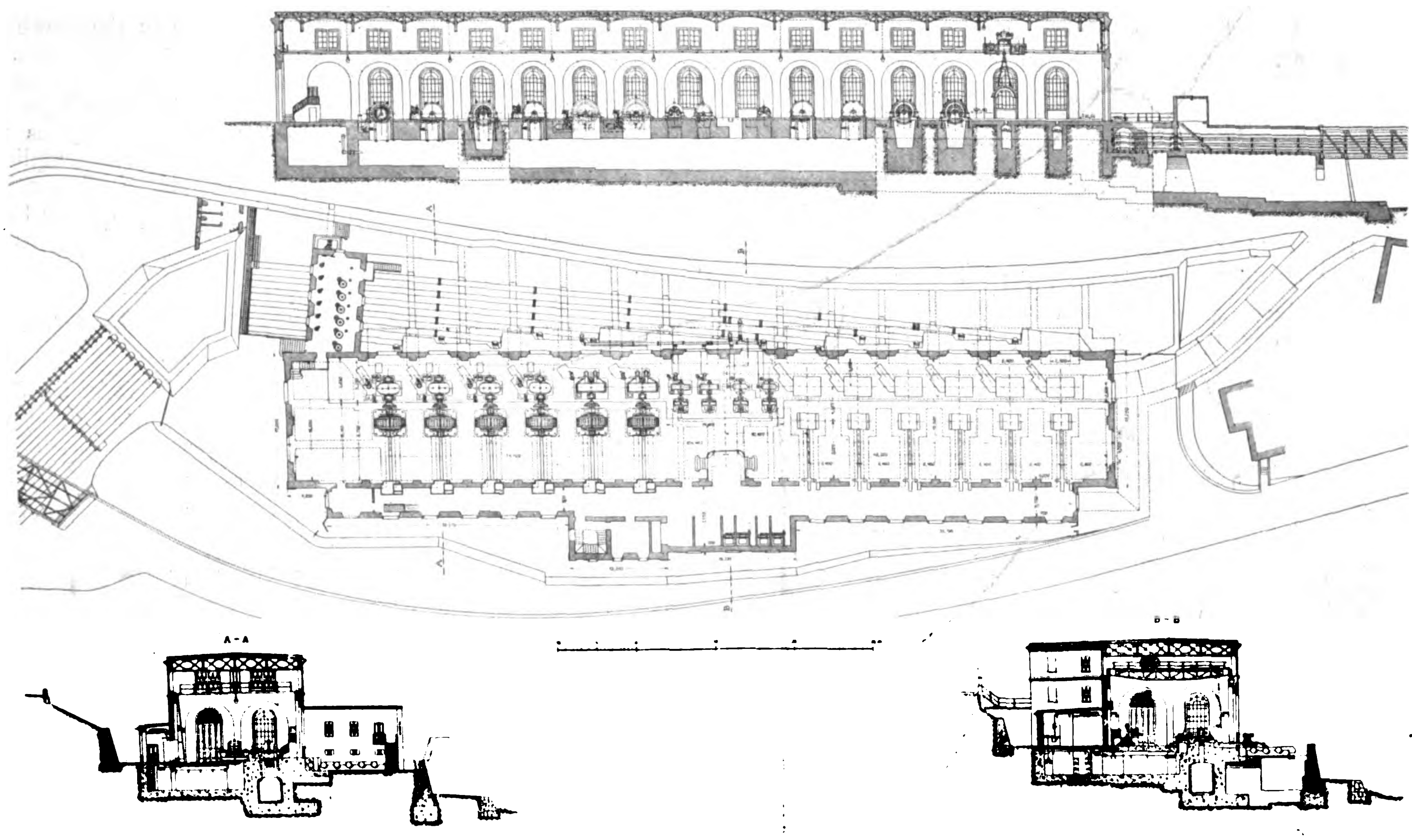


FIG. 2.—GENERAL LAYOUT OF POWER PLANT, BRUSIO, SWITZERLAND.

Current is generated at 7,000 volts and is transmitted through a tunnel across the boundary into Italy, where, at a substation in Piattamala, the voltage is stepped up to 50,000 for use by the Societa Lombarda, an Italian distributing company, to work in parallel with their well-known stations in Vizzola and Castellanza. This company guarantees the use of 16,000 kilowatts. From the power plant itself several aerial lines transmit current to various other consumers in Switzerland, and among them it will assist a small

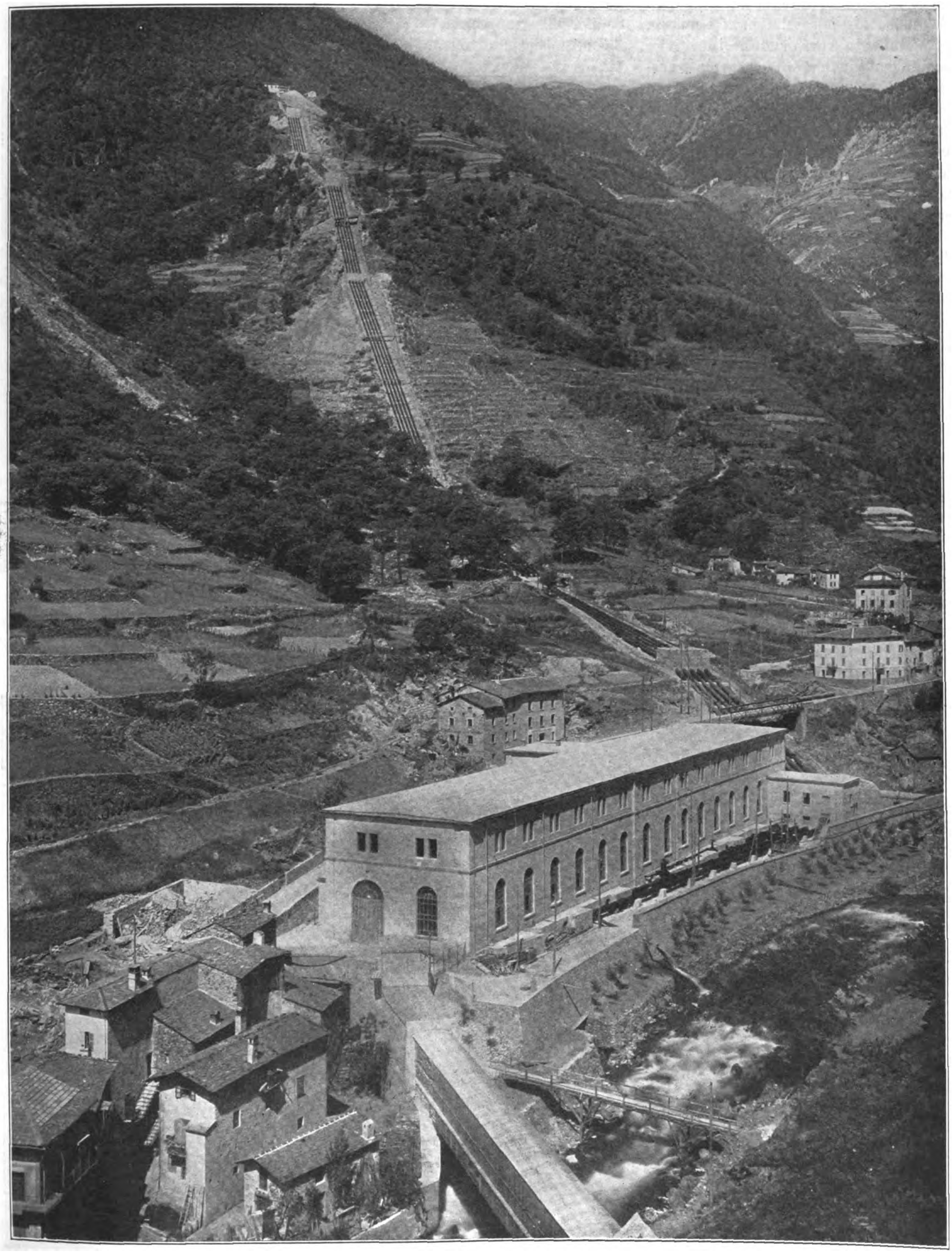


Fig. 3.—Power Plant at Brusio, Switzerland, Showing Also Penstocks and Cable Tunnel.

power plant still under construction at Sajento.

The 40,000-volt transmission line, from Piattamala to the substation at Lomazzo, is 88.5 miles in length and consists of two independent lines. A 20,000-volt transmission line branches off northward to Como from the station at Lomazzo, running a distance of thirty miles. An 11,000-volt line runs southward eight and one-half miles to the steam-power plant at Castellanza for assisting or drawing current from same. The bulk of the current is used for spinning and weaving mills, which begin operations at 7 A. M.; reaching its maximum in a half hour, the load remains steady up to 12 o'clock noon, dropping in thirty minutes to a few hundred kilowatts and again reaching its maximum at 1 P. M., where it remains up to 7 P. M. During the night only 2,000 kilowatts are necessary.

The entire hydroelectric development and transmission system is considered the most up-to-date in Europe, embodying many excellent examples of modern European practice.

SIPHON SYSTEM.

As the level of the water in the lake will vary in the neighborhood of thirty feet, the headrace tunnel is located 32.8 feet below the normal water level. It was not advisable to connect the tunnel directly with the bed of the lake, therefore a siphon was installed. For this purpose a shaft was sunk about seventy-five feet from the water's edge and carried 7.4 feet below the low-water level. The shaft is twelve feet in diameter and the portion below water-level was built under air pressure. From this shaft the headrace or supply tunnel, having a diameter of 8.9 feet at this point, leads to the collecting basin.

The lake is connected to this shaft by means of a siphon tube 6.5 feet in diameter and 270 feet horizontal length or body. The suction leg is twenty-six feet long, provided with a screen and butterfly valve, while the discharge leg is 27.7 feet long. The latter is provided at its bottom end with a disc valve for regulating the flow of water. The tube has a pitch of five feet in a thousand and is provided at its highest point with nozzles; one being three and one-half inches in diameter connected to a double-stage air-pump for starting the siphon, and the other, an eight-inch connection for a centrifugal pump which is used for cleaning the siphon tube and particularly the screen. Instead of using the air-pump for starting, the centrifugal pump may be called upon, in which case, both butterfly and disc valve are first closed. Fig. 1 shows the general arrangement.

Since about 180 feet of the horizontal length of the siphon is located in the lake under the normal water level, this portion of the tube, made in sections of thirty-six feet, was fitted at its ends with blank flanges and then floated to its position between piles and anchored to the framework of the piling. The final flange connections were made by divers.

SECONDARY WATER SUPPLY.

For the purpose of damming the water in the lake six sluice gates were built at the outlet of the lake, five of these gates being 13.12 feet wide and one being 6.56 feet wide. The smaller one, which is located lower than the others, is used for passing sand and gravel. Located at a right angle to the dam or sluice gates, is

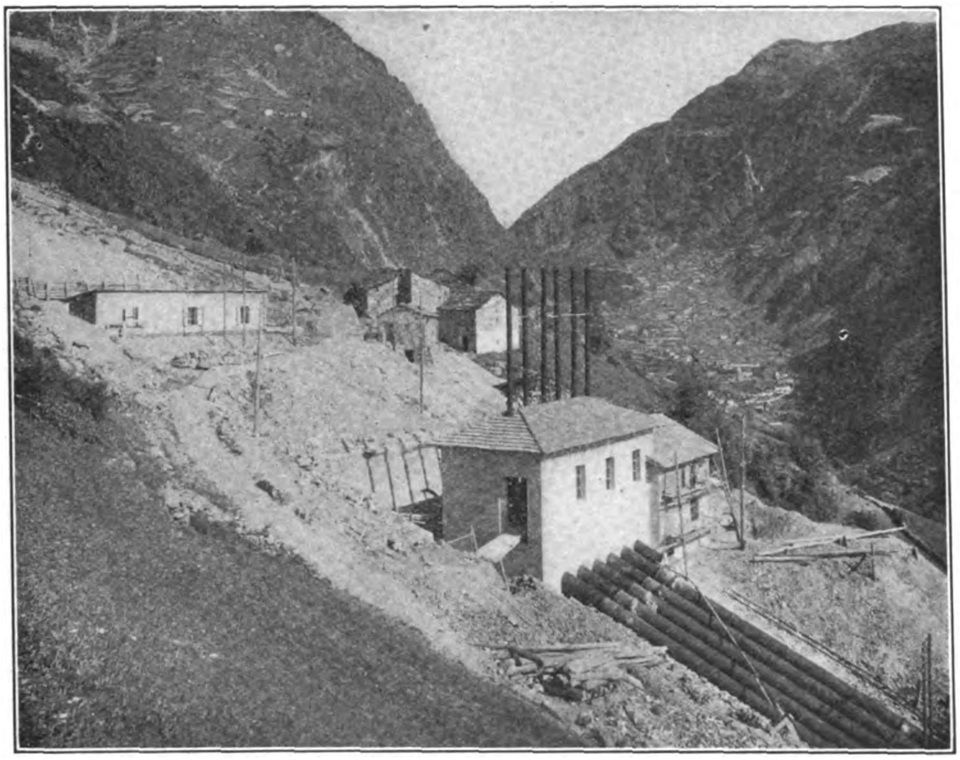


FIG. 4.—GATE-HOUSE FOR PENSTOCKS, HYDROELECTRIC PLANT, BRUSIO, SWITZERLAND.

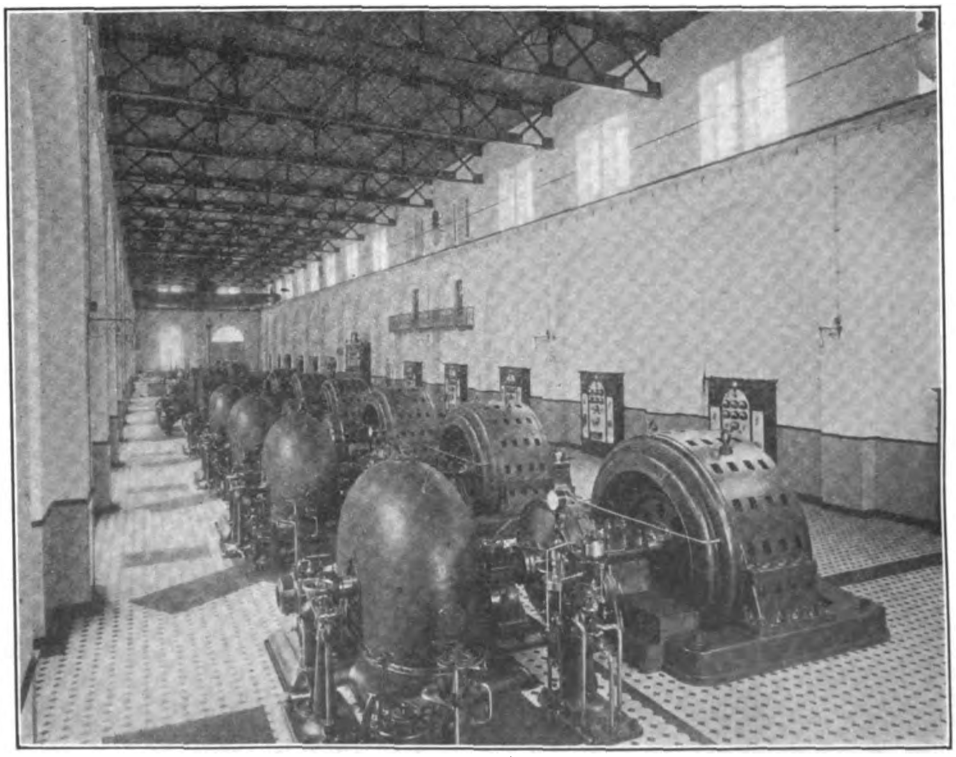


FIG. 5.—INTERIOR OF POWER PLANT, BRUSIO, SWITZERLAND.

a small basin provided with a screen. A thirty-three-inch pipe, provided with a gate, leads from this basin to the headrace tunnel, 800 feet below, where a shaft was sunk to receive the pipe; this arrangement, constituting a secondary water supply, was utilized in order to start up the plant at an early date. The size of this pipe was chosen so that it might later be used as one of the penstocks leading from the collecting basin to the power-house. This pipe by-passes the upper section of the headrace tunnel and the siphon system, furnishing the water supply during their construction pending the securing of necessary concessions.

HEADRACE.

The headrace is 17,056 feet long, 4,920 feet running through moraine (a formation similar to landslides) and the remainder through gneiss. A portion of the tunnel, near the collecting basin, lies about 100 feet deep, while the greatest portion of its length lies some 425 feet beneath the surface. With that portion of the tunnel lying at the greatest depth and running through the gneiss formation, no difficulty was experienced from seepage and air leakage, while in the portion nearest the surface, and where the tunnel runs through moraine, such difficulty was experienced. For the purpose of draining the seepage water and discharging the air, eleven lateral tunnels were cut having their outlet at the nearest point on the mountain slope.

The tunnel, where cut through the rock, was lined with concrete to a point above the water line, while the portion of the tunnel above the water was left unlined. Where the tunnel runs through the loose earth (moraine) it is constructed partly of concrete and partly of reinforced concrete, and where it was cut through the rock, pneumatic drills running on tracks were employed. For this purpose, and for lighting, a temporary power plant was installed, utilizing the fall of the Sajento River. The headrace was constructed of a wooden flume 910 feet long and a twelve-inch steel penstock. A fifty-horse-power turbo-generator, giving 4,000 volts, and the turbine also operated a two-step compressor supplying air at ninety pounds pressure through two main pipe-lines.

At three of the seepage discharge tunnels ventilators were installed during construction, while at the remainder ventilation was produced by means of branches from the compressed-air lines. Leading to the mouths of the seepage discharge tunnels Nos. 6 and 9, 1,000 to 1,500 feet above the valley, were electrical cable transportation lines.

At seepage discharge tunnel No. 2, near the lake, an overflow system is provided with a sand and gravel trap.

The entire tunnel, which is egg-shaped with a flat bottom, has a slope of two feet to the thousand and has a sectional area of fifty-three and one-half square feet. The average velocity of the water in the tunnel when partly filled is 6.5 feet per second. Should the possibility arise that in the future the tunnel should be used as a pressure tunnel, for which provision has been made, the velocity of the water will be five feet per second.

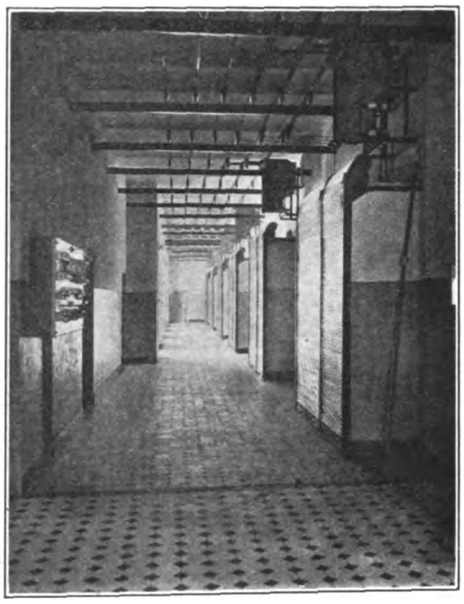


FIG. 6.—REAR OF SWITCHBOARDS AND GENERATOR BUSSES.

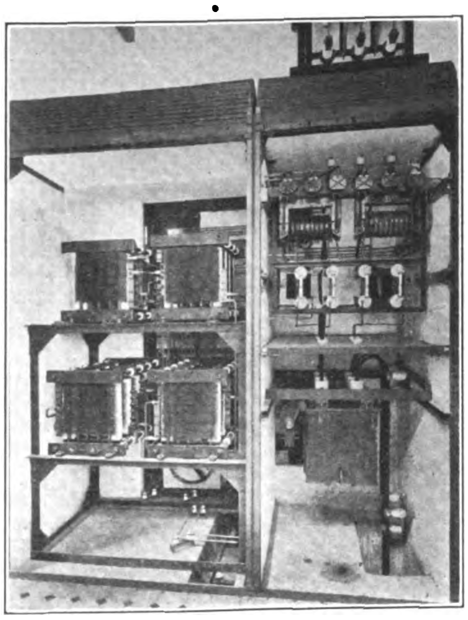


FIG. 7.—REAR VIEW OF INDIVIDUAL GENERATOR SWITCHBOARD.

As will be noted from the dimensions of the tunnel given above, the volume of water contained in same furnishes auxiliary storage capacity to the collecting basin. Furthermore, for a length of one mile the sectional area of the tunnel was increased, and in order to properly regulate the water supply to the collecting basin, an additional overflow was provided at the seepage discharge tunnel No. 9, discharging into the above-mentioned Sajento River. The collecting basin is so dimensioned that with average loads the level of the water will be constant, while with light loads the level of the water will be higher, and during the hours of maximum load the water level will be correspondingly lower.

COLLECTING BASIN AND PENSTOCKS.

The collecting basin is located 1,300 feet above the valley and is provided with six penstock connections arranged in pairs. The connections of each pair are located in separate chambers provided with screens.

The usual practice of providing the penstocks with cutoff gates has not been followed owing to the sudden rise and fall of the water. An automatic float arrangement for signaling the attendant was installed, operating by releasing a pawl and a magnet clutch and allowing a swing gate to close.

About 100 feet from the collecting basin is a gate-house through which pass the six penstocks. At the headgates they have a diameter of 33.5 inches and, owing to the high head (1,380 feet), considerable material was saved by reducing the diameter at the power-house to 23.5 inches by telescoping certain sections of the penstocks, thus giving at its lower end a velocity of 11.5 feet per second. The penstocks are made up of rolled steel in sections 39.36 feet in length. The heaviest material employed is seven-eighths inch. The sections are bolted together by the use of movable flanges. As will be seen in Fig. 2, the penstocks run down the mountain slope at various angles, at which they are anchored in solid concrete blocks, there being ten anchorages. Between these anchorages the penstocks rest on concrete piers, the expansion being provided for by the use of slip expansion joints. At the headgates (Fig. 4) each penstock is provided with a vent pipe about forty-five feet high. Drainage gates are provided at the lower ends of the penstocks for draining into the tailrace. Here the six penstocks are interconnected by a cross pipe having two outlets, one leading to the exciters, and the other being provided with a safety device, so that in case of excess of pressure the "bursting plate" gives way and relieves the penstocks. This cross-pipe connection also serves the purpose of maintaining a uniform circulation.

There are at present installed, corresponding to the main turbo-units, five penstocks. For hoisting the penstocks and other materials during construction, an electrically operated cable road was installed. The drum and motor are located in an annex to the gate-house near the collecting basin.

POWER-HOUSE.

The power-house (Fig. 2 and Fig. 3) is located at Campocologna alongside the River Poschiavino. The main generator room is 342 feet long by 56.4 feet wide. At the side there is a single-story switch annex 311.5 feet long by 10.75 feet wide, with a three-story central section for offices.

Owing to the topography heavy retaining walls were required, with deep and expensive building foundations. Up to the main generating-room floor the building is of concrete, while the superstructure is of quarried stone and tile. The roof construction is expensive and is as follows: Between I-beam purlins are large tile blocks, the undersides of which are glazed to form a finished ceiling. These are covered with a one-eighth-inch layer of cement over which are spread three layers of so-called wood-cement (consisting of sawdust and cement), between each of which is laid a layer of paper. Above the layers of wood-cement are reinforced concrete slabs, an air space of two and three-eighths inches being left between these slabs and the wood-cement. These precautions have been taken on account of the extreme heat in the summer time.

The building accommodates twelve turbogenerator units, each of 3,000 to 3,500 kilowatts' capacity, and four exciter units of 250 horse-power each. Ten of the turbo-generator units are at present installed. A twenty-five-ton electrically operated traveling crane serves the entire generating room.

TURBO-GENERATOR UNITS.

There are two different types of turbines installed: The Pelton wheel of Escher, Wyss & Company, of which there are at present four installed, two main and two exciter turbines, and the Girard turbine with partial admission, of Piccard, Pictet & Company, of which there are at present installed four main and two exciter turbines. The main turbines (3,000 kilowatts) run at a speed of 375 revolutions per minute and the exciters (150 kilowatts) at 430 revolutions per minute. The turbines are direct-connected to the water-wheels by flexible insulated couplings of the Zodel-Voith type.

The generators are 3,000-kilowatt, three-phase, fifty-cycle, 7,000-volt machines, and are designed for an overload capacity of twenty-five per cent. They

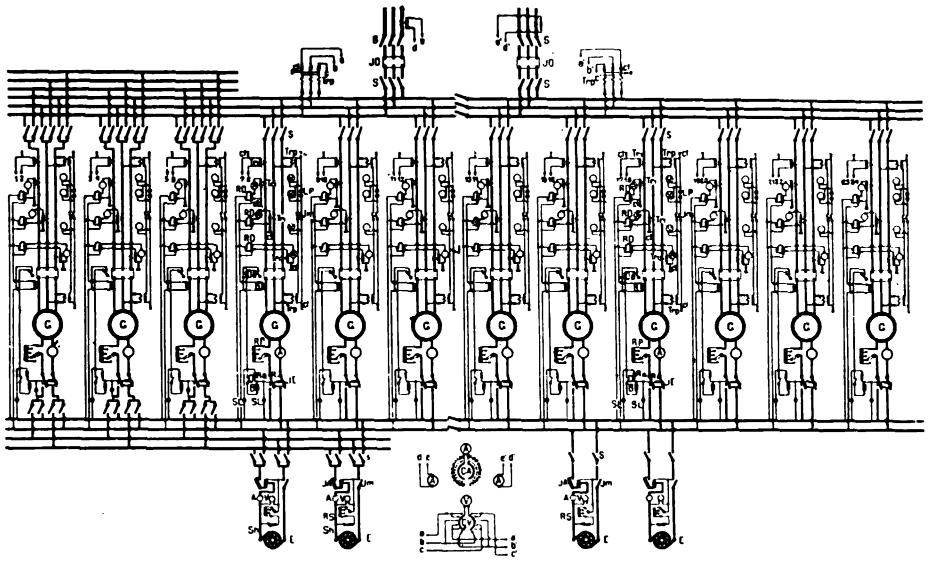


Fig. 8.—Wiring Diagram of Power Plant at Campocologna. A, Ammeter; B, Trip-Coil; CA, Ammeter Switch; CV, Voltmeter Switch; Ct, Ground Connection; Da, Auxiliary Switch for Trip-Coil; E, Exciter; G, Generator; JA, Overload Circuit-Breaker; JE, Field Switch with Discharge Resistance; Jm, Knife Switch; JO, Oil Switch; JOa, Automatic Oil Switch; LP, Synchronizing Lamp; Ra, Rheostat; RD, Relays; Ri, Discharge Resistance for Field Switch; RP, Series Rheostat; RS, Shunt Rheostat; S, Disconnecting Switch; SL, Pilot Lamp; Sh, Exciter Field; Tri, Current Transformer; Trp, Potential Transformer; V, Voltmeter.

are of the sixteen-pole, revolving field type. The poles are cast directly to the field ring. The stator is made in halves and has a bore of ten feet two inches, the width being three feet seven inches. The bedplate is made in two sections with the bearings cast on. The Elektrizitäts Gesellschaft Alioth, Münchenstein-Basel, Switzerland, manufacturers of the generators, who installed also the entire electrical equipment, guarantee the efficiencies as follows:

Power Factor, Cos φ = 1.	Cos φ = 0.7.	Load.
Per Cent.	Per Cent.	Per Cent.
93.5	92.0	0.25
95.0	93.5	0.75
96.0	94.5	1.00
96.5	95.0	1.25

The four exciters are of the six-pole, 115-volt, shunt-wound type. They develop 150 kilowatts at 430 revolutions per minute. Each exciter serves four generators with twenty-five per cent overload.

Contrary to the usual practice of centralizing the switchgear, because it was thought best for the convenience of operation and a material decrease in first cost and simplification of the wiring system, each generator has its own switchboard. As will be seen in Fig. 5, these switchboards are located against the wall next to the switchroom and directly opposite each generator.

Thus the station is divided into complete unit systems. However, to control all switchboards from one central point an instrument column has been installed as will be seen later on. The switchboards are of ornamental design and are faced with white marble slabs. All high-tension parts of the switchgear are located on the

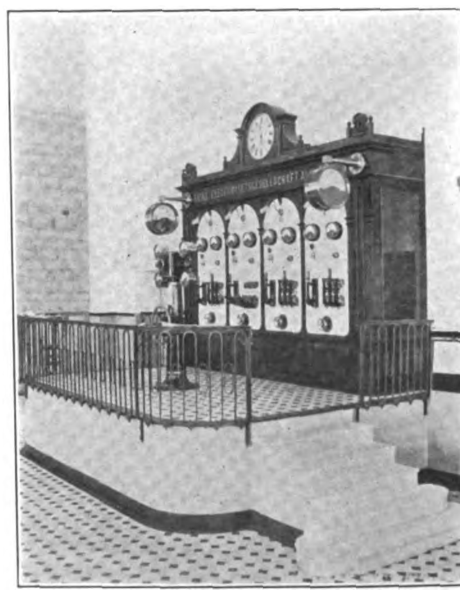


Fig. 9.—Exciter Switchboard and Control Pedestal.

opposite side of the wall (Fig. 6 and Fig. 7) in masonry compartments fitted with corrugated-iron rolling shutters. Each generator switchboard is equipped with the following instruments: Two voltmeters; one synchroscope, with phase lamps; three ammeters, one for each phase; one three-pole oil switch, which may be operated by hand or automatically. There are, further, an ammeter on the central column, a main-current rheostat for excitation, and a field-discharge resistance.

Owing to the non-centralization of the switchgear system it was not considered necessary to install a double bus-bar or ring system so common in Swiss practice. Fig. 8 represents the wiring diagram and it will be noted that there is one main and one exciter bus-bar system. Both systems are divided in the middle by sectionalizing switches. It will be further noted that the three generators at the left, which may also be independently excited, may be thrown upon a separate bus-bar group. The current from these three generators is intended for the Valley of Brusio and for the operation of the Bernina Railway.

The outgoing feeders, with the exception of those just mentioned, are connected at the middle of the bus-bars, which are made up of copper strips two inches by three-sixteenths inch, the area of each strip being sufficient for one generator. Thus, where each generator connection joins the bus-bar an additional layer has been added. The bus-bars run the entire length of the switchroom, above the aisle and close to the ceiling. They are carried on petticoat insulators fastened to I beams and are securely anchored in the middle and at the ends, so that in case of a severe short-circuit the different phases will not be thrown together.

The exciter switchboard (Fig. 9) is located upon a platform in the middle of the generator room opposite the exciters. It is provided with four white marble panels, one for each exciter, and upon each of which are mounted a voltmeter, ammeter, knife switch, shunt rheostat and a Reversite circuit-breaker.

In front of the exciter switchboard is the above-mentioned central instrument column upon which are mounted the following instruments: An ammeter, with multiple-throw switch, to read the current of each generator; one voltmeter, with plugs, for each phase; two ammeters, one for each of the outgoing feeder-systems of the Societa Lombarda, and one hand wheel operating a shaft to which are connected the shunt rheostats of the four exciters. From this column one attendant may control the operation of the entire plant.

(To be continued.)

Illuminating Engineering Society.

The second annual convention of the Illuminating Engineering Society will be held at Philadelphia, Monday and Tuesday, October 5 and 6. The headquarters will be at the Hotel Walton, Broad and Locust streets, and the sessions will be held in the auditorium of this house.

As this meeting will take place on the first two days of the Founders' Week, when a great many out-of-town guests are expected at the hotel, it will be advisable for all members of the society to arrange for their rooms in time.

The following is the provisional programme for the meeting:

President's address, Dr. Louis Bell.

Architecture and Illumination, by Emil G. Perrot.

Modern Gas Lighting Conveniences, by T. J. Litle, Jr.

Railway Car Lighting, by H. M. Davies.

Relation Between Candle-Power, Voltage and Watts of Different Types of Incandescent Lamps, by Dr. F. E. Cady.

Illuminating Value of Petroleum Oil, by Dr. A. H. Elliott.

Structural Difficulties in Installation Work, by J. R. Strong.

Street Lighting Fixtures, Gas and Electric, by H. Thurston Owens.

Oil Burners, by W. T. Sterling.

Design of the Illumination of the New York City Carnegie Libraries, by L. B. Marks.

Intensity of Natural Illumination Throughout the Day, by L. J. Lewinson.

Calculation of Illumination by Flux of Light Method, by J. R. Cravath and V. R. Lansingh.

Specific Intensity of Lighting Sources, by J. E. Woodwell.

Design of Reflectors for Uniform Illumination, by A. A. Wohlauer.

The Ives Colorimeter in Illuminating Engineering, by Dr. H. E. Ives.

International Unit of Light, by Dr. E. P. Hyde.

Some Experiments on Reflections from Walls, Ceilings and Floors, by V. R. Lansingh and T. W. Rolph.

It is possible that some slight changes may be made in this, but such is not anticipated. The Convention Committee is planning to send each member of the society, who indicates his intention to attend the convention, advanced copies of the papers. The meeting will be then conducted by reading papers in abstract, leaving almost the entire time for discussions.

In addition to the many entertainments in celebration of Founders' Week, the Convention Committee is preparing special features for the visiting members. Further information may be obtained by addressing George Ross Green, chairman of the Convention Committee, Tenth and Chestnut streets, Philadelphia.

Electrical Utilities in Zanzibar.

The Zanzibar Railroad Company, the Zanzibar Electric Light Company, and the Zanzibar Telephone Company are three American corporations doing business in Zanzibar. The Zanzibar Railroad Company has built and is operating a line of narrow-gauge railroad from Zanzibar City to Bububu, seven miles distant. According to the Washington (D. C.) *Herald* it is proposed to extend this road the entire length of the island, which will then form one of the principal means of communication between Zanzibar City and the Island of Pemba. The railroad starts at Palace Square in the city, and after running through the Malindi district of the city and the Indian Bazaar follows the west coast of the island to its northern terminus. The trains consist of a locomotive built in Pittsburg, Pa., and two open cars and one chair car, built by the Brill Company, of Philadelphia. The chair-car fare from one end to the other is one rupee, about thirty-three cents. The fare on the open cars is considerably less. The road is well built with iron ties and good-sized rails, but the climatic conditions of Zanzibar reduce the life of an iron tie. Little grading was required for the railroad, since the highest point on the island is said to be only 300 feet above the sea level.

The Zanzibar Electric Light Company has a splendid plant. It is modern in every respect, and furnishes good light and service. The Sultan's palace, as well as the houses of the Sultan's family and retainers, is wired and lighted throughout. By means of a tower studded with incandescent lights, having an aggregate lighting capacity of 3,000 candle-power, the palace square is always brilliantly lighted. The streets are also well lighted by means of incandescent lights.

The telephone is steadily making its way into a great many business and official houses of Zanzibar, and bespeaks Zanzibar's progress in introducing modern inventions and installing all the facilities enjoyed by European and American towns of the same size.

Wireless communication was recently established between Zanzibar City and the Island of Pemba. It is said that the messages are sent in Swahili, which is the language of the natives of Zanzibar and the parent of a great many native languages of the coast.

THE TESTING OF HIGH-VOLTAGE LINE INSULATORS.[1]

BY C. E. SKINNER.

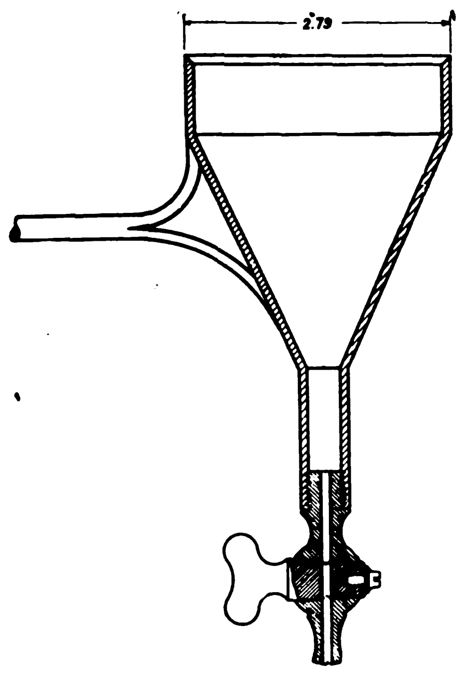
The specification herein proposed as standard for the testing of high-voltage line insulators was written at the request of the chairman of the High-Tension Transmission Committee in order to bring this matter before the Institute for discussion. It is not presented as representing the writer's personal opinion so much as an endeavor to harmonize information which he has obtained from various sources with the view of producing such a specification. Quite a large number of porcelain manufacturers and others interested in the testing and use of high-voltage porcelain line insulators in this country and in various parts of Europe have been consulted, and the information received is embodied as far as possible in the proposed specifications. It is fully appreciated that differences of opinion may exist on any point which is incorporated in such a specification. The fact that such differences do exist, and that tests are so different in different places, seems to the writer to be ample justification for the attempt at a specification which can be used by all as a standard of reference.

At the present time it is almost impossible for one familiar with a certain method of testing to base any judgment whatever as to the bearing of results obtained by some one else who uses a different method. If, after thorough discussion, and any revision which may be found essential, a specification is produced which will allow direct comparisons to be made of the performance of insulators of different types tested in various places and at different times, the object of the specification will have been in part accomplished. If a specification is evolved which can be accepted as a standard performance specification for line insulators in general, the uncertainty regarding comparisons of tests at various places and the widely varying requirements now insisted upon for conditions which are practically the same, will have been eliminated.

The specification naturally divides itself into three general parts. The requirements of routine tests are placed first, as it is considered that any tests of a routine nature which are required on insulators for the acceptance of any lot should naturally form a part of the tests made to determine the limitations of design.

The question of routine inspection for mechanical flaws and other defects is difficult to outline definitely, as a complete description of all points which might constitute cause for rejection would make the specification unduly long and complicated, and it is therefore usually considered better to leave this to the judgment of the inspector.

Some difference of opinion has been expressed as to whether the dielectric test on each individual part of insulators made up of parts should be included in the routine test instead of in the design test. It is the writer's understanding that such tests are invariably made by the porcelain manufacturers for their own information, whether specified as a part of the routine test or not, and it would therefore seem that there should be no very great objection to their being included in the routine test.



SPECIAL RAIN GAUGE.

It is possible that in some designs the voltage tests specified can not be met by certain shells which are used next to the pin for the purpose of increasing the dielectric strength when the other parts of the insulator are wet, due to the short surface distance. If the surface distance on the short shell is so small that this test can not be reached, it is probable that the object of inserting the short shell is in some measure defeated in the particular design. It might be possible to substitute a fixed test for each individual part of a shell independent of the voltage on which the insulator is to be used, as it is difficult if not impossible to get porcelain to stand tests of above 60,000 to 70,000 volts, regardless of the thickness. The better material in the thinner shells gives results equal to the poorer material in the thicker shells, due to shrinkage cracks and other defects which it is ordinarily impossible to eliminate in thick porcelain. The provision to exclude insulators which show excessive local heating is inserted for the reason that those familiar with such tests may at times be perfectly sure that an insulator is unsatisfactory even though it is not punctured. The term "localized discharge" as used does not mean the discharge which occurs uniformly around the insulator at the point of contact, but a discharge at some point on the surface; such discharge sometimes indicating a spongy material which will eventually give trouble.

Under design tests the amount of pull to be applied to the insulators is not specified for the reason that the strength must necessarily depend on the particular design, and the figures to be inserted, of course, should be agreed upon in each case between the manufacturer and the user.

The rate of precipitation specified in the rain test is probably greater than will ever be experienced except in very excessive storms, and even then only for a very limited time. The rate specified is less than that used as standard in some parts of Europe. A fairly wide limit of variation in rate is allowed, partly on account of the great difficulty in securing a perfectly definite and uniform rate, and partly from the belief—borne out by rather limited tests—that little difference in the results of tests will be obtained between the limits specified. It is desirable in the discussion of this paper that as much information as possible be brought out relative to the best possible method of obtaining a satisfactory spray.

The requirement that the insulator shall be tested with the pin at an angle rather than to attempt an angular rainfall is given for the reason that a satisfactory method has not yet come to the writer's attention for the obtaining and maintaining of a satisfactory angular rainfall, under the conditions which usually obtain where insulators are to be tested. It is far easier to incline the insulator and use a vertical precipitation, and it is considered far more probable that results can be repeated than by providing for an inclined precipitation.

The use of a rain gauge for determining the rate of precipitation is specified, as the writer has found it nearly impossible to get the rate of precipitation by measuring the flow of water through the supply pipe, which is frequently done. The diameter is limited to three inches for the

[1] A paper presented at the annual convention of the American Institute of Electrical Engineers, Atlantic City, N. J., June 30, 1908.

reason that a larger gauge would disturb the distribution of the spray to some extent. The type of rain gauge illustrated herewith is suggested as convenient and as having been found satisfactory in tests where it has been used. The diameter of the funnel is so chosen that the precipitation for any elapsed time measured in cubic centimetres and divided by 100, gives the rate of precipitation in inches for that elapsed time. By means of the valve at the bottom the water may be run into a standard chemical burette, and quite accurate measurements made. In use the rain gauge is inserted upside down into the spray, and then quickly turned to the upright position when the location to be measured is reached. A suitable card or other covering is then quickly placed over the top at the end of the elapsed time. It would, of course, be easy to provide a lid which could be opened and closed, in place of the method specified.

The writer would lay special emphasis on the importance of the dew test as probably determining the most severe condition which the insulator will ever be called upon to meet in practice. Also the fact that such a test is more nearly capable of exact repetition than any precipitation test. Furthermore, in such a test the moisture on the surface of the insulator must be perfectly clean water if the insulator itself is clean, and therefore is more like natural rainwater and eliminates any possibility of variations due to the quality of the water used.

PROPOSED STANDARD SPECIFICATIONS FOR THE TESTING OF HIGH-VOLTAGE LINE INSULATORS.

General—This specification is intended to provide a standard method of making tests on porcelain insulators or their equivalent which may be designed for use on transmission systems of 6,000 volts or above. The specification is intended to provide a means of determining the performance of any insulator, and is not intended to restrict design in any way whatsoever. The specification is divided into three parts as follows:

1. Routine tests, or tests to be made on each individual insulator, to show whether or not workmanship, materials and dielectric strength are up to the required standard.

2. Design tests, or tests to show the limitations of a design under a specific set of test conditions.

3. Methods of Testing—The methods to be followed in making the various tests specified, are separated from the body of the specification as a matter of convenience for reference.

1. ROUTINE TESTS.

a. Inspection—Each insulator shall be inspected to see that it is reasonably free from mechanical flaws, defects of glazing and cementing, chipping, etc. Those parts of the insulator which are to be fitted to caps, pins or other fastening devices shall be sufficiently close to design dimensions to insure first-class work in assembling and mounting. The general over-all dimensions shall not vary more than plus or minus five per cent from the designed size.

b. Dielectric Tests—When tested dry each shell of insulators of the cemented type and each unit of insulators made up of units, shall withstand for a period of five minutes three times its proportion of the line voltage, based on the total number of shells or units of which the insulator is composed. (For example, each shell of a four-part insulator shall withstand three-fourths times the normal line voltage on which the insulator is to be used, for a period of five minutes.)

When tested dry each completed insulator shall withstand for a period of five minutes 2.5 times the line voltage on which it is to be used.

If any shell of any insulator shows excessive localized discharge without puncture, the test on same may be continued for two additional periods of five minutes each. Excessive local heating or excessive localized discharge shall, if continued, be considered a failure.

Insulators not to exceed five per cent of any lot shall be tested for flashover by raising the voltage gradually, or by steps of not more than five per cent, until flashover occurs. If there is failure by puncture of more than one-half of those so tested, the flashover test may be required on all insulators of the lot on order.

2. DESIGN TESTS.

Tests to determine the limitations of any particular design are to be made on a few insulators, not more than five per cent of any particular lot on order.

a. Mechanical Tests — Insulators mounted on pins shall withstand a side pull exerted on the tie groove at right angles to the axis of the pin, of .... pounds. Cemented insulators and insulators made up of units shall withstand a direct pull along the axis of the pin, or equivalent, of .... pounds, the force being exerted between the cross-arm and the line fastenings.

b. Routine Tests—Insulators must successfully withstand tests under the heading of routine tests.

c. Rain Tests—In addition to the routine dielectric tests, the insulators shall withstand the following dielectric test when subjected to artificial rain. With a vertical precipitation of not less than 0.3 inch per minute, and not more than 0.4 inch per minute, the insulator in normal position mounted on a crossarm or its equivalent, with pin with which it is to be used, the complete insulator shall withstand for five minutes 1.5 times the normal voltage of the line on which it is to be used. With the same rate of precipitation and with the cross-arm so turned that both the cross-arm and the insulator pin are at an angle of forty-five degrees to the vertical, the complete insulator shall withstand for five minutes 1.25 times the normal voltage of the line on which it is to be used.

d. Dew Test—With the insulator cooled to zero centigrade, or below, and then placed in a moist atmosphere of thirty degrees to forty degrees centigrade, it shall withstand 1.25 times the normal line voltage after the insulator has become thoroughly covered over its entire surface by the condensation of moisture from the atmosphere.

3. METHODS OF MAKING TESTS.

a. Mechanical Test—The strength test of the insulator may be made by any suitable means of obtaining the specified pull. For this test pin insulators should be mounted on the pin with which they are to be used in practice, and a heavy copper wire or cable looped in the tie groove in such a way that there will be no injury exceeding that which would occur from the application of the standing tie. Insulators of other types shall be tested by having the pull exerted between the mounting intended for the crossarm and the line wire.

b. Dielectric Tests—Dry Test—The surface of the insulator shall be clean. The test on pin type insulators shall be made by placing the insulator upside down in a pan of water to a depth just sufficient to cover the tie groove or equivalent. This pan with water forming one testing terminal should be as small in diameter as possible and so arranged that the striking distance over the surface of the insulator is not reduced. Water shall be placed in the pin hole of the insulator, covering that portion of the insulator which would come in contact with the pin or equivalent. When insulators have metal thimbles placed in the pin hole or are mounted complete with metal pins, the thimbles or pins may be used in place of the water in the pin hole. Connection to the water in the pin hole forming the other testing terminal shall be made by means of any suitable metallic conductor, which must be so placed that it is central with the pin hole and extends far enough above the insulator so that it will not shorten the striking distance from the wire groove to this conductor. In testing the shells of insulators made up of concentric shells, tests shall be made from a pan of water in which the insulator is placed upside down as one terminal, to water placed inside the shell as the other terminal, the depth of water in the pan and in the shell being so arranged as to cover that part of the insulator which will be in contact with the cementing material. In testing units of insulators made up of units, the testing terminals shall consist of the metal mountings or their equivalent, with which the insulators are to be used in practice.

Rain Test—The rain test shall be made by mounting the insulator on a metal pin or equivalent, so arranged that it may be placed either vertically or at an angle of forty-five degrees to the vertical. Clean water shall be used and the precipitation shall be such that the water falls in a fine spray and in practically a vertical direction and at a rate of from 0.2 inch to 0.3 inch per minute, over the area formed by the vertical projection of the insulator. The rate of precipitation shall be obtained by the use of a suitable rain gauge of not more than three inches in diameter.

Frequencies—Dielectric tests shall be made at the standard frequencies of either twenty-five or sixty cycles per second. Any frequency between twenty-five and sixty cycles will be considered as meeting the specification. Lower or higher frequencies will be considered as special.

Voltage Control—When only a very limited number of insulators are tested in parallel, the test voltage may be taken from a constant-potential source and applied directly or it may be raised to the required value gradually. When a considerable number of insulators are tested together, the test voltage shall be raised to the required value smoothly and without sudden large increments and then applied for the prescribed interval. Flash-over tests and other tests requiring variation of voltage shall be made by raising the voltage to the required value smoothly and without sudden large increments.

Illumination of a Large Office.

Office lighting is rightly regarded as one of the difficult problems in illumination. Bookkeeping requires close application and demands such constant service of the eyes that office men are notoriously sensitive to the lighting conditions. Especially is this true in a large office where many employés are grouped together. Architects are giving more and more thought to the provision of suitable day illumination, while the demand for improvement in artificial illumination is even more imperative.

Daylight Photograph of the Office of the Stanley Works, New Britain, Ct.

The simplest and most common method of office lighting is to provide small individual units in the form of desk or drop lights. In many cases this is the best available form of illumination, especially when the working illumination is required only at isolated points. Perhaps the most serious fault to which this method of illumination is commonly subject is the glare of the lamps themselves or of the light reflected from desks or papers.

It is not unusual on entering an office

to find the fixtures draped with all kinds of shades and provided with the highest power lamps obtainable. This is an indication of unsatisfactory illumination. Unfortunately instead of improving the illumination the experiments generally result in increased glare and consequently increased eye-strain.

A more modern office lighting is by general illumination, produced by larger units installed near the ceiling and so arranged as to give even illumination. Where work is sufficiently concentrated this method of illumination is cheaper to install and operate. A fine appearing installation can be produced, which will not clutter up the room and will not suggest interference on the part of the employés.

In making such an installation it is advisable to use considerable care in selecting the unit so as to produce a satisfactory result. The light source should be of low intrinsic brilliancy, with a relatively large diffusing surface in order to avoid glare, and dense contrasting shadows. The lamp should be economical to operate, and should distribute the light so as to produce an approximately even intensity of illumination in all parts of the room.

The capacity of the unit should be as large as possible, consistent with an even distribution. In a large room with a high ceiling a relatively large unit may be used. A number of different arc and incandescent lamp combinations are available for this class of lighting. The equipment most suitable for a particular case frequently depends upon local conditions.

A representative installation in which an excellent illumination is produced by means of the ceiling diffuser arc lighting system is in the offices of the Stanley Works, manufacturers of builders' hardware, at New Britain, Ct. This company completed a new office building in the late summer of 1907. The artificial lighting of the large general office was planned by the illuminating engineering department of the General Electric Company in coöperation with the architects and the purchasing department of the Stanley Works.

The room in question has a twenty-two-foot stud. The working area is eighty-two feet by seventy-five feet and is lighted by means of twenty-four six-ampere, direct-current enclosed arc lamps, with the recessed type of ceiling diffusers, consuming 15.8 kilowatts.

The lighting has been in service throughout the dark winter months and has given entire satisfaction to both the company and the employés. The excellent illumination of the office, both by daylight and artificial light, is illustrated by the accompanying photographs, which were made under the regular lighting conditions, without flash light or any special treatment.

Night Photograph of Office of Stanley Works, New Britain, Ct., Illuminated with Ceiling Diffusers.

New Ohio Law Is Valid.

The Ohio state initiative and referendum law has been held constitutional by Judge Chapman in the Common Pleas Court. The test case will be carried to the state Supreme Court, however, for a final decision. The suit was brought after an effort was made to have a vote taken on the franchise granted by the Cleveland city council to the Municipal Traction Company. An election has been ordered by the city council. The law was passed by the legislature last winter.

Electrical Notes from Great Britain.

(From Our British Correspondent.)

IN April last a fire occurred in one of the carriages of an electric train on the Liverpool-Southport Railway just after departure from the Freshfield station. A. P. Trotter, the electrical adviser to the board of trade, has just issued a full report on the occurrence. He divides the cause of the primary fire into two considerations: (1) A short-circuit from a positive cable to the underframe of the carriage; (2) the persistence of the current after it had been automatically cut off. The latter he regards as serious. It was impossible to ascertain the exact nature of the defect which resulted in the short-circuit. Mr. Trotter makes the suggestion that in the construction of new rolling stock, greater care be exercised in protecting cables against the weather so that short-circuits due to water or snow may be avoided. To prevent the persistence of the current, he recommends that each section should have its own feeders, circuit-breakers, etc.

T. O. Callender on July 14 told a sorry tale concerning the variety of unforeseen difficulties that have arisen during the last few years to hinder the progress of the Lancashire Electric Power Company. The generating station, which has a supply capacity of 12,000 horse-power, is at present drawn on only to the tune of 4,000 horse-power, and a considerable part of this is being at present supplied at a loss financially, because there was no practical data available to guide as to correct price for this particular consumer, and the experience has had to be bought. When this contract expires, as it will do in a year, it will be renewed at a higher figure, the consumer having agreed to that course rather than be without the company's supply. Difficulties attending negotiations with municipal authorities in its area for permission to supply energy, have involved heavy expense and serious delays. Another obstacle to electrical installation progress has been the great boom in the textile trades of Lancashire during several years past. Mill owners have expressed themselves as altogether opposed to stopping their works or slackening their operations for the introduction of electrical driving, a good and necessary improvement as they admitted it to be, while there was so great a demand for their manufactures. Now, however, their trade has become slack, and they are beginning to do what they could not undertake when times were so good. Already the Lancashire Power Company is feeling the benefit, and this fact, together with the present improved relations with municipal authorities, points to a better state of things. The development of the business is now in the hands of the Lancashire Power Construction Company, and Horace F. Parshall has, after special invitation, taken the helm as chairman at $5,000 per annum plus ten per cent on the profits in excess of $100,000 per annum before debenture interest is paid.

For many years past the Institution of Electrical Engineers has occupied other people's premises both for general office and library accommodation, and for halls in which to hold its meetings. It is true that at the Victoria street office there is a room sufficiently large for students' meetings and for some gatherings of the Faraday Society, but for anything larger than these, other engineering societies have lent their halls—chiefly the Institution of Civil Engineers. It has been pretty generally felt for a long while that this was a most undesirable position for so important a body of professional men representative of so progressive a department of engineering science and practice, and in consequence a building fund has been accumulating for years. Many a time expression has been given to the desire that all of the great engineering societies might come together to consider a scheme for a large central engineering building in which all could be housed, but the idea has received little encouragement from those most in a position to help toward its fulfilment. The Institution of Electrical Engineers has now, therefore, with pretty general approval from its members, purchased a lease of seventy-six years of what is described as a very suitable building, or one costing comparatively little to make it adaptable to the needs of the Institution. It is situated on the Victoria Embankment and is known as the Medical Examination Hall. The capital cost is £50,000, plus £6,000 for alterations to theatre, furnishings, etc.

The new premises will not be ready for occupation for a year. It is hoped that part of the expenses will be met by letting portions of the building to other societies. The need that electrical men feel for a meeting place in London at which they can hold intercourse with one another at any time—not merely when the announced meetings are in progress—will be met by the foregoing scheme.

Surface contact tramway traction has had most unfortunate experience in England. We announced some time ago that the London County Council was putting down an experimental section of line to be operated on the "G. B." (Griffiths-Bedell) system in Bow and Aldgate, in the East End. It was hoped that after the practical experience with the system in successful running at Lincoln, it would be possible to provide some parts of London with a service which should cost less to construct and equip than the conduit tramway, and should be free from all the alleged objectionable features of the trolley. This hope, according to the latest information, is not to be realized, for defects which have appeared in the running of the Aldgate cars led to the withdrawal of the latter from service on July 17. It is reported in some quarters that this will probably mean the taking out of the system, and if this turns out to be correct it can hardly fail to be fatal to any extension of surface-contact working in this country, especially coming as it does on the heels of the supersession of the Dolter system at Mexborough by the overhead trolley. The chief trouble at Aldgate seems to have been due to live studs, a defect which has to be avoided at all costs in thoroughfares carrying heavy traffic of all kinds.

The Tramways and Light Railways Association held its annual congress on July 9 and 10 at the Franco-British Exhibition at Shepherd's Bush. The Duke of Argyll welcomed the members and Sir Clifton Robinson, who not long since returned from a tour of inspection of tramways in different parts of the world, gave a lecture on "Tramways of the World." He reviewed the course of events in street-tramcar practice since Train put down his first tramway at Birkenhead in 1860. He thought that British tramways if skilfully managed and conservatively financed ought to have an indefinite period of financial prosperity. This should be cheerful news for electric tramway investors who are reaping anything but an adequate return on their investments at the present time. He set down the following directions in which British tramways are handicapped as compared to other countries: (1) British cars are not permitted to travel fast enough, the average speed being less than ten miles an hour. (2) Our double-deck cars, in general use, cause much delay, particularly at stopping points. This type of car was adopted in order to comply with regulations. (3) Traffic could be handled more successfully on special occasions were the present licensing restrictions regarding passengers removed or amended. Speaking of foreign countries he said that the main obstacle to greater development in eastern cities was the narrowness of the streets—this was particularly noticeable in Tokio, Japan, which city has a network of electric tramways, either in operation or proposed. Wherein British tramways lagged behind other countries, it was not the fault of capitalists or engineers, or business men—legislative restrictions and innate conservatism were the real troubles; but we in England had profited by the experience and mistakes of other countries in the matter of efficient apparatus and plant. Sir Clifton Robinson has had to do with the promotion and engineering of a number of important English trolley lines and he has come to close grips with the manifold problems and difficulties, and his views are those of one who has had exceptional opportunities to study the subject—especially from the private company point of view. Alfred H. Gibbings followed with a paper describing modern forms of tramway rail-joints, and the methods which were now being employed to make the joint in operation as nearly as possible like the rest of the rail. A lecture on "Rail Corrugation," delivered by C. A. Carus Wilson, was the other feature of particular interest at the congress.

There is now proceeding at Olympia an exhibition of mining machinery. It contains many specimens of typical English electrical machinery and apparatus for application in mines, electrically driven equipments being present in all parts of the building. The exhibition is timely in view of the great development that is now taking place in colliery equipment. The Franco-British Machinery Hall, with its electrical exhibit, is now in a complete condition. Arrangements are now being pushed forward rapidly for the electrical exhibition which opens at Manchester about two months hence.

ALBERT H. BRIDGE.

London, July 25.

FUNDAMENTAL CONSIDERATIONS GOVERNING THE DESIGN OF TRANSMISSION-LINE STRUCTURES.[1]

BY D. R. SCHOLES.

Before the work of designing a tower or pole for a given transmission line can proceed, a statement must be made setting forth the loads which the structure should be capable of withstanding. This statement is, in general, based on a forecast of the probable extreme weather conditions which may occur in the vicinity of the line, and also on a prediction as to what accidents will probably occur to the conductors of the line.

There are naturally considerable variations in forecasts of this sort and these variations are due primarily to a lack of accurate data regarding the various factors which enter into the case. The cost of a line is affected very largely by the figures which are selected to represent the probable extreme conditions, and the selection and application of these figures are therefore matters of a great deal of importance. Unfortunately, data on this subject are very meagre, and a rational solution of a problem involving weather conditions and possible accidents is manifestly impracticable. It seems, therefore, that the best guide in selecting figures to represent the probable extreme load conditions is experience with existing transmission-line structures and other structures similar to them.

During the last few years many members of the Institute have had occasion to investigate this subject, in preparing specifications for transmission lines. A discussion referring to experience with these lines and bringing out the ideas of each as to what load conditions should be provided for would be very beneficial. It is hoped that there will be such a discussion following this paper.

Figures must, in general, be selected to represent the forces which may come upon a transmission-line structure as a result of one or more of the following influences:

Wind.
Sleet.
Low temperature.
Accidents, as breaking of cables, etc.

It is also necessary to select a factor or factors of safety for use in connection with these figures, and a prediction must be made as to whether or not loads resulting from two or more of these causes are likely to occur at the same time. Considerations of cost often determine to what extent provision shall be made, in a given line, against such combinations of extreme conditions. In a very important line it may properly be considered desirable to provide strength against a combination of conditions likely to occur only once in a hundred years, whereas in a less important line the possibility of such a chance condition might, with equal propriety, be neglected.

[1] A paper presented at the Annual Convention of the American Institute of Electrical Engineers, Atlantic City, N. J., June 30.

Wind Pressure on Structures—The records of the Weather Bureau are available as an aid in estimating the maximum wind velocity to be expected in a given locality. The relation between wind velocity, however, as indicated by a government anemometer, and the actual pressure in pounds per square foot produced by a wind of that velocity on a cable or on the members of a tower, is by no means definitely known. In fact this relation is so uncertain that the most one can hope to gain from an examination of the weather reports is a general idea as to whether the winds occurring in a given locality are likely to be high or not. The anemometers of the Weather Bureau do not take account of sudden gusts of wind. The published velocities are not accurate, but must be corrected according to a correction table which may be obtained from the Weather Bureau.

The relation between wind velocity and the pressure produced by the wind on a plane surface normal to the direction of the wind is given by the formula,

$M = K\ V^2$, where

M = pressure in pounds per square foot,
V = wind velocity in miles per hour,
and
K = constant.

Experiments in general indicate that the form of this equation is correct, but experiments differ as to the proper value of K. The values given range from 0.0035 to 0.0048. According to tests by the Weather Bureau, K = 0.004, which is probably the most reliable figure there is for K.

Experiments indicate that, in general, higher pressures are to be expected at the top of a tower than near the ground, but little is known as to how the pressure is distributed. There is considerable doubt as to what should properly be considered the exposed area of a structure; it is certain, however, that both faces are not, in general, subject to the same pressure. It is usually considered that a reduction factor of 0.5 should be used in figuring the wind pressure per square foot of projected area of cylindrical surfaces. The wide use which has been given this factor is its principal recommendation.

The purpose of the foregoing remarks on wind pressure is to point out some of the reasons for uncertainty in wind-pressure calculations. In view of these uncertainties it seems necessary to turn to some empirical method for providing against loads due to wind pressure. In bridge work pressures of from thirty to fifty pounds per square foot are commonly assumed, and these pressures are used in connection with factors of safety of from four to six. Structures built to withstand loads calculated in this way are found to be strong enough. How much too strong they are is a matter of conjecture. The usual transmission line can not stand the expense of structures built to bridge specifications. Experience with bridges can not, therefore, be of much help in the present connection.

Steel windmill towers have been in general use for about eighteen years. Such towers are built to withstand wind loads almost exclusively and their use is very widespread. It is known that the provision against wind loads in these structures is not excessive, for there are occasional failures. The windmill tower is, in general, similar to the towers used in transmission lines. The success of a given design of windmill tower depends on what might be called the integrated experience of all the users of towers of such design. Competition has led builders to reduce their weight to a minimum. It is probable, therefore, that a windmill tower of standard design which is widely used has just about enough strength to resist the highest winds, tornadoes excepted, and it would appear that a study of such a windmill tower will probably give the best data available for use in connection with transmission-line structures.

An examination of a standard design of windmill tower, of which many thousands are in use, shows that such tower will actually fail under loads calculated on the basis of wind pressures of from forty to fifty pounds per square foot. The tower referred to is of square pyramidal form, and in the calculations it is assumed that the wind is blowing at right angles to one side, and both faces of the tower are considered equally exposed.

It appears, therefore, that it would be good practice in transmission-line construction to specify that the poles or towers should, in addition to their other properties, have strength to resist loads on their members due to a wind pressure of forty pounds per square foot, with a factor of safety of from 1.5 to two, based on actual test. Such a structure would be suitable for locations where the winds are high; in other locations these figures would be reduced by judgment, aided by a consultation of the weather reports and other such data.

Factor of Safety—A few remarks regarding factor of safety may be proper at this point. The factor of safety used in connection with the design of a given piece of engineering apparatus, is, in a sense, a measure of the uncertainty attending the making of calculations of the loads to be sustained or of the strength of the structure under consideration. In designing a complicated structure to sustain a complex system of loads it would be natural and proper to allow a large factor of safety, particularly if the structure were such that it could not be tested to destruction to check all calculations and methods. On the other hand, a smaller factor of safety would be equally safe in connection with a simple structure to sustain certain definite loads, the actual ultimate strength of the structure having been determined by testing it to destruction.

The structures ordinarily used in transmission lines are simple. They are usually built in large numbers from standard designs. It is proper, therefore, that the design for such a structure should be carefully investigated and that specimen structures should be tested in such a way as to remove all doubt as to their ability to withstand the loads for which they are intended. And, notwithstanding the fact that calculations of wind pressure are uncertain, experience with windmill towers removes, to a large extent, the uncertainty which would otherwise surround the figure forty pounds per square foot which has been suggested.

Wind Pressure on Cables—The opinion is commonly held that, in providing against wind pressure on a surface such as that of a long span transmission-line cable, it is not necessary to allow for as high a pressure as is necessary for a surface extending through smaller linear distances. Data on this subject are, as yet, very indefinite, and there is great need of specific figures for the pressure experienced on the cables of a transmission line. The following experiment is suggested as a means of securing such data:

The experimental apparatus would consist of a typical transmission-line span of from 500 to 1,000 feet, erected as near as possible to a Weather Bureau station. The cable would be fixed to the tower at one end and would pass over a pulley at its other end and be secured to a weight, this weight serving to maintain a uniform tension in the cable at all times. The position of the weight would be recorded at all times by means of a pencil and moving drum. Continuous records of temperature and wind velocity are made in the Weather Bureau stations. An analysis of the three records, namely, those of temperature, wind velocity and the length of the cable in the span, would give data from which the wind pressure in pounds per square foot of projected area of the cable could be calculated. It would also be desirable to have a continuous record of the direction of wind, and this record could be readily obtained.

Records from such apparatus extending over a period of a year or more would be of much interest. It is to be observed that the readings would furnish a means of checking the coefficient of expansion of the cable. Data obtained in this way would have direct relation with the Weather Bureau reports, and most questions as to methods of calculation of pressure on conductors would thus be eliminated.

In the absence of specific data relating to wind pressures on the cables of long spans, it seems unsafe to assume a pressure of less than thirty pounds per square foot for localities where the winds are known to be high. The figure thirty pounds per square foot is commonly used in bridge calculations for surfaces extending through horizontal distances of sixty feet or more. It seems that a factor of safety of two should be used in connection with this pressure, so that the conductor will not be stressed beyond its elastic limit, under extreme conditions.

Sleet—Destructive sleet storms occur in the eastern part of the United States at least as far south as Atlanta. During the past winter a sleet storm occurred in the region of Chicago after which a coating of ice over half an inch thick was observed on conductors of various sizes. In many cases the thickness of ice at the centre of the span was much greater than at the insulators, due to the tendency of the water in the sleet to run down to the lowest point while freezing. The sleet formed during this storm was practically solid ice, and it remained on the conductors for several days. In view of observations made after this storm, it is the writer's opinion that, for localities where sleet is known to form, provision should be made against a coating of ice on the cables at least one-half inch thick, in combination with a factor of safety of not less than two based on the ultimate strength of the conductor.

There is much discussion as to whether the safety of a line demands that provision be made against sleet, low temperature, and high wind all occurring at the same time. If the sleet forms at all, it is certainly possible that it will remain on the wires several days. And if it remains on the wires several days it is certainly entirely within the range of possibility that high wind or low temperature, or both, will occur before it melts off. Whether or not provision should be made against a combination of these three extreme conditions becomes, therefore, entirely a question of how much the owners of the line are willing to pay for immunity from interruptions of service due to these causes. These are matters to be settled between the engineer and the owner of the line.

Accidents, as Breaking of Wires, Etc.—In providing mechanical strength in the line to resist loads due to accidents to the cables, there are two well-known plans which may be followed. In the one all structures are given the same strength, each having strength to withstand the loads due to accidents which it is contemplated may occur in any span; in the other plan, two kinds of structures are used—a standard structure intended to support loads transverse to the line only, and a heavy structure having strength against the breaking strength of all the cables. These heavy structures are distributed along the line at intervals of a mile or so. The first-mentioned type of construction is best adapted for lines having relatively small conductors, while the second type is favorable where the conductors are heavy.

In designing a line of the first-mentioned type it is usual to assume that any two conductors may break in a given span due to the formation of an arc between them, and that the tower or pole should be capable of withstanding the loads so developed without damage to itself. Provision is not, in general, made for the simultaneous occurrence of such breakage and high wind or sleet. It would seem, however, that in such cases the towers might be better designed to withstand wind loads transverse to the line in addition to the loads due to the breakage of any two conductors, since arcing is more likely to occur in a high wind than at other times.

It is believed that the factor of safety used in connection with the loads due to breakage of conductors should be greater in the case of suspension type insulators than with pin insulators. When a conductor supported by suspension insulators breaks, it will suddenly move away from the point of breakage and will be brought to a sudden stop when the insulator comes into line with the cable. The movement will occur, in decreasing amount, all along the line or until the strain insulator is reached. This sudden application of load and the attending inertia effect will subject the cross-arm to a greater force than the tension which existed in the cable before it broke. It is suggested that cross-arms be tested to loads equal to 1.25 times the elastic limit of the conductor for pin insulators and 1.5 times the elastic limit of the conductor for suspension insulators.

Foundations—It is a usual assumption that the resistance to uplift offered by a foundation is equal to the weight of the foundation plus the weight of earth contained in the frustum indicated in Fig. 1, the angle of inclination of the sides of the frustum being thirty degrees. The results obtained by this method agree quite closely with practice in anchors for windmill towers. In addition to resisting uplift, the foundation must, in general, have strength against horizontal forces at the ground line. The variety of designs of foundations is so great as to make a discussion of them impossible within the limits of this paper. It is suggested that, in developing the design of a foundation for a given line, tests should be made to determine the holding power, density, etc., of the soil of the locality so that the strength of the foundation will be known as accurately as the strengths of the other parts of the line.

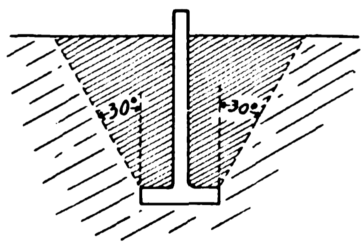


Fig. 1.—Graphical Diagram of Foundation Resistance to Uplift.

Copper Production in 1907.

The Department of the Interior, United States Geological Survey, has issued an advance statement of the country's production of copper in 1907. The output is given as 868,996,491 pounds. This is a decrease of 48,809,491 pounds, or 5.6 per cent, from the record figures of 1906, the largest actual decrease ever recorded and the largest relative decrease since the American copper industry became important. This is the first time since 1901 that the annual production has been smaller than that of the preceding year and the first time since 1872 that it has been smaller than that of the second preceding year.

In the following table the copper production for 1907 is apportioned to the states in which the copper was mined. The total is made up of the fine copper content of blister produced and of the smelter output of ingot and anode copper from Michigan. The production for 1906 is given for comparison:

	1907.	1906.
Alaska	7,034,763	8,685,646
Arizona	256,778,437	262,566,103
California	33,696,602	28,153,202
Colorado	13,998,496	7,427,253
Georgia	....	17,182
Idaho	9,707,299	8,578,046
Massachusetts	....	9,744
Michigan	219,131,503	229,695,730
Missouri	....	54,347
Montana	224,263,789	294,701,252
Nevada	1,998,164	1,090,635
New Mexico	10,140,140	7,099,842
North Carolina	544,040	582,209
Oregon	518,694	545,859
Tennessee	19,475,119	17,809,442
Texas	....	51,377
Utah	66,418,370	50,329,119
Vermont	696,102	11,694
Virginia	57,008	....
Washington	122,263	290,823
Wyoming	3,026,004	106,177
Alabama, Georgia and Maryland	90,655	....
Missouri and unapportioned	1,299,043	....
Total	868,996,491	917,805,682

Of this quantity, approximately 10,075,048 pounds in blister were produced in foreign smelters from domestic materials exported. In addition to the domestic materials handled, smelters in this country turned out as blister 64,145,648 pounds from foreign ore, concentrates, and matte. Domestic blister containing 42,350,963 pounds was exported unrefined, while blister from foreign sources containing approximately 183,530,132 pounds fine copper was imported for refining in this country.

The production in 1907 of refined new copper of domestic origin was 784,271,427 pounds, a decrease of 103,410,960 pounds, or 13.2 per cent, from the production of 1906. The total output of refined copper (exclusive of domestic scrap, etc.) by domestic refineries in 1907 was 1,032,516,247 pounds.

Returns from all the Lake and electrolytic refineries are practically complete and show that the following stocks of refined copper were on hand at the beginning and end of the year:

	Pounds.
January 1, 1908	125,745,796
January 1, 1907	46,497,181
Stocks increased during 1907	79,248,615

Undelivered sales are almost entirely excluded from these figures. Stocks carried by consumers and brokers have not been estimated. In addition to these stocks of refined copper, there were at smelters, in transit to the refineries, and at the refineries blister copper and material in process of refining to the amount of 135,310,239 pounds on January 1, 1907, and of 175,254,659 pounds on January 1, 1908.

The apparent consumption of refined new copper in the United States in 1907 was about 485,000,000 pounds, as compared with about 685,000,000 pounds in 1906. One method of deriving these figures is based on the total refinery output.

American Electrochemical Society.

At a recent meeting of the board of directors of the American Electrochemical Society the previous action of the board in regard to the new class of subscribers, to be called "junior associates," was amended to read as follows: "Students in high schools, technical schools, colleges or universities, or assistants in technical laboratories, furnishing references of good character from their professors or employers, subject to the approval of the board of directors, may, by the payment of the annual dues, without entrance fee, become affiliated with the American Electrochemical Society as 'junior associates.' They will be printed as such on the roll of the society, will receive the transactions, the monthly bulletin and other notices of the society, may attend meetings, offer papers, take part in the discussions of papers and participate in visiting and social functions; but they do not have the right to hold office, vote for officers, or vote on or discuss business motions brought before the society. The said 'junior associates' may remain as such not over five years after their first enrollment and may become members at any time by being regularly elected by the board of directors and paying the entrance fee."

At the same meeting of the board the committee appointed to draw up the regulations governing the competition for the award of the Pacific Coast Borax Company's prize of $500 reported. This committee consists of Alois von Isakovics, Dr. E. F. Roeber and Dr. Leo Baekeland. Their recommendations are as follows:

The sum of $500 has been paid to the American Electrochemical Society, and deposited in trust, as a research fund, to be awarded as a prize, under the following conditions:

The Pacific Coast Borax Company desires to awaken an interest in research work and experiments which may lead to some improvement in the commercial method of manufacturing ferro-boron, by a direct process from Colemanite.

It is essential that the process should be sufficiently economical and suitable to be applied on a large scale, so that the finished product may be available for commercial purposes. (Commercial ferro-boron, as now made, contains twenty per cent or more of boron, less than three per cent of carbon, and sulphur and phosphorus are practically absent.)

The prize has been deposited with the American Electrochemical Society, with the request that the board of directors award the same for the best practical solution of the problem, under reasonable conditions, to be decided upon by the board of directors.

In accordance with the above request, competitors for the prize are notified that they must comply with the following conditions:

1. The treatise on the subject must be in typewritten form and accompanied by a sample produced by the process described in same.

2. The competition for the prize is open to any one and is not restricted to members of this society. The treatise on the subject must be enclosed in a plain, sealed envelope, not bearing the author's name, but identified by a pseudonym. The outside of the envelope containing the paper must be labeled with the pseudonym and with it should be sent another plain, sealed envelope, also labeled with the same pseudonym, which should contain inside the envelope the name and address of the competitor. Both these envelopes should be sent to Professor Morris Loeb, 273 Madison avenue, New York city.

3. All papers competing for the prize must be in the hands of Professor Loeb before October 1, 1909. Professor Loeb shall retain the small sealed envelope containing the address of the competitor and forward the large envelope containing the treatise, as well as the sample of the product, both merely labeled with the pseudonym, under cover, to the secretary of the American Electrochemical Society, to be submitted to the board of directors who will award the prize. In this manner, as the treatise must be typewritten, the board can act with entire impartiality and the paper shall be judged on its own merits so that the author's standing can have no influence whatever on the decision. The competitors for the prize forfeit none of their property rights in the process submitted.

4. As soon as the board of directors has agreed upon the best treatise, it will request from Professor Loeb the address of the author thereof, who will then be required to demonstrate his process before the prize will be finally awarded.

5. The Pacific Coast Borax Company, 100 William street, New York city, has offered to supply any one who desires to compete for the prize seriously with all the crude Colemanite that the parties making the experiment may require, provided that the request for this Colemanite be accompanied by a letter signed by one member of the board of directors of the American Electrochemical Society, endorsing the application for the material. This condition is merely made so as to furnish the material only to those who may have the proper qualifications to experiment intelligently and with some chance of success.

For the convenience of competitors who may desire to consult some of the published literature on the subject, a brief bibliography is herewith attached:

H. Moissan and G. Charpy, Sur l'acier au bore, Comptes Rendus, 1895, vol. cxx, p. 130.

M. L. Guillet, Les aciers au bore, Revue de Metallurgie, August, 1907, vol. iv, pp. 784 to 796 (translated in abstract in "Electrochemical and Metallurgical Industry," 1907, vol. v, p. 421).

A bibliography on boron and borides in general may be found in O. P. Watts, "An Investigation of the Borides and Silicides," Bulletin University of Wisconsin, No. 145 (Engineering Series, vol. iii, No. 3, 1906).

As previously announced the fourteenth general meeting of the society will be held in New York, October 31, at the Chemists' Club, 108 West Fifty-fifth street. The invitation of President Acheson to hold the fifteenth annual meeting at Niagara Falls, Ontario, May 6, 7, 8, 1909, was accepted. Headquarters will be at the Clifton House.

Commission Opposed to Central Express Company.

In denying the application of the Interurban Express Company, Syracuse, N. Y., for permission to exercise rights as an express company on certain railroads in and near Syracuse, the Public Service Commission, Second District, lays down the rule that an operating railway or trolley company should not be permitted to divest itself in favor of another corporation of the obligation to perform any of the public services for which it is incorporated unless it can show clearly that public necessity so demands or public convenience can be better served thereby.

The company in question was organized as an express company to do an express business from and to any points in the United States or otherwise by means of electric cars and vehicles, horses, wagons, boats or other means of transportation. The application to the commission was made particularly in connection with the interurban and electric roads controlled by the so-called Bebe Syndicate, namely, the Auburn & Syracuse Electric Railroad Company, the Rochester, Syracuse & Eastern Electric Railroad Company, the Syracuse & South Bay Electric Railroad Company, the Syracuse, Lake Shore & Northern Railroad Company and the Auburn & Northern Electric Railroad Company.

Under the Public Service Commission's law the company can not do business without the consent of the commission. The opinion written by Commissioner Osborne among other things says that the advantages claimed by the service applied for can be easily secured by the trolley companies themselves without the formation of a central express company. He urges against the granting of the application the duplication of companies whereby the public would pay directly to the express company for carrying the package and would also pay indirectly to the railroad company for the use of its tracks in carrying the same package, and the cost to the public is certainly increased by the addition of the extra company.

Some Interesting Advertising Literature from Central Stations.

The Commonwealth Edison Company, Chicago, Ill., has long been famous for the attractive quality of its advertising literature. Dana H. Howard, manager of the advertising department of this company, has introduced some of the most novel ideas which have come to our notice, and the department is one of the most successful in the field. The accompanying illustrations show some of the newest ideas which Mr. Howard has evolved. The series of postal cards showing the various uses of electrical devices, such as toasting irons, chafing dishes, desk lamps, flat-irons, electric fans and coffee percolators, is very handsome and has attracted a great deal of favorable comment. These cards are all photographic reproductions of the highest grade of postal-card souvenir. Another card which the company is making good use of is the assignment card, an illustration of which is shown herewith. This series includes references to closet lighting, the nursery milk-warmer, the electric corn-popper, the electric chafing dish, and the electric waffle iron. The card is printed in brown and red.

A Beautiful Series of Postal Cards from the Commonwealth Edison Company, Chicago, Ill.

The company has recently published a vest-pocket catalogue of electrical devices for use in the home. This illustrates and describes the electric chafing dish, the electric fan, electric curling-iron heaters, electric flat-irons, the electric coffee percolator, the electric toaster, and gives several recipes for use with the electric chafing dish. Still another illustration is a reproduction of a large-sized lithograph which the company is displaying in department stores, drug stores, stationers, and in all public places.

An Attractive Lithograph in Bright Colors Used by the Commonwealth Edison Company, Chicago, Ill.

The Denver Gas and Electric Company is keeping up its good publicity work, one of its most recent ideas being the distribution of a fine series of postal cards in connection with the Democratic National Convention. The accompanying illustration shows the mammoth electric sign which was used on this occasion, and which has been reproduced and commented upon in the daily papers throughout the entire West. This electric sign was easily the hit of the decorative features of the convention, and impressed the visitors with the ingenuity and availability of the electric sign as a means of attracting attention.

The Commonwealth Edison Company has its mains in this vicinity and is prepared to furnish you with

Electricity for Lighting, Heating and Power Purposes

at unusually reasonable rates.

The Electric current, which supplies the most sanitary light, is used also now-a-days for heating, cooking and small power purposes in the home. There are Electric Fans, Flat Irons, Chafing Dishes, Coffee Percolators, Heating Pads, Water Heaters, Curling Iron Heaters, Toasters, all operated by electricity at small expense.

Our representative will call upon you if you will mail this card, properly filled out. You are not obligated thereby.

Name ______

Address ______

Most convenient time to call ______

One of a Series of Assignment Postal Cards Used by the Commonwealth Edison Company.

The Denver Bryan Welcome.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Absorption of X-Rays.

Probably all elements when subjected to a suitable primary beam become sources of homogeneous Roentgen radiation which is characteristic of the element emitting it. These radiations have been studied by C. G. Barkla and C. A. Sadler, who here give some of their conclusions. When a very absorbable primary radiation is incident on a given element, the homogeneous radiation characteristic of that element is not emitted in appreciable intensity. As the penetrating power of the primary radiation is increased, the absorption decreases only up to a certain point. When the penetrating power becomes greater than that of the radiation characteristic of the absorbing element the absorption of the primary radiation begins to increase and a secondary homogeneous radiation begins to be emitted. Then there is a rapid and considerable increase in both the absorption of the primary rays and in the emission of the secondary rays. When the general penetrating power is increased still further, the absorption decreases again in the usual way, and the intensity of radiation decreases at the same rate as the ionization produced by the primary beam in air. Experiments have not been made to determine if all the extra energy absorbed appears as energy of secondary radiation; but from observations of the absorbability of the secondary radiation and of the ionization it produces, it appears probable that a large proportion is re-emitted. The emergent radiation is a mixture of two homogeneous radiations, the proportions of which depend primarily on the coefficients of the absorption of the incident radiation and of the radiation characteristic of the metal in the metal itself, and the coefficient of the transmission of one into the other type of radiation and the thickness of the absorbing plate. The following is given as a more precise statement of the special power of a homogeneous radiation of penetrating the element emitting it than has previously been given: A radiation which is more absorbable, equally absorbable, or only slightly more penetrating to most substances than the radiation characteristic of the element upon which it is incident, is absorbed much less than one of more penetrating type. It also produces little or none of the characteristic secondary radiation which is produced by the more penetrating radiation.—*Abstracted from Nature (London), July 16.*

On Some Methods of Measuring Capacity with Alternating Currents of Complex Wave Forms.

A quick and convenient method of determining capacity is to measure the current flowing when a sinusoidal electromotive force of known value is applied. But if the wave form departs from a pure sine wave, the ordinary method can not be used without certain precautions. In this article, Robert Beattie describes a number of methods of measuring capacity accurately, which are not affected by the form of the electromotive-force wave. The first of these to be described is the use of a "swamping" resistance placed in series with the condenser under test. If this resistance is so large when compared with the reactance of the condenser that the former determines the magnitude of the current flowing, the capacity may then be measured with an accuracy of a few per cent irrespective of the wave form. Without the "swamping" resistance an irregular wave form might introduce an error of from thirty to forty per cent. If there is any doubt of the adequacy of the swamping resistance, a swamping inductance may be used. The resistance of this must be negligible, and when this is the case the reactance is more effective than a swamping resistance. With this method it is not difficult to measure the capacity accurately within one per cent. If a known capacity be available, the unknown may be compared directly with this, and since the irregularities of the electromotive force affect both to a similar degree, no error will be introduced. In the same way the capacity may be measured by connecting the condenser in series with a known inductance. Rowland in 1898 described a number of zero methods of measuring capacity by means of alternating currents, but did not point out that when these zero methods are used the result is independent of the wave form. Deflectional methods may also be employed, if, instead of measuring merely the current and the electromotive force, the power is also measured. To indicate the value of these different methods, the results of a series of experiments on a single condenser with a wave form of very irregular shape are given. With the simple current and electromotive-force measurements the capacity was apparently twice as much as it was known to be. By placing a swamping resistance in series, the result was within two per cent of the known value. With a swamping inductance the discrepancy was within the limits of experimental error, and the same accuracy was obtained when applying the other methods referred to. — *Abstracted from the Electrician (London), July 17.*

Electricity Supply in Sutton (Surrey,) England.

A brief description is given here of the new electric supply station of the township of Sutton, which lies just outside of the southwestern boundary of the County of London, England. This installation is interesting because of the methods adopted to avoid vibration and noise. The original equipment consisted of alternators direct-connected to reciprocating engines. This gave rise to so much trouble with surrounding householders, through vibration and noise, that the company decided upon the adoption of a steam-turbine plant. This decision was reached after a number of attempts had been made to stop the vibration. One of these consisted in digging a trench thirty feet deep around the edge of the company's land, but this had no appreciable effect. The station stands on solid chalk, as does also private property 100 yards away. The new generating equipment consists of three 500-kilowatt turbines, each coupled to a 250-kilowatt direct-current generator and a 250-kilowatt alternator placed in tandem. Each machine has also an exciter mounted on the end of the shaft. The units run at 3,000 revolutions per minute, and supply fifty-cycle, single-phase current at 2,200 volts alternating, and direct current at 550 volts. The units are mounted on a ferro-concrete pad eighteen inches thick, which in turn is supported on fourteen groups of rubber pads on the Prache system, each group consisting of seven pads carried on a circular cast-iron tray mounted on a concrete pillar which forms the fixed foundation. This arrangement is said to be entirely satisfactory in damping down the vibration. Another interesting feature of this plant is the use of a Raworth cutout on the switchboard. This is necessary since a part of the direct-current output is used for electric railway purposes where the Raworth regenerative system of operation has been adopted. The cutout is a reverse-current breaker which disconnects the feeder when the incoming regenerated current from the car exceeds that sent out by the station.—*Abstracted from the Electrical Review (London), July 17.*

The Economical Aspects of Wood Preservation for Structural Purposes.

There has been more or less discussion during recent years on the value of the various processes of treating wood with a view to preventing decay. However, a good deal of uncertainty still exists respecting the economical value of such treatment. In this article C. P. Winslow discusses the subject from this point of view. After pointing out the enormous consumption of timber of all sorts, which exceeds three times the annual growth of the forests in this country, he emphasizes the necessity for reducing the annual cut of wood, and says that the only apparent method of relieving the situation is some treatment of the timber which will protect it against decay. To be successful, the process employed must reduce the cost of the timber to the consumer; but in determining this cost the effect of the reduction in price due to the reduced cut, as well as the cost of replacement, must be considered. Such a system should render durable the soft woods which to-day can not be used where exposed to the weather. It has already been shown that the life of timber may be doubled by the use of cheap preservatives; and by using a more expensive treatment, the life can be still further prolonged. In applying such treatment on a large scale the additional cost will seldom exceed the present price of the lumber. This cost may then be set off against the cost of replacing the material and the increase in price which would have taken place had the drain on the forests continued at its present increasing rate. During the past five years the cost of mining timbers in the West has increased forty to fifty per cent, and a corresponding increase may be expected during the next five years, if no relief be secured. To show more specifically what the effect of treatment might be, consider the railway tie situation. During 1906 about 103,000,000 ties were purchased, these being in general oak, cedar and chestnut. Oak formerly was the most largely used wood, but the cost of oak ties has doubled in the past ten years, so that other woods are now being taken. It has been estimated that on an important western road the average cost of untreated hemlock is about seventy-five cents a tie; the cost of a satisfactory treatment with zinc chloride is about twelve cents a tie, raising the cost of the treated tie to eighty-seven cents. If the untreated tie last five years, and interest be allowed at four per cent, the annual charge on this tie would be 16.8 cents. If the treated tie last but a single year longer, the annual charge is lowered to 16.6 cents, while if it last ten years, the annual charge is 10.7 cents. By the substitution of creosote for zinc chloride, with some increase in the cost of treatment, the ties can be counted upon to resist decay for twenty years. It is of no use, however, to give a tie a length of life as long as this, if its mechanical life is but ten years; so that screw spikes and tie plates would become advisable when the more expensive processes of treatment are used. To take another instance, during the year 1906, nearly 3,600,000 poles were cut for telephone, telegraph and electric power lines. The average value of these poles at the point of purchase was $2.65. As these poles come from a limited section of the country, the cost of transportation often equals the initial cost at the point of purchase. All these poles must be renewed within fifteen years; and as the supply of cedar and chestnut, the woods principally used for poles, is becoming exhausted, a substitute must be found which may be treated so as to give it a satisfactory life. A thirty-five-foot loblolly pine may be purchased, hauled and set for five dollars; so that allowing interest at five per cent, the annual charge becomes $1.15. A pole of this sort may be given a satisfactory butt treatment with creosote for one dollar and unless set in very unfavorable conditions will have a life of twenty years. The annual charge is thus reduced to forty-eight cents, a yearly saving of sixty-seven cents a pole. These two instances demonstrate the economical value of a preservative treatment when properly applied. Several other examples are given, applying to other lines of construction, all of which show that whenever timbers are to be placed for permanent use under conditions favorable to decay, or where a subsequent replacement would entail heavy charges, a thorough preservative treatment of the best quality is recommended. Frequently when a company is using large quantities of timber the establishment of a treating plant will soon repay the cost of investment.—*Abstracted from the Engineering Magazine (New York), August.*

High-Speed Electric Elevators.

During a discussion on traction elevators before the Western Society of Engineers, John W. Mabbs described the high-speed electric elevators now in service in the Chicago Board of Trade Building. The car of the elevator is suspended from one end of the system of ropes; the latter are then carried over the overhead sheaves, and down around an idler to which is attached the counterweight, and then up to a fixed point. The counterweight is a self-supporting and self-propelled device; it is worm-geared, and climbs up and down two vertical columns by means of four pinions which engage four racks mounted on the columns. As the motor ascends the racks, the car descends at twice the speed, covering the entire travel while the counterweight travels but half the height of the building. To prevent over-running in either direction, automatic stops are provided at both ends of the travel of the counterweight, and there are also mechanical oil buffers which are sufficient to take care of the machine should the controller and all the automatic stops fail. The speed of the elevator ranges from 540 to 600 feet a minute, though it is said a higher speed may safely be given if desired. These elevators may be reversed at full speed without perceptible pause and without a particular shock or jar. The cars stop more quickly and less disagreeably than hydraulic elevators. One of these elevators has been in constant operation in the Chicago Board of Trade Building for five and a half years, and has been out of service but a single day. Two years ago four more similar elevators were installed in the same building and have been in operation since then, and but one machine has been out of service, and that for only a single day. The repairs on the elevators have averaged less than $85 each a year, while the energy consumed has been 3.54 kilowatt-hours per car mile.—*Abstracted from Journal of the Western Society of Engineers (Chicago), June.*

INDUSTRIAL SECTION

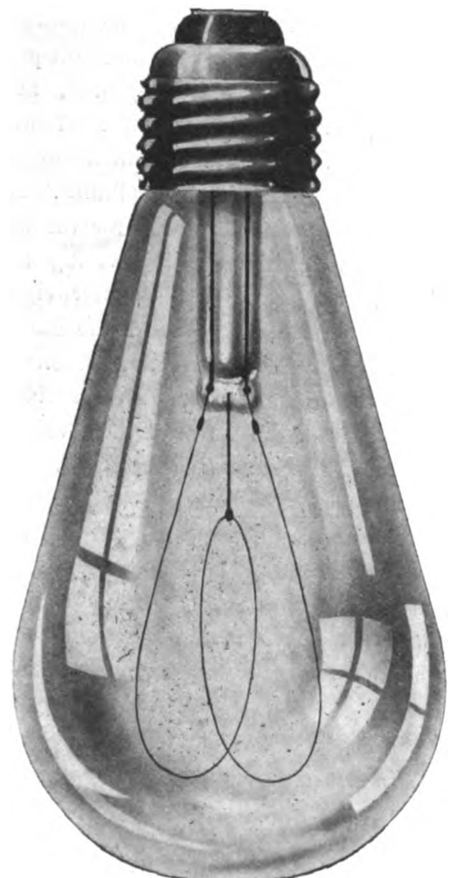
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

New Gem and Tungsten Lamps.

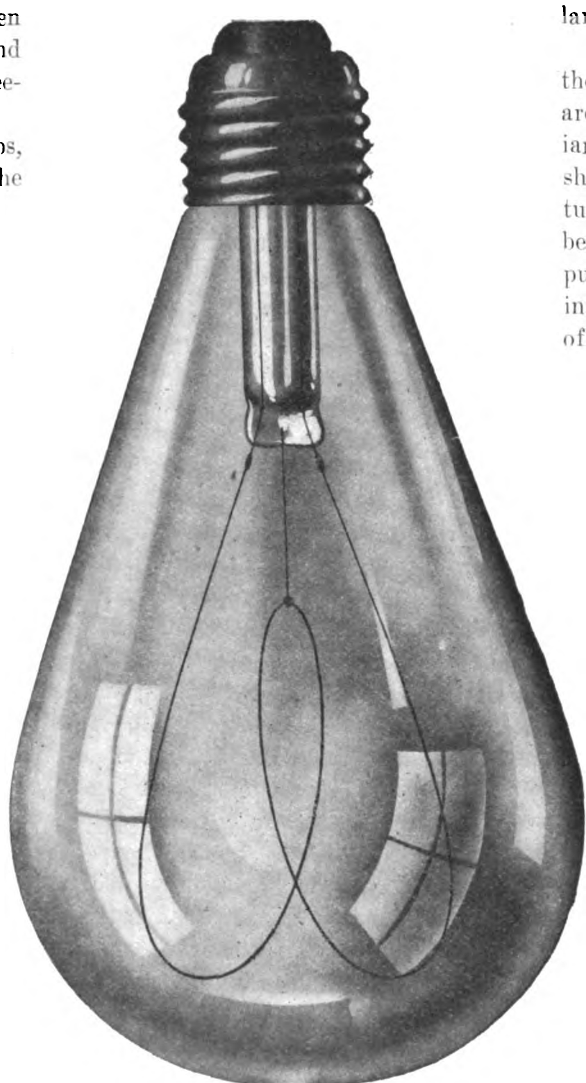
The members of the National Electric Lamp Association are placing upon the market four new types of lamps. Two of these are Gem lamps with oval filaments, all Gem lamps of the same voltages having been heretofore made with two-loop filaments only. Two of these are tungsten Meridian type lamps in the regular round Meridian type bulbs of three and three-quarters-inch and five-inch diameters.

The existing Gem filament type lamps, ninety to 130 volts, are all made in the double-loop type. A great deal of difficulty has been experienced in properly metallizing filaments of other forms and types. This difficulty has been now overcome so far as the oval type is concerned and this type of filament is being employed in the two new Gem lamps now ready for the market.

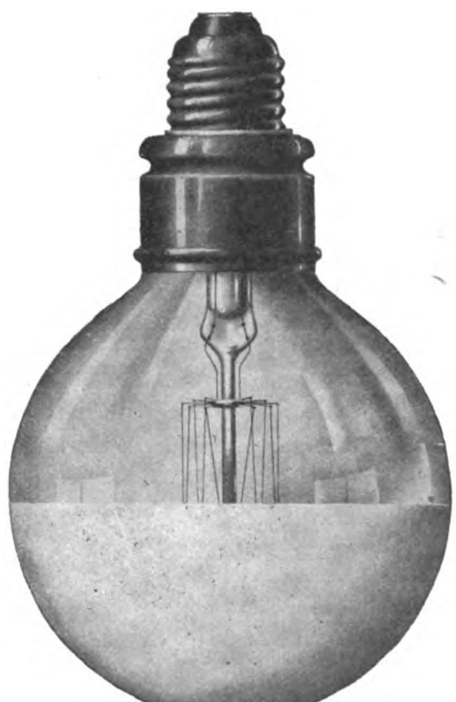
Gem lamps, voltages 90-130, have been made heretofore in the 50, 100, 125, 187 and 250-watt sizes. The two new types are supplementary to the above, are of forty and eighty-watt sizes and are designed for the same voltages, namely, 90-130, as the present Gem lamps. The mean horizontal candle-power of the forty-watt size, therefore, is sixteen candles and of the eighty-watt, thirty-two candles, at two and one-half watts per mean horizontal candle.



Gem Forty-Watt Lamp.



Gem Eighty-Watt Lamp.



Forty-Watt Meridian Tungsten Lamp.

These two lamps are made in bulbs which are standard in the carbon-filament sizes for sixteen and thirty-two-candle-power, respectively. The sixteen-candle-power bulb (the SS 19 bulb) is standard in the Gem fifty-watt size now on the market; consequently, the Gem forty-watt lamp in this size of bulb is similar to the Gem fifty-watt lamp, although dissimilar as above noted, in the type of filament.

The Gem eighty-watt lamp, designed to operate at thirty-two candles at 2.5 watts per candle is made in the bulb (the SS 24 bulb) which is standard in the thirty-two-candle-power carbon type of lamp, and, therefore, so far as cursory inspection goes, this lamp is exactly similar in appearance to the thirty-two-candle-power carbon lamp which it is expected it will largely displace.

Illustrations of these two lamps using the ordinary small standard Edison base are shown herewith. The tungsten Meridian lamps, illustrations of which are also shown herewith, differ from the other tungsten-filament lamps which the members of the National Association have been putting out for these voltages (100-125) in that five filaments are employed instead of four, and in the size and shape of the bulb. Every change in size and shape of the bulb involves new problems in exhaustion and means new apparatus and equipment.

The development of the tungsten lamp in this country has been extremely rapid and the production facilities of the association members have been taxed to supply the demand. The supply, however, of the larger-bulb lamps is now equal to the demand and, inasmuch as these two lamps require somewhat similar manufacturing facilities to the large-bulb lamps, the attention of the staff, which has been devoted to the developing of the larger-bulb tungsten lamps (100-125 watt) has recently been given to equipping for the tungsten Meridian type lamps which are expected to displace the present Meridian type lamps almost universally.

The Meridian type lamps were first placed upon the market with carbon filaments and gave sixteen and thirty-two candles mean horizontal (unfrosted) at sixty and 120 watts, respectively.

SIXTY-WATT MERIDIAN TUNGSTEN LAMP.

With the advent of the Gem filament these same lamps were put upon the market at fifty and 100 watts with an increase in candles (mean hemispherical candle-power, unfrosted) to twenty and forty candles, respectively. It will be noted that these new tungsten lamps give higher candles than any of the preceding types, in the same size of bulb, namely, thirty-two and forty-eight, respectively (mean hemispherical candle-power, clear bulb).

These lamps operate at the same filament temperature that has been adopted for the other types of tungsten lamps, namely, 1.25 watts per candle horizontally.

These tungsten Meridian lamps can be operated at any angle and are designed to give the proper distribution of light with the present Meridian or prismo type reflectors and involve no additional fittings (in the way of sockets, shade-holders, etc., or reflectors), and are made in all voltages from 100 to 125 exactly as are other tungsten-filament lamps.

Data book sheets covering these lamps in detail are in the hands of all members of the National Electric Lamp Association and any further detailed information as to standard package quantities, deliveries, prices, etc., can be furnished by the member companies upon request.

The same life values of the approximate sizes are named for these new lamps.

Sales of Small Curtis Turbines.

The increasing use of small Curtis steam turbines is strikingly shown by an inspection of a partial list of turbines under 500-kilowatt capacity which, up to the present time, have been installed by the General Electric Company or are under construction.

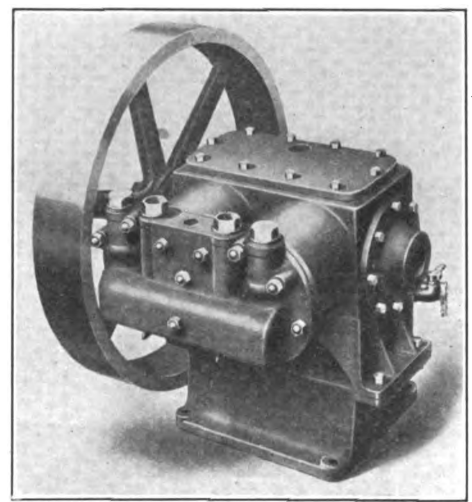
Of the 570 odd turbines listed, representing a total capacity of about 37,000 kilowatts, seven per cent are for the export trade. The remainder are intended for domestic service in central stations, marine work, laboratories of educational institutions, power and lighting plants for hotels and office buildings, laundries, mines, printing establishments and in every branch of manufacturing. It is interesting to note the widely different industries in which small Curtis steam turbines are used. Among the list are woodworking plants, foundries, iron and steel mills, distilleries, chemical plants, ice plants, textile mills, breweries, tanneries, flour mills, shoe factories, paper mills, machine shops, textile mills, and ammunition manufacturing plants.

Turbines for train lighting are finding a ready market and it is interesting to note that the leading railroads are using this method of train illumination. The latest application of moderate size Curtis turbines is for driving fire pumps, in which capacity they have been very satisfactory. On board ship, where a compact generating unit is required, small turbine lighting sets are also rapidly coming into favor.

New Air-Brake Type of Air-Compressor for Industrial Service.

The adaptation of the standard types of air-compressors used with air-brake equipments to many industries requiring compressed air has been decidedly successful. The demand for them has broadened to such an extent that the Westinghouse Traction Brake Company has found it necessary to provide a line of belt-driven compressors similar to their well-known motor-driven compressor for cases where the only power available is from shafting or where it is not expedient to use either steam or electric motive power.

These compressors, designated as the type F-B belt-driven air-compressors, are made in four different sizes, *viz.,* F-1-B, F-2-B, F-3-B and F-4-B, having fifteen, twenty-six, forty-four and one-half and



AIR-BRAKE TYPE OF AIR-COMPRESSOR.

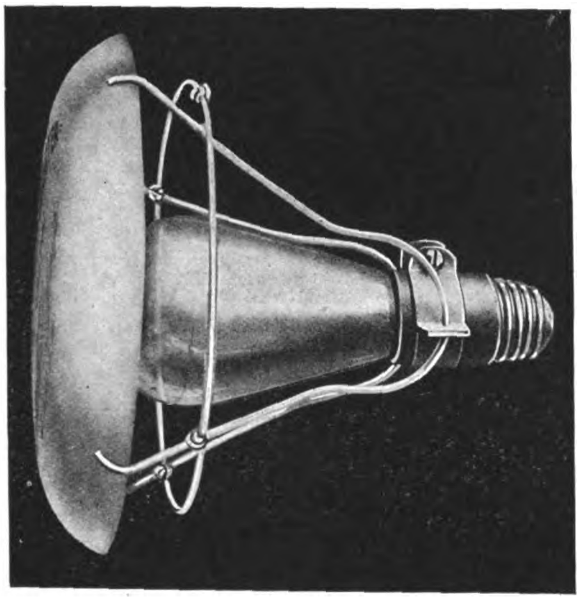
fifty-four and one-half cubic feet of free air per minute capacity, respectively, at the standard speeds, 220 revolutions per minute for the F-1-B and F-2-B, and 200 revolutions per minute for the F-3-B and F-4-B compressors. The horse-power required to operate the compressor in the four different sizes, at 100 pounds pressure, is three, five, nine and eleven respectively.

They will operate successfully against pressures up to 200 pounds per square inch, and may be had with or without water-jacketed air cylinders as occasion requires.

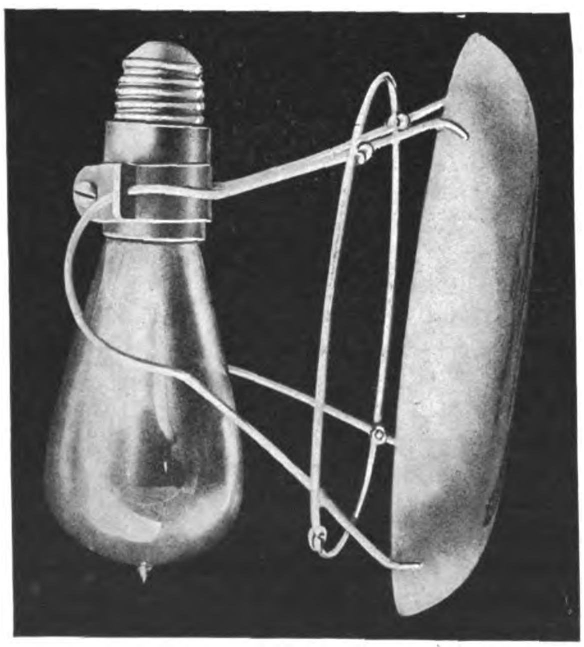
The F-B compressor is most compact in design, being similar in all respects to the motor-driven compressor, except that the motor is replaced by a belt wheel, keyed on the crank-shaft of the compressor. It is of the duplex, horizontal, single-acting type, portable, applicable to any industrial service, and maintained at small cost.

The Phelps Adjustable Sign.

The accompanying illustrations show an adjustable sign which has been developed by the Phelps Manufacturing Company, 54 State street, Detroit, Mich. In designing this sign the aim has been to produce a unique electric sign at a low price. This form of sign is adaptable to every kind of electric fixture, and can be turned to read in any desired direction. As a show-window sign the lamp, while illuminating the sign, also throws light on the goods in the window. It is easy to handle, economical to ship by mail or express, and fits any socket at any angle. The sign is lettered in translucent colors with either raised or surface work.



Phelps Adjustable Sign Placed at End of Lamp Bulb.



Phelps Adjustable Sign Placed Parallel with Lamp Bulb.

Motor-Driven Refrigerating Machinery.

A comparatively new, yet rapidly growing, use to which electric motor drive is applicable is that of the refrigerating outfit. Only those closely connected with the trade realize the varied and extensive use to which these machines are put.

Two years ago motor-driven refrigerating machines were common in residences, dairies, saloons, drug stores, butcher shops, packing houses and hotels. To this list have been added ice cream and candy factories, florists, fish and game markets, hospitals, cold-storage warehouses, tanneries and general office buildings.

The tendency on the part of the public to demand pure, cool drinking water points to the general use of refrigerating machines for cooling drinking water in all public institutions, such as libraries, schools, etc., and in general office buildings. In connection with refrigeration, motor-driven carbonating machines might be suggested. These machines may be installed in drug and confectionery stores for supplying the aerated water used in soda fountains.

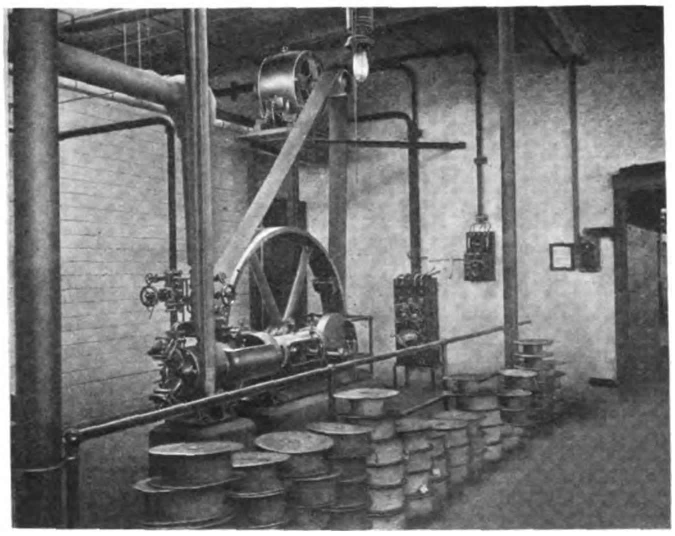


Fig. 1.—Forty-Horse-Power Motor Driving Compressor.

Electric motor drive, besides being in most cases the most economical in operation, is a clean, reliable source of power, and one available at all times. Motor drive, because of its simplicity, can also be readily understood and operated by even the ordinary mechanic. The subject of cleanliness is one not to be overlooked, especially by those engaged in the manufacture of ice cream and candy.

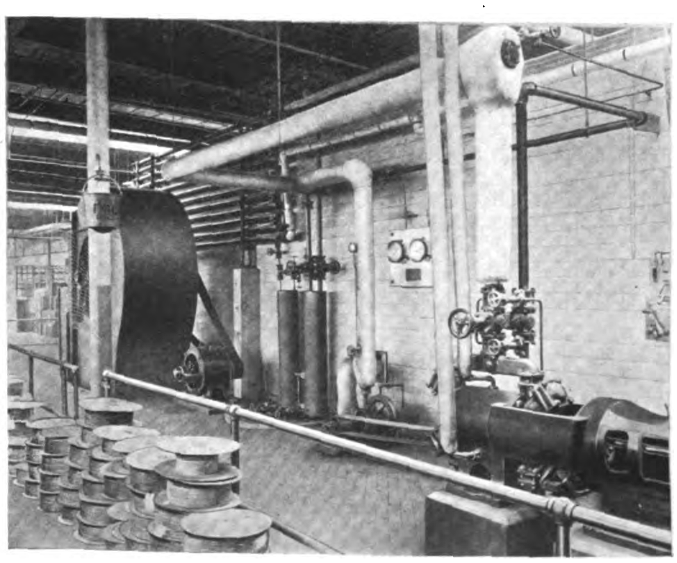


Fig. 2.—Motor-Driven Blower and Centrifugal Pumps.

The cost of electric energy is about one-half that of ice at the present scale of prices, and the owner of a refrigeration plant has no fear of an ice famine. In most cases it is not necessary to operate the plant continuously. This, and the fact that the minimum capacity is required at night and in cool weather, makes it possible for the user of electric energy to keep his machines off the peak load of the station, and thus obtain the lowest kilowatt-hour rate.

The installations in common use vary in size from one-quarter-ton residence outfit to the fifty-ton packing-house plant. In most cases the small machines are belt-connected to motors, and the large machines use silent roller chain drive.

Fig. 1 and Fig. 2 illustrate the equipment of the Western Electric Company's motor-driven refrigerating plant at their Hawthorne works. This equipment, used to cool the rooms of the cable plant during the summer months, acts both as a cooling and ventilating system. The brine circulation system is used exclusively, all expansion coils being located in the brine tanks. The apparatus consists of an ammonia compressor, a cooler containing the brine tanks, a blower and a brine pump.

The compressor, shown in Fig. 1, is driven by a forty-horse-power, direct-current motor, mounted near the ceiling. The compressor, operating in connection with ammonia pipes in the brine tanks, reduces the temperature of the brine, which in turn cools the air in the cooler. These brine tanks are open, and the brine in them is kept in circulation by means of a centrifugal brine pump, driven by an eight-horse-power motor. When the air within the cooler is at the desired temperature, the large exhaust fan, shown in Fig. 2, is started. This fan drives the air through the cooler, where the temperature is lowered, and out into a distributing system. The blower is belt-connected to a twenty-horse-power, direct-current motor. This plant was designed by S. W. Calhoun, consulting engineer, of Chicago, and has a capacity of fifteen tons. The motors used to drive the compressor, brine-circulating pump and fan are all 220-volt, direct-current machines, built by the Western Electric Company.

New Sectional-Gang Conduit Boxes.

The Chicago Fuse Wire and Manufacturing Company, 170 South Clinton street, Chicago, is placing on the market a new conduit box, No. 160, embodying the sectional-gang idea employed in its well-known type "AA" and "BB" boxes for flexible conduit. A box for any number of gang switches can be built up from a two-gang box shown in Fig. 1, by loosening the screws and inserting spacers, the box and cover part of the spacer being formed of one piece, the only detachable part on top being the small end-cover plates which may be removed without taking out a screw, permitting ready access to the bushings of end conduits, also allowing examination of wires without disturbing switches.

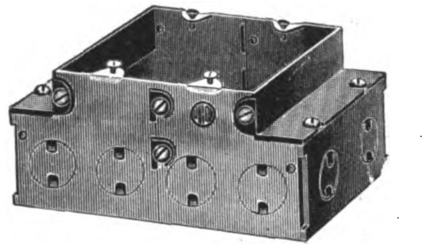


Fig. 1.—Two-Gang Box.

Fig. 2 shows a three-gang box with spacer in place, the hook-eye construction enabling these boxes to be assembled without removing a single screw, forming a perfectly tight box, meeting in every detail the requirements of underwriters, as well as filling a long-felt want of electrical contractors for a sectional-gang conduit box in which there is ample room for conduit connections, wire joints, etc. This box makes an ideal junction box when equipped with a flat cover, and is particularly suitable as a cutout box, being designed to accommodate the single and double-pole main line blocks and also several single and double-branch cutouts manufactured by this company.

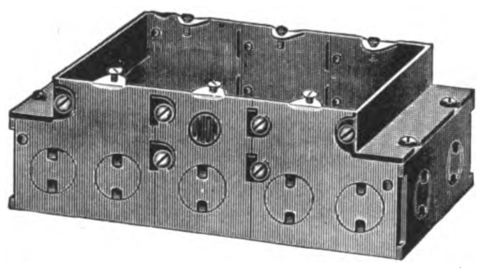


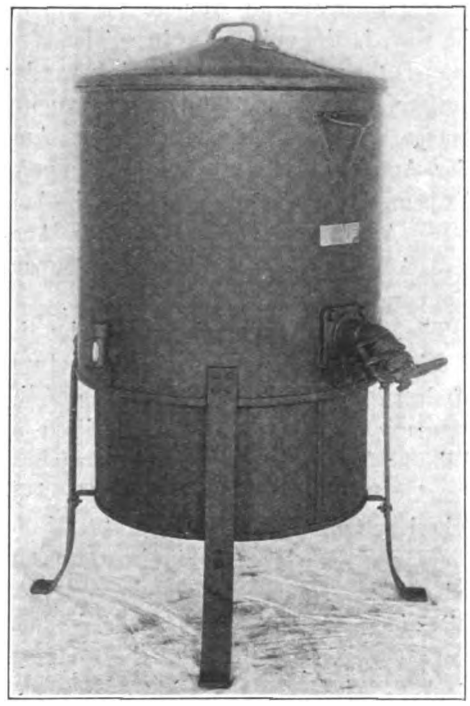
Fig. 2.—Three-Gang Box.

Each spacer is provided with two knockout plugs for one-half-inch or three-quarters-inch conduit as specified, while each box portion is equipped with six such openings.

The spacings between switch-lug centres are standard so that all gang-switch plates fit perfectly. The advantage of this construction over the single-piece gang boxes must appeal at once to every user of conduit boxes, as it enables him to meet any demand for gang boxes with only a stock of two-gang boxes and spacers.

Glue Cookers.

The accompanying illustration shows a ten-gallon glue cooker shipped to the J. B. Lyon Company, Albany, N. Y., by the Westinghouse Electric and Manufacturing Company. The Westinghouse company builds a line of these cookers ranging from five to twenty-five gallons in capacity, and they are used by the manufacturers of printing press rollers, bookbinders and large cabinet work shops where it is necessary to melt and keep in working condition large quantities of glue or other compositions for replenishing the smaller glue pots used on the bench. These glue cookers are arranged with two heats, a high heat for melting down raw stock, and a low heat for holding the stock at a working consistency.



Electrically Heated Glue Cooker.

A New Seamless Trolley Pole.

A new seamless trolley pole is being put on the market by the R. D. Nuttall Company, Pittsburg, Pa. It is made of cold-drawn seamless tubing of the highest grade to be obtained.

Great strength is insured by a reinforcement at the bottom and a gradual taper at the top. The reinforcement is sixteen and one-half inches long and made of the same material as the pole proper. It is inserted cold and with such care as to fit that it practically becomes a part of the pole.

The taper begins three feet from the top and reduces the diameter from one and one-half inches at this point to one inch at the end. This gives to the pole great strength and rigidity.

The pole is made in all lengths up to eighteen feet and combines rigidity with light weight. The average weight of the twelve-foot poles is twenty-two pounds.

The Crocker-Wheeler Company and Ampere.

The island now known as Manhattan has had at various times forty-six different names applied to it, ranging from Manetto and Manath to Munhaddons. The town of Ampere, N. J., is often called out of its name in spite of the natural simplicity of the word. Ampere is named after the celebrated French scientist, whose name is also used throughout the world as the unit of electrical current. Letters addressed to Ampere (which, by the way, is the only place in existence so named) have borne the following words: Amfere, Amphion, Amperre, Ampore, Ampee, Amperr, Ampre, Ampire, Ampier, Ampiere, Ampsere, Ampero, Amperc, Ampen, Ambere, Amerer, Ampeal, Ampeare, Amphere, Amphen, Ampicre, Auspere, Ampeere, Ampers, Amperel, Ampeu, Monpere, Onyiere.

The town was named Ampere by the Crocker-Wheeler Company, manufacturer of electrical machinery. The name of the company has been variously written as follows: Corcker-Wheeler Company, Crocker-Wheller Company, Crooker-Wheeler Company, Crocker Water Motor Company, Croaker & Wheeler, Crocker-Wheeling Company, Crocker-Wheelwe Electric Company, Crocker-Wheel Company, Crocker-Wheeler Electric Company, Booker-Wheeler Company, Brocker-Wheeler Company, Crokett-Wheeler Company, Chrocker-Wheeler Company, Clocker-Wheeler, Cricker-Wheeler Company, Rocker-Wheeler Company, Croker & Wilson Gas Engine Company, Croker & Wheeler Company, Crosier Wheeler Electric Company, Crocker-Wheeles Company, Croker Willer Dynamo Company, Croper & Weeler Company, Croker-Wheeler Company, Croquer-Wheeler Company, Crocker-Whaler Motor Company, Crocker-Wheelef Company, Wicker & Wheeler, Vrocker Wheeler Company, Wheeler & Crocke, Crocker-Williams Company.

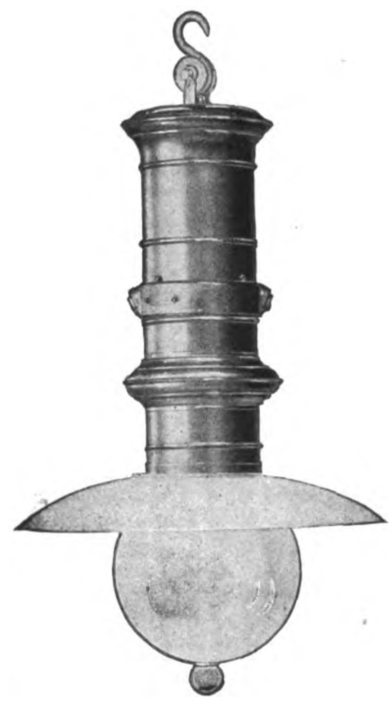
Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on August 18 for the following electrical supplies: 35,000 arc-lamp carbons, 1,000 feet of lamp cord, miscellaneous fuses, miscellaneous electrical supplies, weatherproof wire and rubber-covered wire, for delivery at Norfolk, Va.; 2,500 feet of Circular Loom, miscellaneous electrical supplies, switches and rubber-covered wire, for delivery at Washington, D. C.: two feeder panels for delivery at Boston, Mass.

The "Stavelco" Semi-Enclosed Arc Lamp.

The accompanying illustration shows the new "Stavelco" semi-enclosed arc lamp which has been placed on the market by the Stave Electrical Company, No. 1 Madison avenue, New York city. It is claimed that by allowing a certain amount of the oxygen from the air to burn with the arc, the luminosity of the lamp is added to, and the ultra-violet rays are eliminated. The light emitted by this lamp is almost pure white, and is exceptionally favorable for department stores, printing plants and other industries where colors have to be matched under artificial illumination.

The mechanism of the lamp is decidedly simple and depends upon the clutch-feed



THE "STAVELCO" SEMI-ENCLOSED ARC LAMP.

principle. The matter of trimming the lamp has been carefully worked out, and the carbon guide is split at the lower end so that the carbon-holder is easily accessible for inspection. The life of the electrodes is between twenty-eight and thirty hours, and small-sized carbons are used. The diameter of the carbon is six millimetres, and the crater is thus confined to a small point on the carbon, and there is little tendency for the crater to travel on the outer edge of the carbon, resulting in a greater steadiness of light.

The efficiency of the lamp is stated to be very high. With a current consumption of four amperes, the mean hemispherical candle-power is 800.

The lamps are arranged so that they can burn in multiple on 110 volts or in series on 220 volts. They are made for either direct current or alternating current, and in the latter case for any frequency from forty cycles to 125 cycles.

Wagner Transformers for United States Reclamation Service.

An initial shipment of water-cooled power transformers, forming part of an ultimate equipment of thirty-six transformers, aggregating 10,530 kilowatts, for the United States Reclamation Service in connection with the Salt River, Arizona, irrigation project, has recently been made by the Wagner Electric Manufacturing Company. The specifications for these transformers were issued last July, and the contract was awarded to the Wagner company under severe requirements as to insulation, operating characteristics, etc., and also under rigid stipulations as to prompt delivery. The recent shipment comprises six 350-kilowatt, twenty-five-cycle, 2,300-26,000-volt step-up transformers and nine 235-kilowatt, twenty-five-cycle, 23,100-1,100-volt step-down transformers. The design of the transformers required dealing with certain special conditions at the places of installation, among which were the limited space for handling the transformers in the power-house, and the high temperature of the cooling water due to the hot climate of the desert region. The water is circulated through the cooling coil of each transformer by a Wagner three-phase motor-driven triplex pump.

New Shelby Tube Company Elects Officers.

Permanent organization of the new Shelby Tube Company has been perfected by the election of the following officers and directors:

President, J. C. Fish; vice-president, C. M. Skiles; second vice-president, C. S. Hook; general manager, A. C. Morse; secretary, Howard Seltzer; treasurer, James Brubaker. Directors: J. C. Fish, Charles Hook, G. M. Skiles, A. C. Morse, J. A. Seltzer, Roger Heath, Edwin Mansfield, H. W. Hilderbrandt, T. J. Green, Jonas Feigher, Y. O. Peters, Robert Greer, J. W. Williams, R. P. Bricker and C. S. Moore. The total amount of capital subscribed is $250,000. The company is incorporated for $500,000.

Ground will be broken soon at Shelby, Ohio, to erect the new tube mill. The United States Steel Corporation owned a tube mill at that place, and it was destroyed by fire about six weeks ago.

Current Electricai News

DOMESTIC AND EXPORT.

TO BUILD BIG POWER-HOUSE AT GRAND RAPIDS—At a directors' meeting of the Menominee & Marinette Light and Traction Company it was decided to increase the capital of the company from $450,000 to $1,000,000 for the purpose of building a power-house at Grand Rapids, Mich. Seven thousand horse-power will be developed by this plant, which will be brought to the cities of Menominee and Marinette. The necessary capital has been subscribed.

THE VANDERBILT ELECTRIC LINES—The Mohawk Valley Company, which has been the holding company for the Vanderbilt electric lines in New York, has certified to the secretary of state that it has reduced its capital stock from $20,000,000 to $7,500,000. The paper is signed by W. C. Brown as vice-president of the New York Central & Hudson River Railroad Company, and Horace E. Andrews as manager of the Central Railway syndicate. It is stated that the ascertainable debts and liabilities of the company are $7,104,-657, and that the amount of the reduction of the capital stock is to be distributed among the stockholders of the company. The capital stock of the Rochester & Eastern Railway Company, another Vanderbilt road, is increased from $1,500,000 to $15,290,200, the certificate being signed by Horace E. Andrews as president of the Mohawk Valley Company.

NEW COLORADO POWER PLANTS—Plans for th projected $1,000,000 improvements of the Empire Water and Power Company in Cascade Cañon, west of Colorado Springs, have been approved at a deferred annual stockholders' meeting, and work will be begun soon. The stockholders have authorized the issuance of a $1,000,000 mortgage and the delivery of $500,000 of its first mortgage bonds to a New York banking house, making this amount available at once. Three power plants will be built, one at Green Mountain Falls, a second at Cascade and a third at Manitou. The company will generate electricity by water received from its reservoirs on the north slope of Pike's Peak. The directors would not await the outcome of a suit by L. A. Bigger, of Kansas, owning property in the cañon, who seeks an injunction restraining the company from carrying out its plans on the ground that it will depreciate the beauty of the cañon.

NEW NORTH CAROLINA POWER COMPANY FORMED—The Charlotte Power Company has been formed under the laws of the state of New Jersey. Among those interested are W. S. Lee, W. H. Martin, L. C. Harrison and R. B. Arrington, all officials of the Southern Power Company, and in addition to these, it is understood that a number of prominent capitalists from New York are also behind the movement. The Southern Power Company, as a corporation, has a block of stock in it. The capital stock of the company is $300,000 and the charter provides for the construction and operation of gas, electric and lighting systems in and around Charlotte. The main offices of the concern will be located at Charlotte, from which point as a pivot operations will begin. Permanent organization is expected to be formed at an early date with the election of officers and the transaction of other business incidental to launching a project of such proportions.

NEW VIRGINIA ENTERPRISE—One of the biggest concerns organized in Virginia for a long time is that for which application has been made for a charter. It is the Roanoke Traction Company, with a capital stock of from $500,000 to $2,000,000. Roanoke, Lynchburg and Clifton Forge are to be the principal offices of the company, which is to engage in general lighting, heating and furnishing of power for all sorts of enterprises in the cities named. The power for developing this electricity is to be obtained from the James River, at what is known as the "Horseshoe," up above the city of Lynchburg. The water power there is susceptible of easy development and can be cheaply transmitted to the three cities named. At the same time the small towns intervening between the three cities will be able to have electric lights at the minimum of cost. James P. Wood, of Roanoke, is president; R. C. Jackson, vice-president; James C. Martin, secretary-treasurer. A check for $1,000 accompanied the application for the charter.

NEW PUBLICATIONS.

SOME THINGS A MANUFACTURER SHOULD KNOW ABOUT COAL—The Arthur D. Little Laboratory has issued as professional paper No. 3, an article entitled "Some Things a Manufacturer Should Know About Coal," by E. G. Bailey, chief of the coal department. The work of this laboratory is primarily directed toward increasing the efficiency of industrial effort, by aiding manufacturers, public service corporations and individual clients in the economical selection of raw materials, the mechanical control of processes and products, and the study of special problems. This article was originally presented as a paper at the annual meeting of the National Association of Cotton Manufacturers, held at Boston, Mass., April 16 and 17.

LIST OF APPROVED ELECTRICAL SUPPLIES—The Electrocraft Publishing Company, Detroit, Mich., announces that the third edition of the "Electrocraft Illustrated List of Approved Electrical Supplies" will shortly be issued, and that copies will be sent free of charge only to actual buyers of electrical supplies and persons directly influencing buying. The publisher requests immediate applications for copies, to be made on the letter-heads of the applicants and accompanied by ten cents in stamps or silver to pay postage. The new list will be greatly enlarged and improved, and everything electrical which has been approved by the Underwriters' Laboratories will be fully illustrated and described. It will also contain the National Electrical Code, illustrated and explained.

NEW INCORPORATIONS.

LOS ANGELES, CAL.—Needles Light and Power Company. $50,-000. Directors: W. B. Palmer, W. W. Perry and M. P. Thyl.

MILLTOWN, WIS.—Milltown Mutual Telephone Company, Milltown. $4,000. Incorporators: John H. Rahr, Mads Bank, Simon R. Tweeten.

LITTLE ROCK, ARK.—The Grant and Dallas County Telephone Company. $25,000. Incorporators: R. E. Harrison, president; M. G. Bell, secretary and treasurer.

BEALLSVILLE, OHIO—The Mellott Ridge Telephone Company, Beallsville. A. N. Varner, C. F. McDougal, L. A. Mellott, Charles Bolon, G. Pittman. Capital $30,000.

GUTHRIE, OKLA.—The Hackleberry Farmers' Telephone Company, McPeek. $5,000. Directors: D. M. Davis, D. E. Glency and J. C. Pierce, of Arnette; S. S. Lawrence, of Reason, and H. M. Connor, of McPeek.

DEPEW, OKLA.—Depew Telephone Company, Depew. $1,000. Directors: M. Pate, John S. Crail, L. N. Cothern, W. F. Malley, W. S. Langfitt, W. J. Green, E. W. Sims, J. M. Bryden, O. S. Coppage and W. A. Stanfield, all of Depew.

EASTON, ME.—Easton Electric Company. For the purpose of making, generating, distributing and supplying electricity in the town of Easton, Aroostook County, Maine. $5,000. Officers: President, C. N. Delaite, Easton; treasurer, C. W. Spear, Easton.

MILWAUKEE, WIS.—The Wayside Telephone Company, Wayside, Brown County; $2,000; incorporators: Joseph Hoffman, Thomas Monahan and John Natzke. The McKinley Telephone Company, McKinley, Polk County; $1,500; incorporators: E. J. Pfluger, Anton Lundmark and Oscar Risberg.

TELEPHONE AND TELEGRAPH.

PENNINGTON, N. J.—A special meeting of the Hopewell Township Committee was held on July 22 to vote on the proposition to grant Pennington Telephone Company, No. 1, the right to set poles along the public highway from T. Romine Voorhees's to Nathaniel F. Woodwards's. The committee decided unanimously in the telephone company's favor.

HILLSDALE, IND.—Residents of Hillsdale and vicinity have organized for the purpose of building an independent telephone line. At a meeting of a number of persons interested in this movement the following officers were elected to carry out the temporary organization: President, D. B. Highfill; secretary, John Fagler; treasurer, Samuel Hamersley.

CHIHUAHUA, MEXICO—Chihuahua has 553 telephones in its telephone system, an increase of fifty per cent in two years and a half. There are ten miles here in the city with 500 miles of wire and cable strung over them. The rural lines connected with the city office cover eighty-five miles. The system belongs to a local company which has invested $60,000. F. Lee Clevenger is manager.

SAN DIEGO, CAL.—Announcement is made that the Home Telephone Company of San Diego has been sold to an eastern syndicate. It is said that the purchasers paid $120,000 cash for the plant. The deal was conducted through Louis J. Wilde, president of the American National Bank of this city. An important extension to the system projected is the construction of a line to all points in the Imperial Valley.

MOUNT PULASKI, ILL.—According to a certificate filed with the circuit clerk, the Mount Pulaski Independent Telephone Company is no more. The certificate recites that at a meeting held in the Scroggin opera house, July 10, 220 votes out of 265 were represented and of this number 218 voted for a voluntary dissolution and two against it. In accordance with the vote, the company was dissolved, the property disposed of, debt paid and the residue paid those to whom it was due.

MEMPHIS, TENN.—A new long-distance telephone line between Memphis and Jackson, Miss., along the line of the Yazoo & Mississippi Valley Railroad, upon which construction work was stopped by the Cumberland Telegraph and Telephone Company last year, is to be rushed to completion. The line had been completed as far south as Belzoni, Miss., when suspension was ordered on account of hostile litigation instituted against the company and the heavy advance in the cost of construction material.

WHEELING, PA.—The control of the National Telephone Company of Wheeling, one of the largest of the independent companies of the section, has been secured by S. W. Harper and Hon. John A. Howard, of Wheeling, each taking about a third of the stock. The company has been reorganized, Mr. Howard being elected president; Mr. Harper vice-president and treasurer. The company will extend its operations in Washington County, Pa., where it has many franchises, doing much work in Washington borough at this time.

MORELIA, MEXICO—Several business men of Morelia have gotten together to form a stock company to construct a modern underground telephone installation. The company will be called "Compañia de Telefonos Comerciales." A contract has already been entered into with the firm of Siemens & Halske and the corresponding public deed has been drawn up before Notary Public Lic. Francisco Barroso. The stockholders have already made payment of the first assessment according to the by-law of the company, which is capitalized at $80,000.

PEORIA, ILL.—At a recent meeting of the directors of the Farmers' Mutual Telephone Company it was decided to open an office in Tremont, where headquarters will be established. The $20,000 stock of the company has all been subscribed and will be issued at once. The matter of building a new line or buying out an opposition company has been left to a committee and it will get down to business immediately. The proposed line will traverse six of the best townships in the county and has among its stockholders the best farmers of the county.

NASHVILLE, TENN.—The United States Trust Company, of Louisville, Ky., has filed a bill in the Federal Court asking for a receivership for the Home Telephone Company, of Clarksville, Tenn., and Ernest B. Denizen, who has been manager of the company at Clarksville, has been named receiver. The receivership is, in effect, a step in the direction of complete reorganization of the company. The bondholders are seeking to foreclose a mortgage for $140,000 spent in constructing the plant. The company controls exchanges in Montgomery, Houston and Stewart counties.

LAPORTE, IND.—The Merchants' Mutual Telephone Company, of Michigan City, and the Central Union Telephone Company, which for some time past have had under consideration the proposition of a consolidation of the telephone business in Michigan City, make public the fact that the negotiations are about completed and that the Mutual company is soon to absorb the Central Union's exchange and business. The Central Union plant is to be taken over by the Mutual company, the exchanges are to be consolidated and Michigan City will have but one exchange, operated by the Mutual company.

ST. LOUIS, MO.—The Bell Telephone Company of Missouri will erect an addition to its present building at the southeast corner of Beaumont and Locust streets, to cost about $75,000. The addition will have a frontage of fifty-three feet on Locust street, giving the entire structure a frontage of 100 feet on both Locust and Beaumont. The structure will conform in architecture with the present building. It will be of brick and stone and in all details modern. The improvement is planned to meet the growing business of the Beaumont exchange and long-distance station, located in the present building.

ALBUQUERQUE, N. M.—Colonel D. K. B. Sellers, representing important telephone interests, has let a contract to the Nash Electrical Supply Company, of this city, for the immediate construction of forty miles of telephone line from this city to Moriarty, in the Estancia Valley. The contract marks the beginning of a new telephone enterprise which is of first importance to Albuquerque, for not only will it give direct connection with all the towns in the Estancia Valley, but through additional lines now under construction will shortly give direct telephone connections with all the towns along the El Paso & Southwestern Railroad.

ELECTRIC LIGHTING.

BRUNSWICK, ME.—It is understood that the Brunswick Lighting and Power Company is negotiating for the purchase of the real estate and water rights of the Androscoggin Pulp Company.

BRAINERD, MINN.—A $120,000 bond issue has been voted by the city of Brainerd, Minn., for the construction of a new electric light plant and waterworks. The municipal plant does the exclusive electric lighting of Brainerd.

MORRISTOWN, N. J.—It is announced that negotiations have been concluded between the Public Service Corporation and the Morris & Somerset Electric Company whereby the latter leases for a term of 900 years the Public Service Corporation's Morristown electric lighting plant, which also includes franchises in Morris Township.

SILVER CITY, N. M.—The electric light company has been doing some extensive improvement work on its plant. New machinery sufficient to double the capacity of the plant has been installed and work on a new power-house is now in operation. Arrangements have been made to furnish motive power in any quantity to all consumers.

KINGSTON, N. Y.—The Public Service Commission, Second District, has granted the petition of the Kingston Gas and Electric Company for authority to issue $33,000 bonds, not to be sold for less than ninety, the proceeds to be devoted by the Kingston Gas and Electric Company for the refunding of the $32,500 bonds of the Rondout & Kingston Gas Light Company, which are past due.

POCATELLO, IDAHO—James H. Brady, president of the Idaho Consolidated Power Company, of Pocatello, and principal owner of various irrigation and power properties in this section of the state, including the Rexburg Light and Power Company, has closed a deal for the sale of the last-named property to T. M. Hodgins, of Butte, the consideration being $25,000. Mr. Hodgins is owner of the St. Anthony electric light and power plants, and will inaugurate a day and night service.

LEON, IOWA—The Leon Electric Light, Heat and Power Company is to be incorporated, the incorporation papers having already been filed. The company is to be incorporated with a capital stock of $15,000 and shares at $100 each will be offered for sale. The present owners, who are experienced electric light men, are preparing to use the funds derived from the sale of stock in the reorganized company for the improvement of the plant. H. E. Chase and W. S. Curtis are the owners of the plant.

HARTFORD, WIS.—The city council has purchased the L. Kissel & Sons' electric light plant, exclusive of power plant, the price paid being $5,000. The city voted some weeks ago to install a municipal alternating lighting plant at a cost of $27,000, bonds to be issued for that sum. The Kissel company has been operating an electric plant for a number of years, its franchise expiring this year. As it is not incorporated it was unable to secure an indeterminate franchise. The city will proceed at once to install a power plant on a site recently purchased.

YOUNGSTOWN, OHIO—The Consolidated Gas and Electric Company has secured a new contract for city lighting. The company agrees to light the city all night and every night from now until the end of the year at the present rate. The city is now paying $64 per year for each light on a moonlight schedule. The ordinance provides for an all-night and every-night schedule at $68 per light. As the semiannual appropriation has been made the company will have to furnish the light at the present rate, but has agreed to give an all-night and every-night schedule. The contract is for a term of five years.

FARMINGTON, ME.—Work will be begun shortly on the building of a 200-foot log dam with concrete bottom at Cleveland Rips, in North Anson, on the Carrabasset River, by the Franklin Power Company, chartered in 1903 under the name of the Carratunk Power Company, capitalized at $100,000, to provide Farmington, New Vineyard and ultimately the town of Wilton with electricity for illuminating and manufacturing purposes. The president of the Franklin Power Company is S. O. Tarbox, a well-known Farmington man, and the treasurer is C. O. Sturtevant, of Winthrop. Judge A. L. Fenderson, of Farmington, and Hon. George G. Weeks, of Fairfield, are on the board of directors.

CHEYENNE, WYO.—The Cheyenne Light, Fuel and Power Company has secured a new franchise of the city council, material concessions in rates having been made by the company. The new rate to consumers will be twelve cents per kilowatt-hour. The old rate was twenty cents and was reduced to fifteen cents, the company offering to make a further reduction to fourteen cents. Electricity for power will be five cents per horse-power-hour, all bills being subject to a discount for prompt payment, the minimum bill to be one dollar. The city has also secured a concession in the rate it is paying for street lights. The new franchise includes a contract for ten years; for five years the city is to pay $95 for its street lights each per year and for the remaining five years $90, when a new contract will be made. In order that the company may suffer no reduction of revenue by the reduction in rate, the city agrees to install additional lights to make the monthly payments the same as at present.

SALT LAKE CITY, UTAH—Work on the preliminary surveys for a third power plant for the Utah County Light and Power Company has begun. Professor Richard R. Lyman, of the University of Utah, is in charge of the work. The third power plant, which will be constructed by the company, will be built in Alpine Cañon, about six or eight miles from American Fork. The other two plants of the Utah County Light and Power Company are located in American Fork Cañon. Construction work on the second plant has hardly been completed, but the demand for electrical power has been so great within the last few years that the backers of this company deem it wise to build a third plant. Two sites have been suggested in Alpine Cañon for the third plant, but the matter of selecting the site will be held pending a report from Professor Lyman. The Utah County Light and Power Company furnishes the electrical power for the pumping plant owned by Salt Lake City at the mouth of the Jordan River. Last spring the company secured a contract to supply the Knight smelter at Tintic with electrical power. The power line has only recently been completed. Electrical energy will soon be transmitted to and used at the smelter at Silver City. Besides having these two large contracts, the company supplies all the electric light used in the northern end of Utah County.

ELECTRICAL SECURITIES.

While prices still made slight gains last week, there was apparent a falling off in speculative activity and a diminution in the interest manifested by the outside public in both stocks and bonds. The commission houses reported considerably curtailed business, and it is expected that the present month will witness some slight reaction, although business is expected to continue improving. While it is agreed quite generally that there will be very little improvement in the value of stocks until after the election in the fall, it must be remembered that prices are now at a higher level than they were last August. This is particularly significant of the fact that the present prices will discount considerably gains for the next three or four months. The report of the United States Steel Corporation for the second or June quarter was considered reasonably assuring. Net earnings were slightly larger, but orders on hand showed a small decrease. The improvement in profits reflects the gradual recovery of this important industry.

Dividends have been declared upon the following electrical securities: Electric Properties Company, regular quarterly dividend of 1½ per cent on the preferred stock, payable August 10; Consolidated Gas Company, regular quarterly dividend of 1 per cent, payable September 15 to stock of record August 19. Susquehanna Railway, Light and Power Company, regular semi-annual dividend of 2½ per cent on the preferred stock, payable September 1 to stock of record August 15.

ELECTRICAL SECURITIES FOR THE WEEK ENDED AUGUST 1.

New York:	*Closing.*
Allis-Chalmers common	10½
Allis-Chalmers preferred	33
Brooklyn Rapid Transit	52⅜
Consolidated Gas	138½
General Electric	146
Interborough-Metropolitan common	11½
Interborough-Metropolitan preferred	32½
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	70
Mackay Companies (Postal Telegraph and Cables) preferred	69⅛
Manhattan Elevated	138
Metropolitan Street Railway	25
New York & New Jersey Telephone	112
Western Union	55¼
Westinghouse Manufacturing Company	78¾

Boston:	*Closing.*
American Telephone and Telegraph	121½
Edison Electric Illuminating	215
Massachusetts Electric	49
New England Telephone	113
Western Telephone and Telegraph preferred	68

Philadelphia:	*Closing.*
Electric Company of America	10
Electric Storage Battery common	39
Electric Storage Battery preferred	39
Philadelphia Electric	9¾
Philadelphia Rapid Transit	15
United Gas Improvement	88

Chicago:	*Closing.*
Chicago Telephone	—
Commonwealth Edison	—
Metropolitan Elevated preferred	47
National Carbon common	69
National Carbon preferred	109

The July average of passengers carried by the Northwestern Elevated was 99,463, an increase of 7,921.

LEGAL NOTE.

METAL SLEEVE DRUM CONTROLLER CASE—Judge Taylor has handed down an opinion in the United States Circuit Court, Northern District of Ohio, Eastern Division, June 24, in the Metal Sleeve Drum Controller case, involving the Lange and Lamme patent No. 518,693, between Westinghouse Electric and Manufacturing Company, complainant, and the Electric Controller and Supply Company, defendant, adjudging the validity of the patent, and concluding that infringement has been discovered.

PERSONAL MENTION.

MR. C. E. F. AHLM has been retained as consulting engineer by the Board of Public Service of Wooster, Ohio, in connection with the proposed municipal electric lighting plant for that city.

MR. CYRUS OSBORNE BAKER, the head of the house of Baker & Company, and known as the platinum king of America, is spending the month of August at the Samoset, Rockland Breakwater, Me.

MR. ARTHUR H. KIMBALL has resigned as superintendent of the Fitchburg Gas and Electric Light Company to accept the position of general manager of the Fall River Electric Lighting Company.

MR. E. J. KULAS, one of the well-known men in the incandescent lamp field, and for years secretary and general manager of the Brilliant Electric Company, of Cleveland, Ohio, has been elected president and general manager of the Tungstolier Company, of Cleveland. The "Tungstolier" is a new departure in electric lighting, consisting of tungsten lamps, Holophane shades, and a special fixture, the whole presenting a practical and harmonious illuminating device which may be utilized for every character of electrical illumination. Mr. Kulas has been very successful in his management of the Brilliant Electric Company, and the same forceful, enterprising and affable characteristics will win for the Tungstolier Company the hearty support of all those requiring lighting devices of this nature.

ELECTRIC RAILWAYS.

MADISON, WIS.—Solomon Perris, attorney for the Interstate Transfer Railroad Company, appeared recently before the railroad commission to ask for a certificate to authorize the road to begin at once the construction of a line from the steel mills near Duluth to Superior.

HAGERSTOWN, MD.—A movement is on foot to construct a trolley line from Hagerstown to Security, a village located about two miles east of Hagerstown. A cement plant costing over $1,000,000 is being erected at Security by the Maryland Portland Cement Company, in which Baltimoreans are interested.

FREMONT, OHIO—The Fremont City Railway, now operating a line between Fremont and Ballville, a village on the south, has made application to the city council for a franchise which will enable the company to extend its lines to the Lake Shore station and to Spiegel Grove, the Hayes home. The council now has the application under advisement.

GRAND JUNCTION, COL.—The city council has granted a twenty-year franchise to the Fruit Belt Power Company for the construction of a street-car line in the city of Grand Junction and from Grand Junction to Fruita. The company is controlled by Colorado Springs and Grand Junction capital. The work on the new road is to begin under the terms of the grant by October 1.

BETHLEHEM, PA.—A new trolley company has been organized at Mauch Chunk and named the Carbon Transit Company. These are the officers and directors: president, Horace Lentz; vice-president, J. C. Dolan; secretary and treasurer, Charles Neast; directors, John C. Dolan, N. D. Cortright, Horace Lentz, Charles Neast, of Mauch Chunk; George K. Moser and Andrew S. Keck, of Allentown.

PENDLETON, ORE.—The city council has granted eastern capitalists a franchise for a street railway system through Pendleton. Work will begin soon. Connection will eventually be made with Columbia River and different Umatilla County points. Montie B. Gwinn represented the company before the council. The capitalists back of the project are the same Pittsburg people who built the line from Bois to Caldwell, Idaho.

UNIONTOWN, PA.—Plans have been made to build an interurban traction line across the Allegheny Mountains from Oakland, Md., to Uniontown, Pa., most of the way near the main line of the Baltimore & Ohio. The company will be known as the Oakland, Sparrow Falls & Uniontown Electric Railway. A charter has been secured in Maryland and one will be secured in Pennsylvania by J. B. Hogg and others, of Uniontown. A double-track survey from Swallow Falls to Oakland is now being made.

MONROE, MICH.—The city council has granted a street-railway franchise to the Toledo, Ottawa Beach & Northern. Provision is made that the company shall forfeit $2,000 for each year the road is not completed and in operation after three years from the date of the franchise. It is the purpose of the company to extend the road to Detroit as soon as possible. Right-of-way agents have been busy for some time, and it is anticipated that everything will be in readiness to proceed with construction next spring.

DENVER, COL.—Articles of incorporation have been filed with the secretary of state by the Burlington Interurban Railway Company for the board of directors. The incorporators are: Ray C. Watson, Frederick O. Olsan, John P. Klug, Frank K. Hatch, Charles I. Moore, Clarence A. Fletcher and Milton L. Chapman. The company is capitalized at $2,500,000 and has its principal offices in Denver. It will operate electric cars in the counties of Denver, Adams, Larimer and Weld and will have terminals at Denver, Fort Collins and Crow Creek in Weld County. The existence of the corporation is fifty years.

LAKE CHARLES, LA.—The Lake Charles Railway and Light Company will take over the franchises and property of the Lake Charles Street Railway Company. The capital stock of the company is fixed at $750,000, divided into shares of $100 each. One-third, or $250,000, shall be preferred stock, bearing a fixed dividend of six per cent, and the rest common stock that shares in the ordinary net profit. The officers and first board of directors follow: Thompson J. Bird, president; J. Alfred Landry, first vice-president; D. J. Landry, second vice-president; A. J. Pujo, third vice-president; Paul O. Moss, treasurer.

JANESVILLE, WIS.—With the incorporation of the Cincinnati Construction Company, which seeks to build an electric interurban railroad between Janesville and Madison, the first step in the construction of the road proposed by an Ohio syndicate was made The incorporators are all Janesville men, being J. M. Bostwick, M. P. Richardson, Archie Reid, P. H. Korst and Richard Valentine. Chief Engineer Joseph Ellis, of Columbus, has finished the first survey of the line from Janesville to Stoughton. It is understood the road will run from Janesville to Madison by way of Edgerton and Stoughton. It will leave Janesville by what is known as the river road and cross the Rock River above Indian Ford. It will be an air line, running to the west of both lakes Kegonsa and Waubesa.

ALLENTOWN, PA.—Mayor Stiles signed the ordinance providing for trolley freight in Allentown. It was passed by councils on July 14, granting the privilege to the Lehigh Valley Transit Company to establish a trolley express service, under certain reasonable restrictions. The cars are to be neat and no freight is to be carried which would be dangerous or offensive. The establishing of a trolley freight system was conceived by President Stevens. The freight house in Allentown is to be located at the old power-house. A special effort will be made to establish a prompt and efficient service to Philadelphia, as well as all other points along the system. From present indications the Philadelphia Milk Exchange will ask the Transit Company to put on refrigerator cars to carry milk. It is proposed to expend $80,000 to start the service.

COLUMBUS, OHIO—At a meeting of the board of directors of the Scioto Valley Traction Company, held recently, the franchise lately granted the company by the city council of Chillicothe was accepted. The company has been making a fight for this franchise ever since the line was completed to Chillicothe some three years ago. The city insisted that the Scioto Valley must enter over the track of the local street railway company, which would have added largely to the mileage operated by the interurban cars. The traction company refused to do this, and as a result has stopped at the corporation line. In the end, however, the company gets the right to lay its own tracks in Chillicothe, and thus will gain an entrance into the heart of the city by the construction of about 2,000 feet of new line. The franchise will mean much more traffic for the company to and from Chillicothe.

INDUSTRIAL ITEMS.

THE NOVELTY INCANDESCENT LAMP COMPANY, Emporium, Pa., is distributing its usual attractive monthly calendar card.

FOX BROTHERS & COMPANY, 126-130 Lafayette street, New York city, are mailing a card calling attention to the merits of the "Polar" flaming arc lamp and the "Radiante" Economy lamps.

THE F. BISSELL COMPANY, Toledo, Ohio, has ready for distribution its calendar card for August. This contains the suggestion that "it is easy to see through" the constant increase in the company's business. The allusion is completed by reference to a piece of clear window glass.

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., is distributing several attractive bulletins, as follows: No. 20, direct-current ceiling fans; No. 21, direct-current Universal fans; No. 151, types "F" and "FC" motors and generators; No. 501, small ventilating fans; No. 502, electric coffee mill.

THE GAS MACHINERY COMPANY, 715-722 Citizen Building, Cleveland, Ohio, announces that the Wile producer heretofore furnished by the Wile Power Gas Company will hereafter be exclusively manufactured by the Gas Machinery Company. J. I. Wile will be sales manager of the Wile producer department.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has issued bulletin No. 1,107, describing and illustrating standard alternating-current, single-phase switchboard panels. Bulletin No. 1,108 describes and illustrates multiphase, revolving-field, belted generators, form A. Copies of these bulletins will be furnished to those interested upon request.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has prepared a bulletin describing in detail an American Blower engine direct-connected to an Allis-Chalmers "NJ" generator. The conditions met with in small isolated light and power plants in public places, factories, private residences and aboard ship are satisfied in this combination of engine and generator. Copies of this bulletin, No. 1,042-A, will be furnished to those interested upon request.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., on Friday, the 24th ult., suffered the loss by fire of a portion of its Tonawanda plant, where is located its casting mill and foundry. Plans are made for rebuilding the burned portion on an enlarged scale, which is to be of fireproof construction as nearly as may be. The company states that its business for the season will not be delayed on account of the fire. The loss is fully covered by insurance.

DOSSERT & COMPANY, 242 West Forty-first street, New York city, have received orders from Westinghouse, Church, Kerr & Company for 115 special solderless elbow-connectors, 300 and 600-ampere sizes, to connect the station buses through oil switches to the 2,400-volt outgoing lines at the Dutch Point station of the Hartford Light and Power Company, Hartford, Ct. These elbow-connectors can be used to make joints at either right or left angles, and afford a striking illustration of the flexibility of the Dossert devices.

THE MASSACHUSETTS CHEMICAL COMPANY, Boston, Mass., announces that it has entered into a contract with one of the great and conservative insulated-wire manufacturers to supply its entire requirements of cable cloth. The wire and cable company has for many years made its own cable cloth, but has been convinced that by delegating this part of its cable making to the Massachusetts Chemical Company it will get not only a better and more uniform product, but get it at a lower cost per yard than it has been producing it itself.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued two bulletins, 4,601 and 4,602, describing its improved automatic voltage regulators. These are made in various styles for the regulation of one generator or of two or more generators in parallel, either alternating or direct current. Bulletin 4,609 describes a new lamp-testing watt indicator. This instrument is of the portable type and may be carried in the pocket, is intended for use with Edison base lamps, but can be fitted with an adapter for use with either Thomson-Houston or Westinghouse socket lamps, and is designed to give a practical demonstration of the relative watt consumption of various incandescent lamps.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing information on its meter-testing load box for use in testing integrating wattmeters, either in the laboratory or at the point of installation. The boxes are of novel design in that the various resistance units are mounted in enclosed fuse clips and are handled in very much the same manner as the Standard Code fuses. The company is also distributing a new handbook giving considerable data on lighting with tungsten lamps. Tables are given showing the cost of lighting with tungsten lamps as compared with gas mantles and gas arcs, this being worked out at various values from two cents to thirteen cents per kilowatt-hour. This book embodies some twenty-four pages and should prove of interest to central stations in demonstrating to their customers the efficiency of tungsten lamps.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the Second Issue of Each Month.)

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AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth street, New York city. Annual convention, Atlantic City, N. J., October 12-16.

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AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, J. W. Corning, electrical engineer Boston Elevated Railway Company, Boston, Mass. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION. Secretary, George B. Keegan, 2321 Park Row Building, New York city. Annual convention, Atlantic City, N. J., October 12-16.

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ORDER OF THE REJUVENATED SONS OF JOVE. C. B. Roulet, Mercury, Dallas, Tex.

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DATES AHEAD.

Michigan Electric Association. Annual meeting, Grand Rapids, Mich., August 18-21.

International Association of Municipal Electricians. Annual convention, Detroit, Mich., August 19-21.

Ohio Electric Light Association. Annual convention, Put-in-Bay, Ohio, August 25-27.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Old Time Telegraphers' and Historical Association, and Reunion of Military Telegraphers, Niagara Falls, N. Y., September 16-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 6-7.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

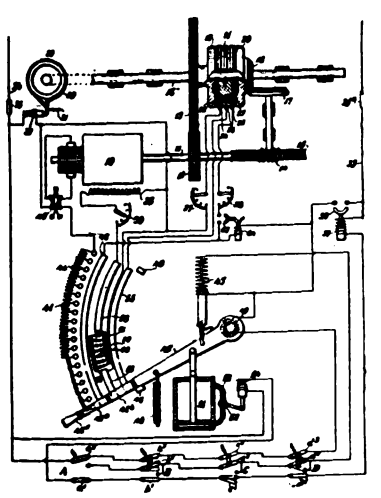
Record of Electrical Patents.

Week of July 28.

894,193. INCANDESCENT LAMP. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A telephone signal lamp, the ends of the terminals being bent so as partially to enclose the bulb.

894,199. SYSTEM OF CONTROL FOR ELECTRIC MOTORS. Ralph M. Gaston, Morgan Park, Ill. A controller in an auxiliary circuit governs a motor which controls the operating current.

894,201. INSULATOR. Thomas E. Hallett, Chicago, Ill. The insulator is held on a rigid support by a threaded wedge.



894,232.—MOTOR-CONTROLLING SYSTEM.

894,212. TROLLEY GUARD. George S. Keck, Baltimore, Md. Laterally swinging guard arms are provided.

894,214. TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa. A system employing true current reversals and using an inductorium for this purpose.

894,217. ELECTRIC RAILWAY. Mathias A. Lazareff, New York, N. Y. A sectional supply conductor normally connected to the feeder is used, the connecting switches being held open by electromagnets.

894,232. MOTOR-CONTROLLING SYSTEM. Walter J. Richards, Norwood, Ohio, assignor to Allis-Chalmers Company. Gears for driving at different speeds are controlled by magnetic clutches.

894,233. SYSTEM OF MOTOR CONTROL. Walter J. Richards, Norwood, Ohio, assignor to Allis-Chalmers Company. A controller operated from a distance.

894,237. MEANS FOR CHARGING STORAGE BATTERIES. Mary N. Stivers, Jersey City, N. J. A reversing motor is connected in an auxiliary circuit, the former being mechanically connected to the controlling rheostat.

894,257. TELEPHONE APPARATUS. Arthur M. Cobb, Lynn, Mass. A telephone head set supporting two receivers and one transmitter.

894,258. TELEPHONE APPARATUS. Arthur M. Cobb, Lynn, Mass. A head set with a universal joint for the transmitter.

894,305. TURBO-GENERATOR. Alfred H. Wouters, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. An enclosing end bell is provided for supporting the end turns.

894,317. ELECTRODE FOR ELECTROLYTIC OR LIQUID OSCILLATION-DETECTORS FOR WIRELESS TELEGRAPHY. Lee de Forest, New York, N. Y. An electrode of the insulation-covered type for detecting feeble electrical impulses.

894,318. AEROPHORE. Lee de Forest, New York, N. Y., assignor, by mesne arrangements, to De Forest Radio Telephone Company. A device for transmitting electromagnetic waves in predetermined directions.

894,323. ELECTRIC WATER-HEATER. Frank E. Holt, Vancouver, British Columbia, Canada. The water passes through a series of passages, each of which is provided with a heating element.

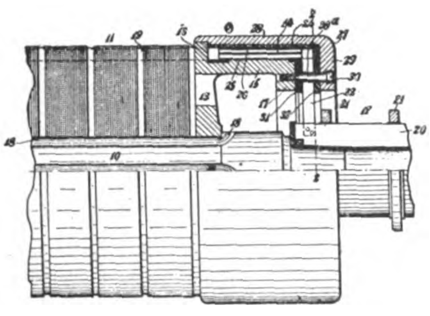
894,326. ELECTRIC SWITCH-REGISTER. John H. Jackson, Watonga, Okla. The track switch automatically closes an electric signal in circuit.

894,329. ELECTRIC GENERATOR OR MOTOR. Carlton L. Kennedy, Braintree, Mass. The pole-pieces are divided and provided with magnetic shunts.

894,333. ELECTRICALLY PROPELLED VEHICLE. Joseph Ledwinka, Philadelphia, Pa., assignor to Russell Thayer, Philadelphia, Pa. A car drawing its power intermittently from an external wire or a storage battery.

894,378. WIRELESS SIGNALING APPARATUS. Lee de Forest, New York, N. Y., assignor to De Forest Radio Telephone Company. The combination of a sending device having a plurality of wave producers and a receiving apparatus consisting of a plurality of complemental wave-responsive devices.

894,435. ELECTROLYTIC APPARATUS FOR PURIFYING LIQUIDS. John T. Harris, New York, N. Y. Water is passed between parallel electrodes formed of metal capable of yielding a colloidal hydroxide.



894,305.—Turbo-Generator.

894,460. TELEPHONE TRANSMITTER. Emile J. Pitrat, Urbana, Ill. A receiver in which the button is kept vertical although the diaphragm may be set at different angles.

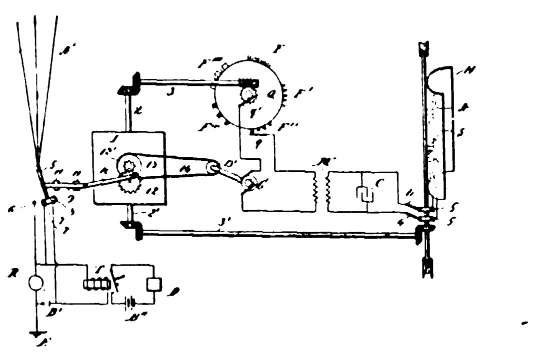
894,468. TANK INDICATOR. Julius E. Smith, North Lansing, Mich. A float for closing a signal circuit when the tank is filled.

894,479. INDUCTION COIL. Amos R. Bliss, Lowell, Mass. The secondary winding is composed of units each consisting of a coil of wire wound on a spool provided with external contact members.

894,482. PLATING MACHINE. Seth C. Catlin, Bloomfield, N. J. A rocking plating tank.

894,518. LIGHTNING ARRESTER. Maurice Milch, Nagy Bittse, Austria-Hungary, assignor to General Electric Company. A plurality of conductors of different material disposed to form a series of air-gaps having greater resistance to the flow of current in one direction than in the other.

894,522. VOLTAGE-REGULATING SYSTEM. Wilbur L. Merrill, Schenectady, N. Y., assignor to General Electric Company. A plurality of counter-electromotive-force generators, each controlled by a separate rheostat, is employed.



894,318.—Aerophore.

894,533. DYNAMOELECTRIC MACHINE. Henry G. Reist, Schenectady, N. Y., assignor to General Electric Company. A binding band comprising a metal strip having holes therein and clips acting as fan blades.

894,539. REGULATION FOR MULTIPHASE SYSTEMS. Edward Schildhauer, Washington, D. C., and Albert A. Radtke, Chicago, Ill. A regulating generator is connected in each phase of the main supply circuit, all the auxiliary machines being mounted on one shaft.

894,547. APPARATUS FOR MANUFACTURING NITROUS COMPOUNDS. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. Electric arcs are drawn out in an enclosed air chamber.

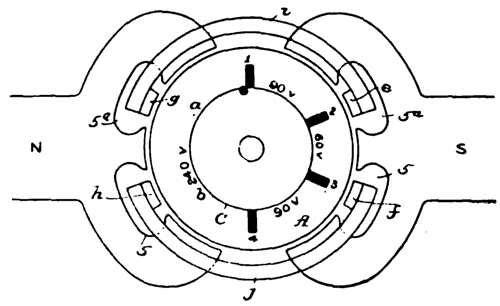
894,563. STARTING RHEOSTAT. William C. Yates and George W. Cravens, Schenectady, N. Y., assignors to General Electric Company. Means are provided for rendering neutral a switch having a tendency to return to the off position.

894,564. RHEOSTAT. William C. Yates, Schenectady, N. Y., assignor to General Electric Company. A reversing rheostat which normally returns to the off position, but which can be held in any position when desired.

894,565. RHEOSTAT. Paul H. Zimmer, Schenectady, N. Y., assignor to General Electric Company. A rheostat with an overload switch.

894,602. SECONDARY OR STORAGE BATTERY. Charles H. Clare, Stratham, N. H. An element having an assemblage of electrodes, active material and plates for supporting the latter, with an opening for receiving and holding an exciting fluid.

894,614. RHEOSTAT. George H. Gorgeloh, Schenectady, N. Y., assignor to General Electric Company. A combined armature and field rheostat.



894,329.—Electric Generator or Motor.

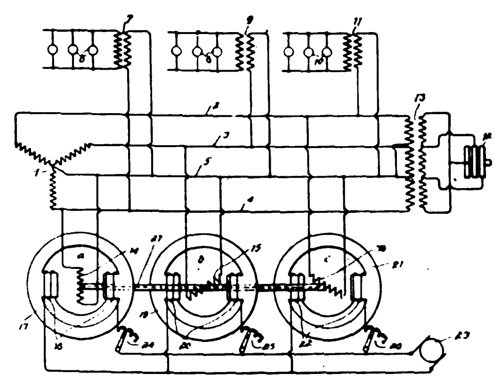
894,620. TRANSFORMER. John J. Frank, Schenectady, N. Y., assignor to General Electric Company. A combined step-up and step-down transformer, the latter having its primary and secondary windings spaced apart.

894,625. INCANDESCENT LAMP. Emery G. Gilson, Schenectady, N. Y., assignor to General Electric Company. The tubular members for supporting the filament are sealed with metal caps.

894,637. TROLLEY CONTACT. Laurence A. Hawkins, Schenectady, N. Y., assignor to General Electric Company. A long, flat, flexible strip of metal.

894,643. CONTACTOR. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. An electromagnetic switch.

894,644. BUS-LINE COUPLING SOCKET. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. The socket member of the coupler is of insulating material having a terminal projecting from the bottom of the cup.



894,539.—Regulation for Multiphase Systems.

894,645. CONTACTOR. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. An electromagnetic switch operated by a coil and plunger magnet.

894,651. METER. Charles E. Holmes, Lynn, Mass., assignor to General Electric Company. An induction meter.

894,668. SYSTEM OF ELECTRICAL DISTRIBUTION. Osias O. Kruh, Schenectady, N. Y., assignor to General Electric Company. A combination of a mercury rectifier and transformer.

894,714. VARIABLE-VOLTAGE TRANSFORMER. Mercer G. Young, Pittsfield, Mass., assignor to General Electric Company. Means are provided for varying a portion of the primary flux which passes through the secondary winding.

894,766. MEANS FOR OPERATING VAPOR ELECTRIC LAMPS. Ezechiel Weintraub, Schenectady, N. Y., assignor to General Electric Company. A plurality of vapor electric lamps connected in series with one another.

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

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ADVERTISING
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NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

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CONTENTS

PREVENTING VIBRATION.

Sometimes it happens that an engineer is called upon to prevent vibration of a building or apparatus, caused by neighboring machinery. Many can recall the annoyance and trouble experienced during their college days, when working in a physical laboratory near a street along which heavy vehicles traveled, or even due to the operation of some piece of apparatus in another part of the same building. Various plans have been devised for preventing this trouble, the simplest possibly being to mount the galvanometer or other instrument on a block of stone supported in a box of sawdust. Under the right conditions the motion of the pedestal or table upon which the box is supported is absorbed in the sawdust, so that the galvanometer remains comparatively quiet. Sometimes the instrument can be supported on a light board carried on rubber bands, with good results. Probably the most satisfactory arrangement is that known as the "Julius Suspension," in which a system of springs and weighted supports, adjusted so as to avoid any harmonic swaying which might be set up, carries the instrument. This device, however, is somewhat expensive and elaborate, and is not available at every point.

It occasionally happens that annoyance is caused in other quarters than the physical laboratory by the operation of machinery. Sometimes, under unfavorable conditions, this annoyance becomes serious. An interesting example of this was noted in the ELECTRICAL REVIEW for August 8, in which the running of the reciprocating engines driving generators in the central station of the township of Sutton, England, gave rise to so much complaint that it was decided to change the type of equipment. This decision was not reached until other means of avoiding the trouble seemed to have been exhausted. Deep trenches were dug around the power-house, going well down below the engine and house foundations; but as both engines and houses were on the solid chalk, this plan, as might have been expected, failed. It was therefore decided to adopt steam turbines, which it was thought would not be as objectionable, as vibration should be less; but, in addition to this, special arrangements were made to absorb any vibration which might arise in the turbines. The plan adopted was quite similar to the arrangement resorted to in the physical laboratory. The turbine was set on a solid block of concrete, which was, in turn, supported on rubber cushions. In this case, of course, it is the vibrating device which is cushioned, and not the object which it is desired to protect. The result, of course, is the same, but it is interesting to note that the plan would not have been feasible for any present type of prime mover, except the turbine. It is true that well-balanced reciprocating engines are frequently run without being bolted solidly to their foundations, but few engine builders or operating engineers would be willing to trust these engines on a flexible support such as cushions of rubber.

While on this subject of vibration it is rather interesting to call attention to the recent improvement in the running conditions of the steamship "Mauretania," which, it will be remembered, is driven by four steam turbines, and which recently damaged one of her propellers. While repairing the latter advantage was taken of the opportunity to change the propeller blades a little, and it is said the change reduced very appreciably the vibration of the vessel. It seems that there was more or less resonance between the vibration caused by the propeller blades and the speed at which they were driven; so by throwing the two out of harmony, the effect is damped out. Doubtless similar conditions exist elsewhere and frequently are the cause of the entire trouble due to vibration, and by some slight change, throwing the apparatus or its support out of tune, the effect is removed.

ELECTRICAL SMELTING OF IRON.

The greater part of the efforts to apply the electrical furnace to the production of iron in its various forms has been in the direction of making special kinds of iron and steel. For such purposes a somewhat higher cost of production is not prohibitive, since the special character of the product brings a good price. In the electric furnace the treatment can be brought so thoroughly under control that any special character or quality of product is more surely produced. And at a time when steel capable of use under extraordinarily severe conditions is demanded, such, for example, as cutting metal while the tool is red hot, the commercial application of a method of production which, under present conditions, is somewhat expensive has been possible. Recognizing this condition, electro-metallurgists have been largely content to supply the present requirements, and to leave to a later day the development of an electric furnace for smelting the ore.

Not all investigators have, however, been content with the most obvious application of the electric furnace to the metallurgy of iron, as some have sought to use it for the reduction of special ores which are not profitable to treat in the usual blast furnace. Others again have sought to devise a plan by which the energy of waterfalls might be utilized, in places where fuel is expensive, and thus start an iron industry in countries where lack of coal at present prohibits it; such, for example, as Sweden and Italy, where attempts have been made to reduce iron ore in electric furnaces; and also in Canada, where some rather elaborate experiments were carried out not long since. It is certain that the results of these experiments, which have been made public, seem to be favorable to the processes, but they have been generally considered rather too optimistic. It has been shown that iron can be produced from the ore in an electric furnace, which no one disputes, but the conditions under which the various tests were conducted make it somewhat difficult to determine accurately the cost of production by each process. In each case it becomes evident that the electric furnace can only compete with the blast furnace when the cost of electrical energy is much less than what it is sold for anywhere to-day. Hence certain of the reports of such tests devoted a good deal of attention to the question of power production, and in the Canadian reports and those of the work in Sweden, it was said that an electrical horse-power-year could be produced for $8 or $10, or even less.

The most recent attempts to smelt iron in an electric furnace are those which have been made during the present year in California. After preliminary experiments at the Lewis and Clark Exposition, a furnace of the Heroult type was built last year by H. H. Noble, in California, to determine whether it was commercially practicable to apply electric smelting for the production of iron from the California ores. This furnace was somewhat large, requiring when in full operation about 1,500 kilowatts, the power being supplied by the Northern California Power Company. Iron was produced, but the output of the furnace was considerably less than had been expected, and the power-factor was low, being only seventy-three per cent. Moreover it was found impossible to work the furnace continuously at full capacity.

The work was then taken up by Mr. G. H. Clevenger and Professor D. A. Lyon, who constructed a small furnace requiring only 160 kilowatts, but the design of which was intended to avoid the objections of the larger furnaces. A steel casing was not used, so as to keep the power-factor high; and a design resembling more nearly a blast furnace was adopted, with the expectation that this type could be run continuously, and a good part of the heat given off would be saved by using it to heat the cold charge as it moved slowly down the stack. The results of these experiments are given in a brief abstract elsewhere in this issue. They seem to be unexpectedly good, but still leave the question of the commercial value of the process at the present time in doubt.

The performance of this furnace as regards power consumption does not seem to be as good as that of the larger Heroult furnace; for the latter, it is said, produced a ton of iron with an expenditure of 0.26 kilowatt-year, while the latest furnace required about 0.35 kilowatt-year. This figure includes, it should be noted, the energy required for the preliminary heating of the furnace; and since the furnace can be run continuously for months at a time, a slightly lower energy consumption is to be expected. It is estimated that for a large furnace operating without intermission, the energy required to produce a ton of pig iron will be about 0.31 kilowatt-year. The power-factor of the furnace is said to be ninety-five per cent, and by varying the applied voltage the heat energy developed at any time is under complete control.

In the article referred to above, the author, Mr. C. F. Elwell, attempts to determine what will be the cost of producing pig iron in a furnace of the type just referred to, but large enough to produce fifteen tons a day. Such a furnace would require about 1,500 kilowatts, and the daily cost of operation would be $207.10. This includes everything. Electrical energy is charged for at $5 per ton produced, or at about the rate of $16 a kilowatt-year or $12 a horse-power-year. The cost of a ton of pig is found from these figures to be $16.14.

At this figure of $16.14 per ton of pig, it would seem that the furnace can be applied successfully only under special conditions: it can not compete with the large blast furnaces. Moreover, the price of $16 a kilowatt-year can be secured in very few localities; and an addition of $4 to the cost, bringing it up to, say, $20 per kilowatt-year, would bring the cost of the pig iron to about $17.50 per ton. Another difficulty is the comparatively small size of the furnace, as it produces only fifteen tons a day. This objection will doubtless be overcome by the construction of still larger furnaces, after more experience has been obtained. It might be found, indeed, that there is less need to go to such sizes as are customary in blast-furnace work.

On the other hand, it is urged, in favor of the electric furnace, that it costs little to install, is simple and easily controlled, repairs are not expensive, a breakdown is not fatal, and the quality of the output is under better control. The most important advantages, however, are the substitution of the energy of waterfalls for that of coal, in locations where fuel does not exist, and the ability to smelt ores which are valueless for blast furnaces. From what has already been done it does not seem to have been shown that the electric furnace can enter immediately into competition with the blast furnace, but it must not be overlooked that the price of fuel is constantly rising, and the work of adapting the electric furnace to smelting iron ores has only been begun. Although the process may not be commercial to-day, it is well worth further study.

TELEGRAPH STATISTICS.

Telegraph statistics for various countries are made public from time to time, but it is not often that a compilation showing conditions in the various countries at one time is possible. Such a compilation has, however, been made by the German Government. The figures which it shows are interesting, not only as indicating the enormous use of this means of communication, but as showing the differences existing in telegraph conditions among the several countries. The most striking figures are those for this country, Germany, the United Kingdom and France. We lead in the extent of our telegraph lines, but only come second in their use, due no doubt to the difference in rates existing here and abroad. In England, for example, there are about 94,000,000 messages annually, while we send only 65,500,000. France comes next to us with 58,000,000, with Germany close behind with 52,500,000. The income from the use of the telegraph in this country is estimated at $27,985,000, as against $15,247,000 in the United Kingdom. Thus, although fewer messages are sent in this country, the considerably higher average rate, due, of course, not only to the higher rate for similar service, as compared with other countries, but to the greater distances over which messages are sent, brings the total expenditures for messages above that for other countries. Thus the average rate in England is sixteen cents for a message, while in this country it is forty-two cents. In Germany the rate is lower even than in England, being only fifteen cents, and it is still lower in France, where it is twelve cents. The total receipts of the telegraph service in Germany are $8,299,000, and in France, $7,334,000. In the three foreign countries considered the service is rendered by the governments, and in this country alone is it given by private companies.

ELECTRICALLY PROPELLED FERRY BOATS.

Some years ago we suggested that a very acceptable application of the electrical drive might be on the many ferry boats which furnish transportation between the island of Manhattan and the neighboring cities. The idea was to install storage batteries of suitable capacity on the boats, and to charge these fully during periods of rest and as much as possible in the intervals between trips. The service would possibly be rather hard on the batteries, as the idle periods are short and most of the time is spent in making the runs; but when all of the suburban traffic, as well as that within the city itself, is transported electrically, it seems as though the connecting link above water should be operated in the same way. For the service through the many tunnels now in operation or under construction beneath the two rivers flowing on either side of the island, no other system of propulsion was contemplated. However, no movement has yet been made in this direction toward converting the ferry boats—indeed, the tendency seems to be to abandon the ferries at New York, and depend entirely upon the tunnels and bridges. The scheme has, however, been adopted in Germany, where an electrically propelled ferry boat has been fitted up for service on the route between Godesberg and Niederdollendorf. This boat will carry about 650 passengers. Further details of the service are not at hand; but it is to be presumed that it will not be as severe as would be the case at New York. Thus again have our German friends become the pioneers in an interesting electrical adaptation.

AN ELECTRIC MOTH-TRAP.

According to dispatches which have been noticed in several daily papers, the municipal authorities of Zittau, in the province of Saxony, Germany, have made capital use of electric searchlights in reducing the damage created by a pest of nun moths which have been ravaging the trees of the valley of their foliage, threatening some of the more densely planted sections with destruction. The scheme apparently is to use a large induced-draft fan in connection with a high-power arc and reflector. The moths are attracted along the beam of light and, getting in proximity to the reflector, are drawn by the suction of the fan into a chamber and destroyed. It is stated that on the first night no less than three tons of moths were caught.

THE TEST-METER METHOD OF TESTING SERVICE METERS—II.

BY JOSEPH B. BAKER.

THE MOWBRAY TEST METER—FIRST FORM—OBJECTS OF DESIGN.

W. J. Mowbray, in a paper entitled "The Testing of Meters on Consumers' Premises by Means of a Specially Constructed Watt-Hour Meter," read before the 1902 convention of the Association of Edison Illuminating Companies, described a form of portable test meter[1] of the commutator type, in the construction of which it was sought to eliminate the defective features of existing forms of this apparatus that were mentioned in the preceding article. This form of test meter consisted of a standard test-recording wattmeter with the register removed, and with several simple modifications designed to facilitate the connecting and manipulating of the apparatus and to eliminate the sources of error already mentioned to which the ordinary integrating wattmeter is liable when used as a portable test meter.

SPECIAL HIGH-TORQUE FIELD-WINDING.

The principal feature of the Mowbray test meter, which is shown in the accompanying views, Figs. 1 and 2, is a composite field-winding made by adding a second pair of field coils to the existing fields of the meter as received from the manufacturer. The object of this composite field is to eliminate the first-mentioned source of error by enabling the torque of the test meter to be increased for a given load constituting a light load on the meter under test.

In a recent communication to the writer Mr. Mowbray makes the following statement:

"Hearing of the above method [of testing by the use of a portable standard meter], and recognizing the disadvantages just cited, I conceived the idea that a test meter with a plurality of field-windings would eliminate the light-load error in testing. For example, if a test meter were constructed with a ten-ampere winding and also a one-ampere winding, and used to check a consumer's meter of ten-ampere capacity, on full load the ten-ampere fields of both would be connected in series and an accurate full-load test would be obtained—the same as by the original method. However, on light load—one ampere—we would make connections with the one-ampere field of the test meter, and the latter would run at full torque, speed and accuracy; and would, if the consumer's meter happened to be correct, make ten revolutions while the consumer's meter made one revolution. Thus the error on light-load tests was eliminated.

"It was found possible to make not merely a one and ten-ampere test meter,

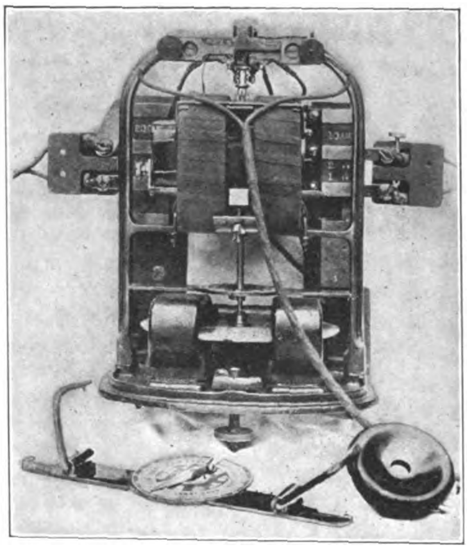


Fig. 1.—Mowbray Test Meter.

but a one, four, sixteen and eighty-ampere meter, and it was obvious that such a meter would suffice to test all sizes of consumers' meters, from three to 150 amperes' capacity, especially as it was wound

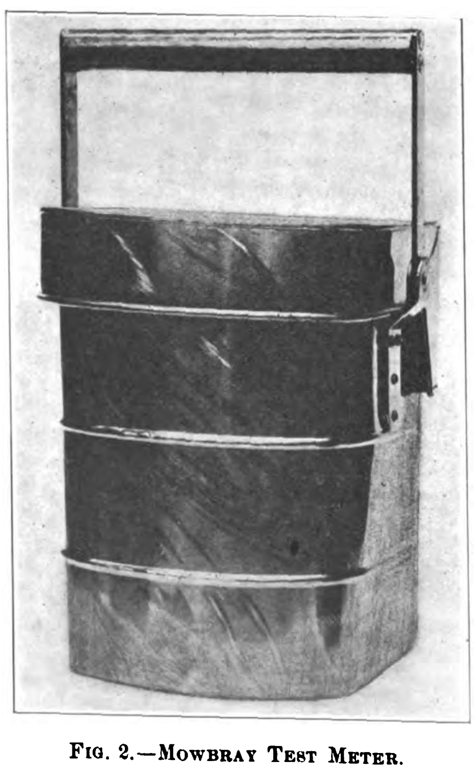


Fig. 2.—Mowbray Test Meter.

to give a very high torque, enabling each winding to be used with accuracy from one-half to one and one-half rated load. The old method of comparing the revolutions by sighting from one disc to the other evidently could not be used, as consumers' meters run in sizes such as three, three and one-half, five, seven and one-half, ten, fifteen, twenty-five, seventy-five, 100, 150, etc., and would not all run at the disc speeds given by the one, four, sixteen and eighty connections of the test meter. For this reason the method of comparison by two stop-watches, in the hands of two men, was temporarily used."

This feature may be illustrated by a concrete example. In the ten-ampere size of the test meter, which is initially a regular ten-ampere, 115-volt, two-wire test-recording wattmeter, the additional field-winding, placed outside the original ten-ampere fields, consists of a pair of coils wound with No. 20 B. & S. wire, giving the same number of ampere-turns for a current of one ampere as are given by the regular fields for a current of ten amperes. By connecting up this composite field-winding in various ways, three different field strengths—or "scales," as they have been termed in analogy to the various scales of an indicating ammeter, for example—giving correspondingly different torques for the same load through the meter, are obtained as follows:

A one-ampere scale, obtained by connecting the one-ampere field-coils in series.

A two-ampere scale, obtained by connecting the one-ampere field-coils in multiple.

A ten-ampere scale, obtained by connecting the ten-ampere field-coils in series.

The different field strengths, or "scales," obtained in this way constitute an important feature of the test meter. As in an (indicating) ammeter, a choice of several scales facilitates the obtaining of accurate *indications* on different loads, so in the recording wattmeter, equipped as described with means of obtaining different torques for a given load, accuracy of *integration* of the power passing through the meter is facilitated by the ability to make a light load give a strong torque, thus minimizing the effect of variation in friction or vibration. By always connecting the test load through a suitable scale or field of the test meter, the latter is always run at full-load conditions of torque and accuracy, even for light load on the meter under test—never at an ordinary low torque which would admit errors due to friction.

The test meter is, in fact, an apparatus of the rotating-wattmeter type especially designed to secure positiveness of operation on small loads, and thereby accuracy of integration of such loads, at the sacrifice of mere motor efficiency; the excessive energy required to give the abnormal positiveness consumed in each of the very small number of test meters that might be

[1] See the following references in the *Electrical World and Engineer*:

Article entitled "The Testing of Recording Wattmeters on the Consumer's Premises by Means of a Specially Constructed Portable Test Meter," by W. J. Mowbray, page 475. Editorial entitled "Testing of Recording Wattmeters on Consumer's Premises," page 470, March 21, 1903.

Letter to the Editor by W. J. Mowbray, headed "Meter Testing," page 527, March 28, 1903.

in use on the central station system at a given time being of negligible importance compared with the object in view.

Returning to our concrete example: It is generally known that the accuracy of the Thomson meter is practically independent of ordinary changes in friction and vibration on loads exceeding one-half its rated capacity, and that it will carry twenty-five per cent overload for a considerable time without introducing serious errors due to heating. In other words, that portion of its accuracy curve from fifty to 125 per cent of its rated capacity is very nearly a straight line.

RAPID WARMING UP OF POTENTIAL CIRCUIT.

Another advantage of the direct-current test meter as compared with an ordinary standardized meter used for testing purposes, and logically to be referred to in connection with the composite field construction, is the facility provided for rapid warming up of the potential circuit to normal running temperature, thereby avoiding the second-mentioned source of error. The potential circuit of the ordinary direct-current meter, consisting of armature and resistance in series, must be connected to the supply mains for at least fifteen minutes in order to attain normal temperature and therefore normal resistance under running conditions. In the test meter provision is made for rapid warming up by having two potential circuits, or "scales," for 115 volts and 230 volts, respectively. The 115-volt potential circuit consists of the standard ten-ampere, 115-volt, two-wire meter armature, in series with an ordinary adjustable shunt having 1,200 turns and approximately 450 ohms resistance. The 230-volt potential circuit consists of this armature and shunt in series with a resistance card of resistance at normal working temperature equal to that of the armature and shunt. This extra card is wound with tinned iron and German-silver wire in the proportion of seventy-six and one-half per cent of the former to twenty-three and one-half per cent of the latter, the proportion used regularly by meter manufacturers in order to get a potential circuit having a temperature coefficient equal to that of the metal of which the meter disc is composed. By connecting the 230-volt scale to the 230-volt mains, a period of only one and one-half minutes is required to bring the resistance of the circuit up to normal running value; or if this double voltage is not available the same object may be attained by connecting the two potential scales, in parallel, to the 115-volt mains. By this means the inspector can get his test meter into accurate running condition with entire avoidance of error due to "cold potential circuit," with minimum loss of time.

The inductance of these potential circuits is stated by the inventor to be sufficient to introduce some error, requiring to be compensated for, when the test meter is to be used on alternating-current loads.

The connecting of the test meter on the correct polarity, to avoid the third source of error, is of considerable importance owing to the existence in the test meter, as in other forms of direct-current motor meters, of a flux composed of (a) the compensating coil flux, and (b) the stray field from the braking magnets, which exist notwithstanding the care taken in the factory to equip the meter with magnets of equal strength, symmetrically disposed.

The correct poling of the compensating coil of a meter, *i. e.*, the way it is poled when sent out from the factory, is that poling which gives a flux through the armature in the same direction as the stray field from the system of magnets, thereby producing a stronger tendency for the meter to creep than when the compensating coil's flux is opposed to the magnets' stray field. The correct poling of every meter is therefore that which gives the greater tendency to creep. In the communication already referred to Mr. Mowbray states that in the operation of calibrating his test meter an abnormally large current is passed through the fields, thereby distorting the distribution of flux from the braking magnets and making component (b) of the no-load flux abnormally large, so as to give the test meter a very decided "polarity," which should be followed at all times in connecting up the test meter.

The correct poling of the test meter is most readily determined during the heating up of the potential circuit by touching the potential leads to the source of potential first one way and then reversed. As the potential circuit during the heating is on double voltage, the current in the armature and compensating coil is twice as strong as under normal running, hence the difference in rate of creep on reversing the potential leads at the source of potential will be very great; so that the operation of determining the correct poling of the potential circuit takes only a few moments. After the heating is done, and as the load is being connected through the fields, it is only necessary to connect the load so that the test meter rotates in the forward direction to be assured that its polarity is correct.

Prior to this method of determining the correct polarity of the test meter, an ordinary electrolytic "pole tester" was used. Its use was superseded by the above method, not only on account of its troublesome operation and liability to cause short-circuits, but mainly because in case the no-load flux of the test meter became reversed, its use insured that the meter was always connected on the wrong polarity. For example, it sometimes happens that a careless tester will momentarily connect a heavy load to a low-value field-winding, and if the current happens to be in the wrong direction it will reverse the polarity of the test meter. The indication of the "pole tester" would give the wrong poling of the test meter; whereas the mere reversal of the connections to the test meter, after such accidental reverse overload, would insure that the compensating coil's flux and the stray field from the magnets were in the same direction.

Another plan to indicate the polarity (now also superseded) was to mount a small compass near the field coils and follow its indications by poling the meter so that the S end of the needle pointed to the coils. This device was open to the same objection as the "pole tester," and it also had a fault of its own, *viz.*, that if the needle happened to be caught in a certain position when the current was applied to the fields it would be reversed.

(To be continued.)

An Electric Moth-Trap.

The Saxony authorities have discovered what would seem to be an excellent way to put an end to the caterpillar plague which is having such a disastrous effect on the local forests. They have discovered a method to catch the brown nun moths that lay the eggs from which the caterpillars come in enormous quantities. They make use of what they call the electric light trap. This consists of two large and powerful reflectors placed over a deep receptacle and powerful exhaust fans. The whole has been erected on top of the municipal electric plant at Zittau. At night two great streams of light are thrown from the reflectors on the wooded mountain sides half a mile distant.

The results have been astonishing. The moths, drawn by the brilliancy, come fluttering in thousands along the broad rays of light. When they get to a certain distance from the reflectors the exhaust fans take up their work and with powerful currents of air swirl them down into the receptacle. On the first night no less than three tons of moths were caught. It has been decided to build another trap on the Rathaus Tower, and the fight with the moths will be continued.

The forests of central Europe have, from time to time, been ravaged by raids of moths from Russia, whose larvæ denude the trees of their foliage. The splendid pines of the Lausitz Mountains are this year threatened with destruction.

The Reduction of Iron Ores by Electricity.

A discussion is given in the issue of July 18 of the *Journal of Electricity, Power and Gas*, San Francisco, by C. F. Elwell of the attempts to reduce iron ore in an electric furnace which have been made recently in California. After a brief historical introduction the author takes up the California work. This was instigated by experiments made by Dr. David T. Day for the United States Government at the time of the Lewis and Clark Exposition, Portland. A furnace of the Héroult type was constructed, controlled by varying the voltage. This control was found to be satisfactory, but no quantitative results were obtained. After Dr. Day's return to Washington the work was taken up by G. H. Clevenger, of Leland Stanford, Jr., University. In July, 1907, H. H. Noble, of the Northern California Power Company, looking for a market for some of the power developed by his company, retained Dr. Héroult to design and build a furnace for smelting iron ore of the Shasta Iron Company. A 1,500-kilowatt, three-phase furnace was built and put into operation. It consisted of a steel shell thirteen feet long and five feet six inches wide, lined with brick. Three electrodes were suspended above it, on a plan similar to that adopted at the Soo. The bottom was of carbon, and formed the neutral point of the three-phase star connection of the furnace. It was confidently expected that this furnace would produce twenty-four tons of iron a day. However, the largest production was only eleven tons a day, and it was found impossible to run the furnace for any length of time. The electrodes were exposed to the air and were consumed rapidly, and due to the open construction of the furnace the heat was unbearable, so that men refused to work. The thermal efficiency of the furnace was good, as but 0.26 kilowatt-year was required per ton; but the furnace would not produce enough iron at that figure to make it pay, one reason being the low power-factor, which is seventy-three per cent, and another the inability to keep full power on the furnace all the time. In January of this year Mr. Clevenger, co-operating with Professor D. A. Lyon, constructed a 160-kilowatt, single-phase furnace. The stack is of concrete, twenty-nine feet high. The electrodes are fixed in the walls of the crucible, and a variable-voltage transformer is used to keep full power on the furnace at all times. The charging is done from the top, so that the long column of charge is effectually preheated before it reaches the zone of fusion between the electrodes. The latter are twenty-four inches apart. The crucible is lined with fire-brick, and water-cooled. The metal tap hole is a water-cooled casting, but the slag tap hole is not cooled. Current is supplied by means of a 160-kilowatt, variable-voltage transformer, supplying from sixteen to ninety-six volts, in twenty steps. The highest potential is used at starting. When running normally, the voltage is about thirty-five, and the current 4,000 amperes. Up to the present time, six runs have been made, varying in length from ninety to two hundred and seventy-nine hours. The lowest figure for a run was 0.35 kilowatt-year per ton of pig. This includes the preheating of the crucible before any charge is put into it. This preheating of the crucible takes current for about twenty-four hours before smelting is commenced. This charge will become insignificant in a furnace which will run for three or six months without being shut down. Plans are now being drawn for a 1,500-kilowatt furnace similar to the one just described. This, however, will use three-phase current. The author then discusses some of the problems presented in designing an electric smelting furnace. The rate of heat production necessary to maintain a given temperature in the furnace depends upon the thickness and the conductivity of the walls. An analysis of furnaces which have been built up to this time shows a fair uniformity, which may be stated to be from seven to fifteen kilowatts per cubic foot of crucible. Sometimes it is difficult to determine just what constitutes the crucible. The lining must be adapted to the character of the ore, a basic brick being used with basic slag. The brick must be efficiently cooled, or it will not last for any length of time. Care must be taken in the arrangement of the water jackets, or electrical difficulties will be met. The bricks at high temperatures become good conductors of electricity. The power-factor of the 160-kilowatt furnace just described was ninety-five per cent. A good deal, however, depends upon the layout of the bus-bars carrying the large currents to the furnace. There is difficulty in securing electrodes which will stand the service. Those giving the most satisfaction have been manufactured by the Héroult process. They are usually sixteen inches square and six feet long. An electric furnace can compete successfully with a blast furnace only where water power is cheap and coal dear. Assuming a heating efficiency of twenty-five per cent for fuel, and seventy-five per cent for electric heating, then electricity is cheaper than coal only when one ton of coal costs more than half the cost of an electric horse-power-year. The author estimates that the running cost of a 1,500-kilowatt furnace, producing fifteen tons a day, would be \$204.60, or \$13.64 per ton. Allowing \$2.50 for incidentals brings the total cost to \$16.14. The cost of energy is estimated at \$5 for each ton produced. The consumption allowed for is 0.31 kilowatt-year per ton. The method of operating the furnace consists of first filling it to the top with previously heated coke, which is a conductor. By applying a low voltage the temperature can be gradually increased. After twelve hours the first charge is fed in, consisting of iron ore, lime and andesite. This is put in at the rate of a shovelful every four minutes, and after it is all in the regular charge is commenced. It may consist of 1,000 pounds of iron ore, 253 pounds of charcoal, 100 pounds of lime and 160 pounds of andesite, which is fed in rapidly at first, so as to get a column of charge in the stack. After four hours the furnace is tapped and a part of the iron drawn off. A proper amount of slag is maintained by drawing off occasionally from the slag tap hole. The advantages given for this type of furnace are the original small cost of the furnace and the absence of bulky and costly charging machinery, the small expense involved through breakdowns, the small cost of repairs and the ease with which they may be made, the loss due to wrong composition of charge is reduced to a minimum, the quality of iron is much better, high-sulphur ore can be converted into low-sulphur pig, there is no danger of the formation of cyanides due to the presence of nitrogen, and the silicon in the iron may be varied as required. It is said that ore containing as much as one and one-half per cent of sulphur can be reduced successfully in the electric furnace.

Street Railways in England.

There are 2,391 miles of street railways in England, an increase of 1,330 miles in the past ten years. In that period the capital expenditure per single mile of track has increased from £10,469 to £16,618, while the ratio of expenditure to receipts has decreased from 76.93 per cent to 62.11 per cent, and the average fare per passenger from 1.23*d.* to 1.1*d.*

COPPER PRODUCTION IN 1907.

ADVANCE STATEMENT BY UNITED STATES GEOLOGICAL SURVEY.

The smelter production of copper in the United States in 1907, according to L. C. Graton, of the United States Geological Survey, was 868,996,491 pounds. From the record figures of 1906 this is a decrease of 48,809,191 pounds, or 5.6 per cent, the largest actual decrease ever recorded and the largest relative decrease since the American copper industry became important. This is the first time since 1901 that the annual production has been smaller than that of the preceding year, and the first time since 1872 that it has been smaller than that of the second year preceding.

The total given above is made up of the fine copper content of blister produced and of the smelter output of ingot and anode copper from Michigan. Of this quantity, approximately 10,075,048 pounds in blister were produced in foreign smelters from domestic materials exported. In addition to the domestic materials handled, smelters in this country turned out as blister 64,145,648 pounds from foreign ore, concentrates and matte. Domestic blister containing 42,350,963 pounds was exported unrefined, while blister from foreign sources containing approximately 183,530,132 pounds fine copper was imported for refining in this country.

The greatest decreases in smelter output are shown by the returns from the three states that rank highest. Montana's production, which was 294,701,252 pounds in 1906, was but 224,263,789 pounds in 1907, and the state yielded first place to its rival, Arizona, whose production, however, showed a decrease of nearly 6,000,000 pounds, from 262,566,103 pounds in 1906 to 256,778,437 pounds in 1907. Michigan still holds third place, with its production decreased from 229,695,730 pounds in 1906 to 219,131,503 pounds in 1907. Decreased production is also shown by the returns from Alaska, Oregon, Washington and North Carolina.

Many of the other copper-producing states showed substantial gains. The output of Utah, the fourth state in point of production, was nearly 16,000,000 pounds in excess of that of 1906—66,418,370 pounds in 1907 as against 50,329,119 pounds in the preceding year. The production of California increased from 28,153,202 pounds in 1906 to 33,696,602 pounds in 1907; that of Colorado from 7,427,253 pounds in 1906 to 13,998,496 pounds in 1907; that of New Mexico from 7,099,842 pounds in 1906 to 10,140,140 pounds in 1907, and that of Idaho from 8,578,046 pounds in 1906 to 9,707,299 pounds in 1907. Nevada and Vermont also showed productive gains.

REFINED COPPER.

The production in 1907 of refined new copper of domestic origin was 784,271,427 pounds, a decrease of 103,410,960 pounds, or 13.2 per cent, from the production of 1906. The total output of refined copper (exclusive of domestic scrap, etc.) by domestic refineries in 1907 was 1,032,516,247 pounds. In addition to this production of refined copper 25,129,617 pounds were recovered during the year by the regular copper-refining companies of the country from domestic scrap, drosses, etc., and returns from practically all the known refiners of secondary materials indicate that 35,355,966 pounds additional were turned out by them as casting copper and in alloys. The copper produced from secondary sources in 1907 was therefore somewhat in excess of 60,000,000 pounds, or more than 7.5 per cent of the year's production of refined new copper.

STOCKS.

Returns from all the Lake and electrolytic refiners are practically complete and show the following stocks of refined copper on hand at the beginning and end of the year:

	Pounds.
January 1, 1908	125,745,796
January 1, 1907	46,497,181
Increase during 1907	79,248,615

Undelivered sales are almost entirely excluded from these figures, and stocks carried by consumers and brokers have not been estimated. In addition to these stocks of refined copper there were at the smelters, in transit to the refineries, and at the refineries blister copper and material in process of refining to the amount of 135,310,239 pounds on January 1, 1907, and 175,254,659 pounds on January 1, 1908.

CONSUMPTION.

The apparent consumption of refined new copper in the United States in 1907 was about 485,000,000 pounds, as compared with 685,000,000 pounds in 1906, and it is probable that in addition most or all of the 60,000,000 pounds of reworked copper was consumed.

The figures given above are compiled by Mr. Graton from the exact records of all but one known producing company. A comprehensive report on the copper industry in 1907 is in preparation and will be published by the Geological Survey as an advance chapter from "Mineral Resources of the United States, Calendar Year 1907." The preliminary statement herewith presented is made in advance to meet a demand for official figures at the earliest possible date, covering the two most important statistical features of the industry—production and consumption. So far as is known at present, no revision of the figures will be necessary, but the right is reserved to make in the complete report any slight reapportionment that final analysis of the figures may require.

The Arkansas Association of Public Utilities Operators.

The first annual convention of the Arkansas Association of Public Utilities Operators will be held at Little Rock, Ark., September 17 and 18. This association was formed at Little Rock, July 17 and 18. The purpose of the organization is the mutual benefit of the members and the advancement and development of public service corporations in Arkansas. The membership of the association has been classified as follows: Class A members are operators and executive officials of public service corporations. Only this class of member has a voice in the executive business of the association. Class B is composed of salesmen representing supply and jobbing companies selling to the gas, electric and water utilities. Class C is composed of honorary members who, while they may not be directly identified with a public utility corporation, take an interest in such concerns.

The following officers have been elected:

President, D. A. Hegarty, general manager of the Little Rock Railway and Electric Company.

First vice-president, G. B. Harpole, general manager of the Batesville Water and Light Company.

Second vice-president, W. H. Walkut, Searcy Electric Light Company.

Third vice-president, J. M. Hewett, president of the Marianna Lighting Company.

Secretary, J. E. Cowles, superintendent of lighting, Hot Springs Light and Railway Company.

Treasurer, D. L. Ellis, general manager of the Camden Lighting and Power Company.

Executive committee—the president, secretary and the following: Edwin Hardin, superintendent of railways, Hot Springs Light and Railway Company; W. C. MacGuire, superintendent Wilson Water and Electric Company, Arkadelphia; S. A. Stearnes, general manager Home Water Company, Little Rock.

Brooklyn Edison Company Dines Electrical Men.

The annual dinner tendered by the Edison Electric Illuminating Company of Brooklyn to the electrical contractors of the borough of Brooklyn, New York city, was held on the pier at "Dreamland," Coney Island, Tuesday evening, August 4. Two hundred guests were present. W. W. Freeman, vice-president and general manager of the company, was toastmaster. Among those who made addresses were: T. C. Martin, C. A. Christensen, president of the Independent Electrical Contractors' Association of Greater New York, and A. S. Beach, president of the Long Island Electrical Contractors' Association.

In his address of welcome to the contractors Mr. Freeman stated that the company had increased its business very largely during the past year. The contracts held by the company for the seven months ended July 31 showed that 317,000 sixteen-candle-power lamps had been used, as against 298,000 during the same period in 1907.

A suggestion had been made concerning the organization of a club of the electrical contractors, and all those directly or indirectly interested in the electrical business, to be known as the Kilowatt Club. Mr. Freeman stated that at an early date a meeting would be called for discussing the formation of such an organization.

M. S. Seelman, Jr., manager of the publicity department of the Edison company, was chairman of the dinner committee. Among those present and the concerns represented at the dinner were the following:

Acme Electric Construction Company, Alzman Brothers, Edward F. Andrews, Edward J. Anthony, Gillard W. Apgar, F. A. Armstrong, Thomas F. Attix Electric Engineering Company, W. F. Austin, C. F. Adams, H. C. Alvord, P. R. Atkinson, C. A. Barton, Barrell & Treshen, Bateman & Miller, A. S. Beach, F. Birk, George Bischoff, H. W. Bishop, Frank G. Blanchard, Francis T. Braillard, Brooklyn Electric and Construction Company, A. W. Brown, Brown Brothers, M. S. & P. S. Brown, I. Bugg, William Banta, C. W. Brown, Thomas Boudreau, J. F. Becker, Jr.; E. W. Babcock, G. E. Brown, E. A. Baily, G. E. Bruen, T. Beran, A. D. Bablon, James D. Campbell, Carrano Brothers, Charles H. Clark, Lincoln C. Cocheu, Collier, Smith & Company, Contractors Electrical Company, Thomas H. Cooper, C. Cumberworth, J. J. Carboy, C. W. Copeland, William A. Carey, N. A. Cassidy, J. D. Coveney, Samuel Chase, C. A. Christensen, H. E. Conklin, W. J. Canning, P. De Latinovics, J. C. Donnelly, Jr.; H. G. Disque, S. Davies, Electrical Contracting and Repairing Company, Emergency Electrical Construction Company, J. H. Evans, Henry Fallek, Force & Sheldon, H. Fortenbach, John Fowler, W. W. Freeman, H. F. Fresse, W. T. Fairbairn, Robert Findlay Manufacturing Company (E. J. Greene), J. C. Forsythe, W. Ferris, A. E. Green, F. Gunian, W. P. Graef, C. A. Graves, Theodore R. Guild, J. J. Gohan, Globe Electric Company, Philip J. Hamm, M. J. Hanson, Paul Helfer, Louis Hirtenstein, William Hurth, Leonard J. Huking, Z. M. Hyer, R. A. Haight, W. F. Hutchinson, H. Hochhavsen, Fred C. Hill, R. Holt, J. J. Holshuh, F. E. Hall, Harding & Roth, Joseph Ingram, Interurban Electric and Equipment Company, J. A. Johnson, P. Johnson, Johnson & Sloan, George O. Jenney, Louis Kallisher, L. Karan, Kent Grete Electric Company, A. Kleinfeldt, P. J. Koster, John L. Kruger, Kirshmer, G. L. Knight, James A. Kenney, William Keener, G. M. Kebbe, Justus G. Lang, A. Lang, Levine Electric Company, Isaac Lillenstern, Thomas J. Little, J. J. Leddy, Edward Latham, J. W. Lafferty, Frederick Luckett, James Luckett, R. D. Langley, R. Manquis & Son, Martin Electric Company, John A. Mattefeld, A. J. McNamara, Mezger & Company, Monaton Construction Company, Moncrief & Dean, F. M. Montignani, C. J. Mullin, D. Murphy, Noel A. Myers, Peter D. Myers, H. F. Musgrave, G. M. McMullin, L. E. Moffitt, A. T. Murray, T. C. Martin, A. O. Miller, W. J. Moore, R. M. Mann, Alfred Moore, E. H. Myer, H. C. Mathey, C. C. McIntyre, R. H. Mount, J. E. Muhl, W. C. Meinch, A. Newberger Electric Company, William Nicolay, Frederick Nolte, Nowak & Ward, William Nelson, A. B. Neill, Nicholas Gas Fixture Manufacturing Company, P. O'Rourke, Charles Piesch, Potbury & Wagner, Prospect Electric Construction Company, John Powers, I. D. Phillips, J. H. Porter, C. W. Price, Joseph M. Quigley, A. W. Reamer, Robert Reichard, F. J. V. Rhodes, E. J. Roeder, James Rooney, Charles Rosenberg, Ross Brothers, F. E. Richards, George W. Regan, C. P. Stephan, Staines, Bunn & Taber Company; M. S. Seelman, George Sabel & Son, J. G. Saltsman, N. Samuelson, Schaefer Construction Company, C. Schweitzer & Company, O. E. Seastrand, Leo Skememe & Company, Sleaster-O'Byrne Company, A. Solberg, Charles A. Soper, Frederick Spring, Eugene B. Stratton, J. A. Swin, J. K. Simmonds, E. Schaible, P. D. Sharkey, Edward Sullivan, O. E. Smith, C. W. Simpkins, Thomas J. Spence, F. Slater, M. Tannebaum, E. J. Theimer, E. F. Thomas, C. H. Thurling, C. F. Tuttle, W. D. Van Roden, W. C. Vosburg Manufacturing Company, C. H. Van Der Leith, George J. Wagner, Wall & Klein, Frederick H. Ward, R. J. Ward & Son, George L. Warren, William Watson, George Weiderman Electric Company, A. T. Weigold, Jr.; F. Weitzstein, Chester Wells, H. F. Walcott, Charles J. Woodward, W. J. Walsh, J. E. Wallace, F. E. Wegner, H. H. Wells, J. L. Wiltse, Cecil R. Wood, W. F. Wells, H. P. Wood, C. E. White, Herbert S. Wynkoop, W. C. Ward, Roger Williams.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

LAKE SHORE ELECTRIC RAILWAY COMPANY.

The report of the Lake Shore Electric Railway Company, Cleveland, Ohio, for June and the twelve months ended June 30 shows June gross of $78,827; expenses and taxes, $43,644; interest, $25,893; June surplus, $9,920. This compares with $14,134 for the same period last year. Twelve months' gross, $922,914; expenses and taxes, $514,670; interest, $305,785; twelve months' surplus, $102,459; a decrease of $25,907 over the same period last year.

CHICAGO TELEPHONE COMPANY.

The Chicago Telephone Company reports gross revenue for the six months ended June 30 last of $4,188,844, an increase of $7,935; total net revenue of $1,546,880, an increase of $298,315, and surplus after dividends of $540,840, an increase of $55,596. The report says:

"The new ordinance rates went into effect December 1 last. It is not possible to make an exact comparison between operations for 1907 and 1908, with reference to the effect of the new ordinance which lowered rates materially, for the reason that operations of the company in the city and outside of the city were not kept separately for 1907. A rough approximation of the effect of the new ordinance rates is that receipts of the telephone company from 210,000 telephones (city and country) is the same as for 180,000 telephones at old rate, a money difference of about $1,400,000 per annum. At the same time the average capital account is increased $3,340,000 in part payment for 31,000 additional telephone stations. Operating conditions have been more favorable in 1908 than last year in that the heavy repairs required because of frequent storms were less, so that operating expenses were less."

The American Street and Interurban Railway Association Convention.

The annual convention of the American Street and Interurban Railway Association and the affiliated associations of the Engineers, Claim Agents, Accountants, Transportation and Traffic Association and the Manufacturers' Association, will be held at Atlantic City, N. J., from October 12 to October 16.

Young's million-dollar pier has been selected as the exhibit place, and a majority of the convention meetings will also be held on the pier. Over 60,000 square feet of space for exhibit purposes is available, and the indications point to an exhibit which will be fully as large and as interesting as that given in 1907.

The committees on subjects for the various associations have been actively engaged on programmes for several months, and interesting papers will be presented at the sessions of each association.

The morning of Monday, October 12, will be reserved for registration purposes and the first meetings of the convention will be held on the afternoon of that day. The meetings will continue throughout the week, closing on Friday, October 16. The following general schedule of meeting days has been decided upon:

MONDAY, OCTOBER 12.

9.30 A. M.—12.30 P. M.—Registration and Badges—Claim Agents' Association; Transportation and Traffic Association.

2.00 P. M.—5.00 P. M.—Meeting of Claim Agents' Association; Meeting of Transportation and Traffic Association.

TUESDAY, OCTOBER 13.

9.30 A. M.—12.30 P. M.—Registration and Badges—American Association; Engineering Association; Meeting of Claim Agents' Association; Meeting of Transportation and Traffic Association.

2.00 P. M.—5.00 P. M.—Registration and Badges—Accountants' Association; Meeting of American Association; Meeting of Engineering Association; Meeting of Claim Agents' Association.

WEDNESDAY, OCTOBER 14.

9.30 A. M.—12.30 P. M.—Meeting of Accountants' Association; Meeting of Engineering Association; Meeting of Claim Agents' Association; Meeting of Transportation and Traffic Association.

2.00 P. M.—5.00 P. M.—Meeting of American Association; Meeting of Engineering Association.

THURSDAY, OCTOBER 15.

9.30 A. M.—12.30 P. M.—Meeting of Accountants' Association; Meeting of Transportation and Traffic Association; Inspection of Exhibits by Engineering Association.

2.00 P. M.—5.00 P. M.—Meeting of American Association; Inspection of Exhibits by Engineering Association.

FRIDAY, OCTOBER 16.

9.30 A. M.—12.30 P. M.—Meeting of Accountants' Association; Meeting of Engineering Association.

2.00 P. M.—5.00 P. M.—Meeting of Engineering Association.

In addition to the above programme the Accountants' Association will have a "Get Together" lunch and smoker on Wednesday afternoon; the Claim Agents will have a smoker on Tuesday evening and the Transportation and Traffic Association will have a dinner on Wednesday evening. Similar arrangements will probably be made for the American and Engineering associations.

Two convention halls, located on the convention pier and each capable of seating approximately 300 people, will be provided for the meetings of the convention. In addition, suitable meeting rooms are available in the Chalfonte Hotel and in the Traymore Hotel.

All of the meetings of the American Association, the Engineering Association and the Transportation and Traffic Association will be held in the meeting halls on the convention pier. The accountants will hold their two sessions on Wednesday at the Chalfonte Hotel, and their Thursday and Friday sessions on the convention pier. The claim agents will hold all of their sessions at the Traymore Hotel.

Advanced Degrees in Electrical Engineering, Including the Degree of Doctor of Engineering, at the Massachusetts Institute of Technology.

The demand for young men with a more extended and a deeper training in electrical engineering theory than can be obtained in an undergraduate engineering course has led the Massachusetts Institute of Technology to emphasize its graduate courses. These graduate courses lead either to the degree of Master of Science, for young men who propose to spend one year in advanced study of electrical engineering, or to the degree of Doctor of Philosophy or Doctor of Engineering, for young men who propose to spend longer periods in their advanced study and research. The degrees of Master of Science and Doctor of Engineering are particularly applicable to students following electrical engineering studies, and lectures, seminars, and other advanced instruction for students who are candidates for the doctor's degree will be well under way in the electrical engineering department during the next school year. In addition to students who will follow the course leading to the degree of Master of Science, candidates who will follow the work leading to the degree of Doctor of Engineering have already arranged to begin this work next fall at the institute. The advanced work leading to the doctor's degree may follow in its major part either the lines outlined by Professor Jackson's lectures on the organization and administration of public service companies, or by Professor Clifford's advanced course on alternating currents, as the individual student may choose, and it is expected to be accompanied by such other work as may be chosen by the individual student (subject to faculty approval) from other departments of science and engineering. It is believed by the faculty of the Massachusetts Institute of Technology that engineering students of particular ability can well afford to spend from one to three years of special advanced study under competent instructors along the lines of engineering theory and practice, and that such students will profit largely from the results of such study. Indeed, this seems to be proved by the experience of numbers of engineering students who have gone through courses of advanced study in engineering or scientific schools either in this country or abroad. The schools of foreign countries were doubtless formerly in advance of the American schools, for the purpose of advanced study in engineering and applied science, but it is believed that this condition no longer prevails. The advanced courses in electrical engineering at the Massachusetts Institute of Technology are planned particularly with a view to meeting the needs of such students as have hitherto found it necessary to go to foreign countries for advanced engineering instruction.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts, Washington, D. C., will open bids on September 8 for the following electrical material: Six primary condensers, miscellaneous insulators, 600 Leyden jars, 250 condenser plates, 20,000 feet phosphor-bronze wire, for delivery at Mare Island, Cal.

Coal-Mining Reports.

Indiana continues to rank sixth among the coal-producing states of the Union, and in 1907 it was a close rival of Alabama for fifth place.

The total coal production of the state in 1907 was 13,985,713 short tons, having a spot value of $15,114,300, an increase over the production of the preceding year of 1,893,153 short tons, or 15.66 per cent, in quantity, and of $1,998,039, or 15.23 per cent, in value. The growth of the industry in the last three decades, as shown by the statistics published by the United States Geological Survey, has been remarkable. The production of coal in the state in 1870, reported by the census for that year, was 437,870 short tons; in 1880 it was 1,454,327 tons; in 1890 it amounted to 3,305,737 tons. In the closing year of the last century the production had nearly doubled again, amounting to 6,484,086 short tons, and this output was once more nearly doubled by the tonnage of 1907.

The output of coal in Kentucky in 1907—10,753,124 short tons, having a spot value of $11,405,038—was the largest in the history of the state, being nearly three times that of 1897 and nearly double that of 1901.

In a preliminary statement given to the press by the United States Geological Survey early in February it was estimated that the coal production of Kentucky for 1907 had increased about 10 per cent over that of 1906. The complete statistics for the state, as reported to the Survey, show a gain in production of 1,099,177 short tons, or 11.39 per cent, in quantity, and $1,595,100, or 16.26 per cent, in value. The increase would probably have been considerably greater, in spite of the financial flurry marking the closing months of the year, had not the abnormally high temperatures that prevailed during November and December lessened the usual demand for coal for local consumption.

The total production of coal in North Dakota in 1907 was 347,760 short tons, having a spot value of $560,199—a gain over the output in the preceding year of 42,071 short tons, or 13.76 per cent, in quantity, and of $108,617, or 24.11 per cent, in value.

The lignite mines of the state gave employment in 1907 to 562 men, who worked for an average of 223 days, as compared with 488 men, who worked for an average of 209 days, in 1906. The average production per man decreased from 626.4 tons in 1906 to 619 tons in 1907, while the daily production for each employé decreased from three tons in 1906 to 2.78 tons in 1907. The number of mining machines in use increased from nine in 1905 to eleven in 1906 and to twelve in 1907, while the machine-mined product, which decreased from 97,789 tons in 1905 to 97,035 tons in 1906, increased to 136,700 tons in 1907.

Oppose Funding Plan.

Dissatisfaction among the bondholders of the Hudson River Electric Power Company over the plan announced by the company recently providing for funding of the coupons for a period of four years, has resulted in the formation of a committee to protect the interests of the bondholders. The offer of the company to give, in exchange for the coupons, five per cent notes secured by the coupons themselves, in addition to a ten per cent stock bonus, is not liked by many of the bondholders.

Recently Eugene L. Ashley, president of the company, in a circular to stockholders requesting them to consent to the funding scheme, stated that there had been a substantial increase in gross and net earnings of the several controlled companies, until the last quarter of last year, when the falling off then made it impossible for the company to meet its interest charges. In addition to the decline in earnings, he said, the company had a floating debt of $600,000, which it had been unable to retire by the sale of bonds. At that time a large majority of the bondholders assented to the plan, according to President Ashley.

Now some of the bondholders contend that they are not satisfied concerning the necessity of defaulting the August 1 interest payments, and substitute this plan of funding cash. They state their intention of taking steps to secure an independent audit of the company's books to determine just what the financial status of the company is, and also the relation of the parent company's finances to those of its subsidiary companies, the Hudson River Water Power Company, the Hudson River Electric Company, the Hudson River Power Transmission Company, and others.

To further these steps the following committee has been formed: John A. Young, president of the Windsor Trust Company, of New York; James C. Chaplin, vice-president of the Colonial Trust Company, of Pittsburg; Harlan W. Whipple, president of the Central Trust and Savings Company, of Philadelphia; Le Roy W. Baldwin, president of the Empire Trust Company, of New York. Parker, Hatch & Sheehan and Rollins & Rollins, of New York, and J. H. McNeal, of Philadelphia, are counsel for the committee. Winthrop E. Scarritt, of New York, is secretary.

Public Service Commission Ruling on Isolated Plants.

Chairman Stevens, of the Public Service Commission in the Second District, state of New York, announced at Albany on August 5 that the commission holds that under the definition of an electrical corporation as laid down in the Public Service Commissions law, persons may be considered as electrical corporations. This is the first public announcement of the commission in regard to its position as to its jurisdiction over individuals operating lighting plants.

The announcement was made after the hearing in the case of Albert H. and Lynn B. Murdock, of Oneonta, who appeared on an order to show cause why the commission should not begin suit against them for an alleged violation of the Public Service Commissions law in operating an electrical lighting plant and occupying public streets and places in the village of Oneonta. The order was made on the complaint of the Oneonta Light and Power Company, which now furnishes light to the village.

The Murdocks asserted that they were not an electrical corporation, and therefore not subject to the jurisdiction of the commission. They, however, said they did not intend to proceed further in furnishing light or occupying streets in Oneonta, and the matter was dismissed.

Power Companies Merge.

Announcement has been made at Raleigh, N. C., of the merger of the Raleigh Electric Company, of Raleigh; the Central Carolina Power Company, of Buckhorn Falls, and the Consumers' Light and Power Company, of Sanford, the new concern being known as the Carolina Power and Lighting Company. It controls the street car and lighting system of Raleigh, the power systems of Raleigh, Fayetteville and Sanford. These companies are all financed by the Electric Bond and Share Company, of New York. From the power plant at Buckhorn Falls power is now transmitted to Fayetteville and this will be brought to Raleigh and Sanford.

Wireless for Alaska.

A wireless station in Prince William Sound, Alaska, is to be erected by the Navy Department, the exact site to be selected shortly. This will be about 500 miles from the military wireless station being installed in Fort Gibbon, and will form a connecting link between that station and the naval wireless station at North Head, Wash. The government then will be able to maintain wireless communication up the Pacific coast to the Alaska station, which forms a part of the Alaska military wireless telegraph system.

The Brusio Hydroelectric Plant and Its 50,000-Volt Swiss-Italian Transmission System.—II.

(Concluded.)

By Frank Koester.

CURRENT DISTRIBUTION.

As previously stated, much of the current generated must be transmitted across the boundary line into Italy, and it was deemed advisable to run duplicate circuits to the substation at Piattamala. Since, however, the valley is quite narrow and atmospheric discharges are of great frequency, a tunnel was built for the purpose of carrying these wires to this station.

The conductors leave the basement of the switchroom and cross the River Poschiavino through a covered bridge (see Fig. 3[1]), where they then enter the tunnel mentioned. This tunnel, which runs to the substation, is 1,650 feet long. It is 8.2 feet wide and 9.8 feet high, the top being arched.

Owing to the customs regulations between the two countries, the tunnel can not be entered from the power-house end. Entrance is obtained, however, through a door visible from the street, while at the boundary line the tunnel is closed off by an iron door separating the Italian and Swiss sections. The accompanying cross-section, Fig. 10, illustrates the scheme of arranging the conductors in the tunnel. These conductors consist of copper bars, 0.25 square inch in section, which are carried on petticoat insulators supported on channel irons projecting from the side walls of the tunnel. These channels are spaced longitudinally 4.9 feet, with reinforced concrete slabs spanning them and forming partitions between the conductors. The outgoing feeders tap the middle of the bus-bar system, then are carried on either side of the tunnel to the substation. For the protection of the customs officials the conductors are provided with a removable wire netting.

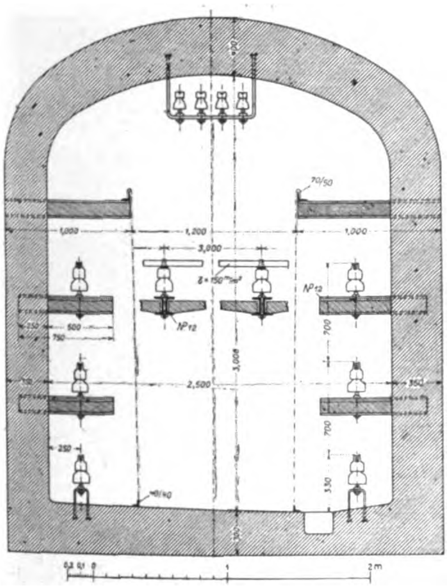


Fig. 10.—Cross-Section of Cable Tunnel Leading Across Boundary, Between Power-House and Step-Up Transformer Station, Brusio Hydroelectric Plant.

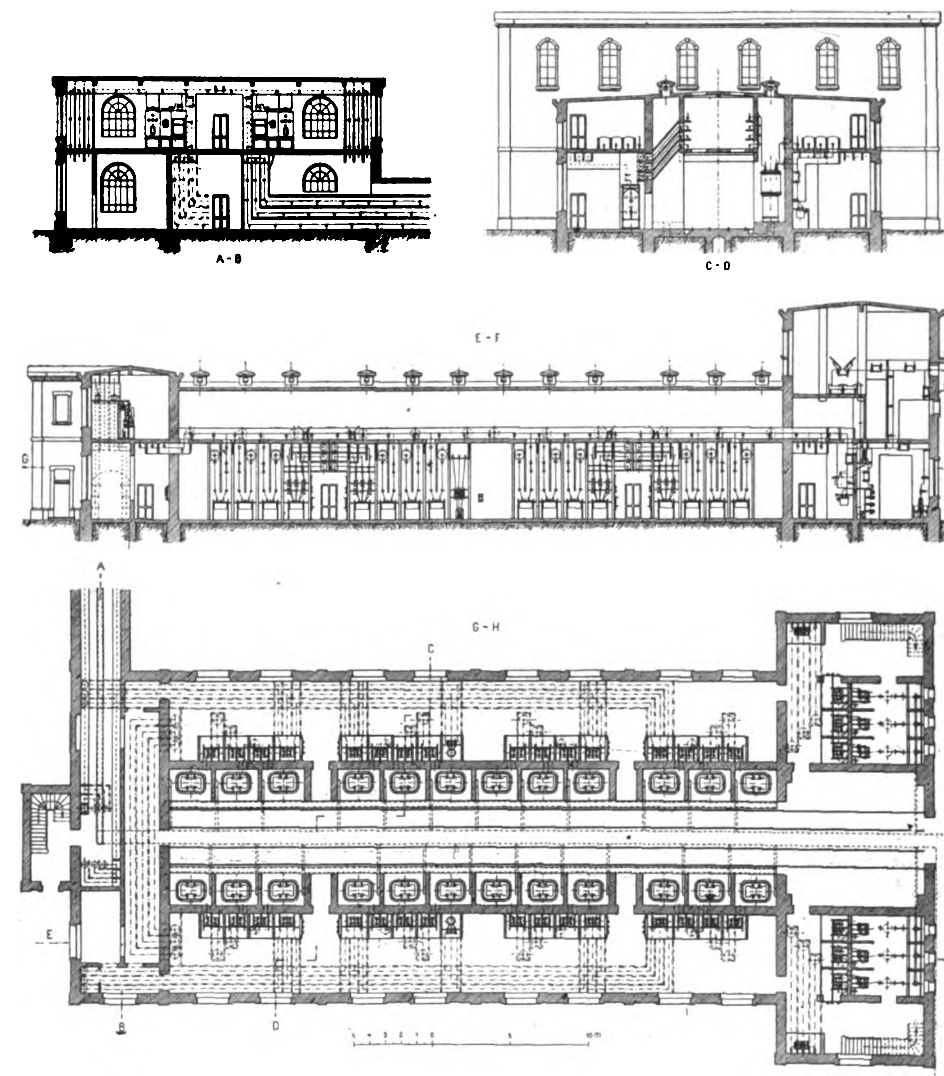


Fig. 11.—Plan and Elevation, Step-Up Transformer Station at Piattamala.

STEP-UP STATION, PIATTAMALA.

As will be seen from the accompanying plan, this station is built in the shape of a T, 180.5 feet long, 68.8 feet wide and 28.2 feet high, the cross-arm being ninety-two feet long by 42.6 feet high. It is designed to accommodate twenty-four single-phase transformers having a capacity of 1,250 kilowatts each. At present there are thirteen installed, with a total normal capacity of 16,250 kilowatts.

At one end of the transformer room is the meter room, where the current is checked by the two companies. The transformers are arranged in two rows, between which are two tracks leading into the inspection and repair room. This is in the middle of the cross-arm of the T, in which there is a ten-ton traveling crane. The transformer-switchboard rooms are directly behind each row of transformers. From the illustration it will be seen that the substation is divided into two distinct sections. The outgoing feeders leave the building from the third story of the cross-wing.

The feeder lines from the power station enter the substation from the tunnel on the ground floor, as the station (Fig. 12) is built into the hillside. As two companies are concerned in the amount of current used, the Brusio company supply-

[1] Electrical Review, August 8.

ing the power and the Societa Lombarda receiving the current for distribution, this room, on the second floor, is thoroughly equipped with measuring instruments, some of which are kilowatt meters of different makes, and are switched in series in order to check each other.

The meter switches are so arranged that the current may be thrown onto either row of transformers from either of the two feeder lines, or the current from both feeders may be thrown on one row of transformers only. The oil switches in the meter room are of the remote-control, hand-operated type. It was not deemed advisable to install automatic switches, because a sudden cutting out the whole load, which might amount to 20,000 kilowatts, might seriously interfere with the operation of the plant, particularly the hydraulic end.

Above the aisle, between the two rows of transformers, and extending the full length of the room, is a mezzanine floor carrying the feeders in two vertical rows, one on either side, to the transformers. The phases of the bus-bar system are separated by concrete shelves, the front remaining open. The high-tension, or 50,000-volt, bus-bars run on the mezzanine floor above the transformer switchboard or operating rooms. These bus-bars are arranged in horizontal rows separated by concrete partitions but not covered.

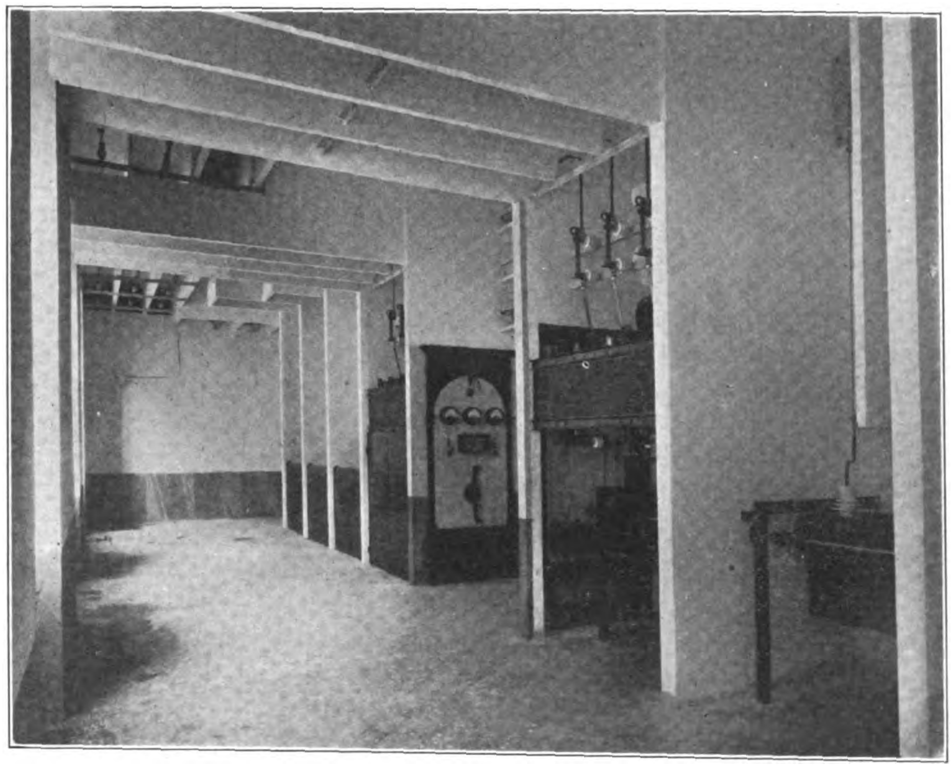


FIG. 13.—SWITCH ROOM AT THE STEP-UP TRANSFORMER STATION AT PIATTAMALA.

The transformers are of the Alioth water-cooled oil type, a system of water circulation from a spring under a head of twenty-six feet being provided. The efficiency of the transformers under actual test at full load was 97.5 per cent; at half load, 96.5 per cent. The drop in voltage between no load and full load with a power-factor, cos $\phi = 1$ is one per cent. With cos $\phi = 0.8$ is 2.2 per cent. The greatest drop is 2.8 per cent.

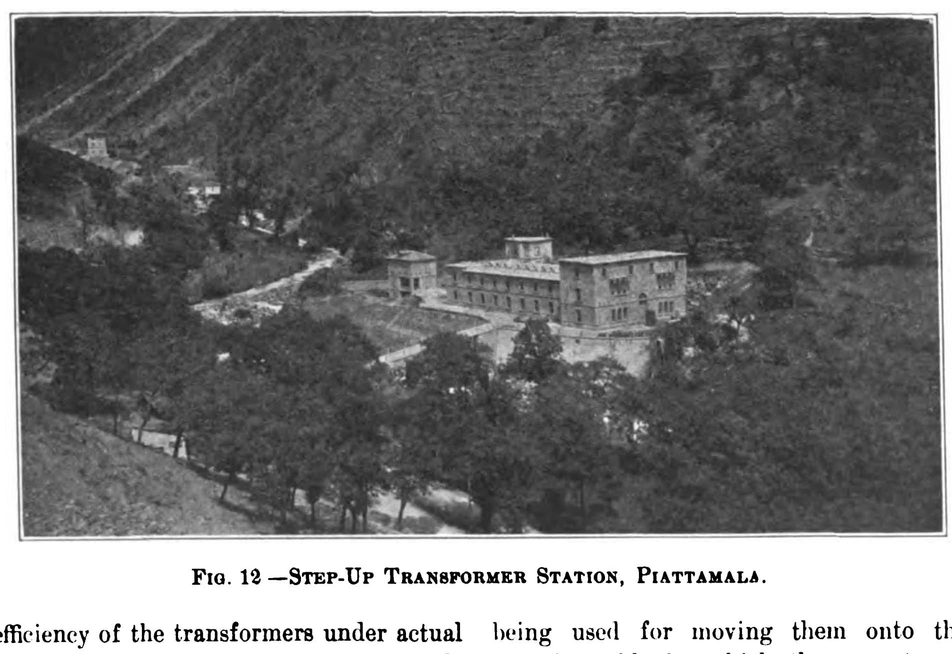


FIG. 12.—STEP-UP TRANSFORMER STATION, PIATTAMALA.

Each transformer is contained in a well-ventilated concrete compartment, the front being provided with a corrugated-iron rolling shutter. The transformers are provided with pinion wheels resting on pairs of racks secured to the floor, the transfer table also being provided with such racks. This device greatly facilitates the handling of the transformers, a ratchet being used for moving them onto the transfer table by which they are transported on the track to the inspection and repair room, where the cores are easily taken out by the overhead crane.

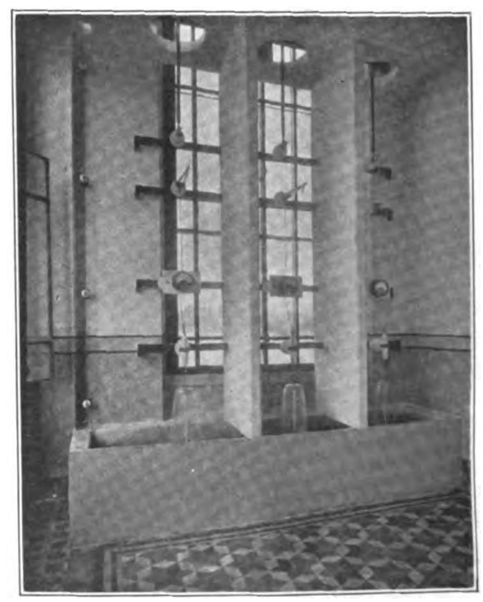


FIG. 14.—FIFTY-THOUSAND-VOLT WATER-FLOW LIGHTNING ARRESTERS AT STEP-UP STATION, PIATTAMALA.

Each transformer is provided on the low-tension side (7,000-volt) with a three-pole oil switch, while on the high-tension side (50,000-volt) three oil switches, one for each phase, are provided. These switches, interconnected, are remote-controlled, and may be operated either by hand or automatically. Access to the 7,000-volt switches, which are protected by doors, can only be had when the current is off. The 50,000-volt switches are similarly protected. All these switches are accessible from the aisles of the operating rooms. Between each group of transformers sectionalizing switches and choke-coils are provided for protection against variations in load caused by throwing the switches.

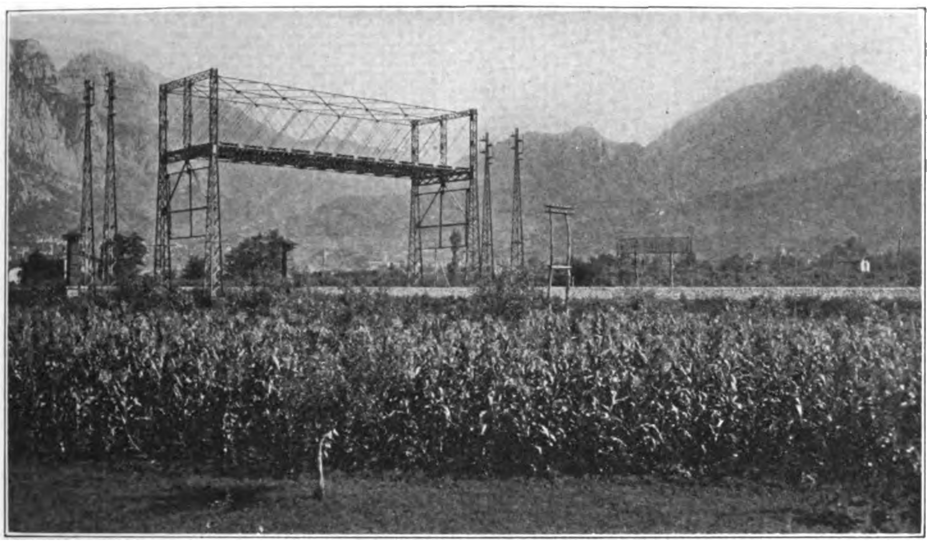


FIG. 15.—RAILWAY CROSSING.

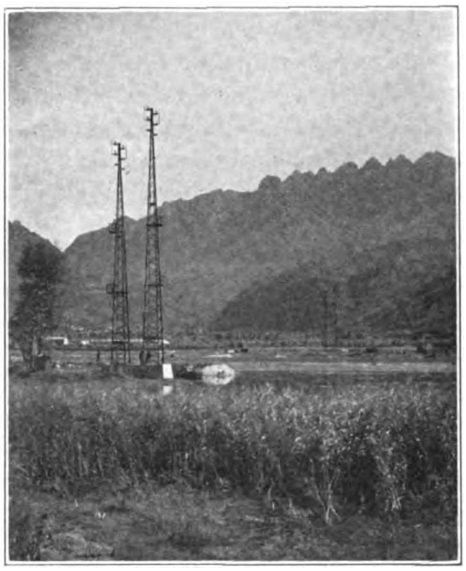


FIG. 16.—SPAN OVER RIVER ADDA BELOW LECCO.

On account of the high tension and long transmission line, the great variation in altitude and consequent difference in temperatures, and particularly on account of the frequent storms and atmospheric discharges, various devices were installed for protection against surges. For this purpose the choke-coils above mentioned are placed on each side of the transformers, and horn lightning arresters are placed on the outgoing feeders. The latter have a gap of two and three-eighths inches and are connected in series with water-flow resistances. The choke-coils consist of two spools, having a brass core, upon which is tightly wound a copper band of sixty turns, separated by insulating material, thus forming a solid tightly wound spool which sudden surges will not distort. For taking up lighter static and atmospheric discharges, the more sensitive roll lightning arresters were installed and connected in series with water-flow resistances. Finally, as all surges will create more or less variation in pressure, water-flow rheostats are installed for each phase to maintain a uniform pressure. This apparatus consists of a nozzle for forcing a jet of water, under a head of twenty-six feet (supplied from above-mentioned spring), against a baffle-plate connected to the line. The stream of water is three-eighths inch diameter and twenty-eight inches high and allows a leakage of one-tenth ampere. Ammeters are inserted in the wire connection to this apparatus in order to detect failures in the grounding. All lightning arresters, as well as the outgoing lines, are provided with disconnecting switches. All metallic features of the installation are interconnected and well grounded. Figs. 13 and 14 show switch-room and water-flow rheostats at Piattamala.

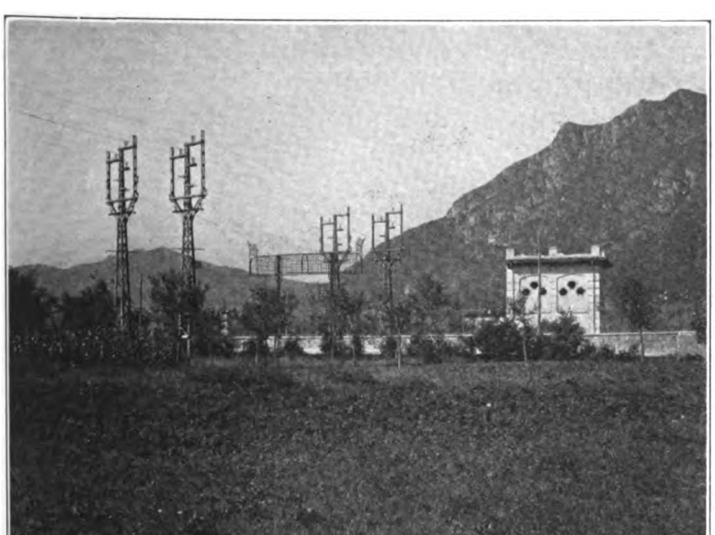


FIG. 17.—STREET AND TELEPHONE CROSSING NEAR LECCO; ALSO SECTION SWITCH HOUSE.

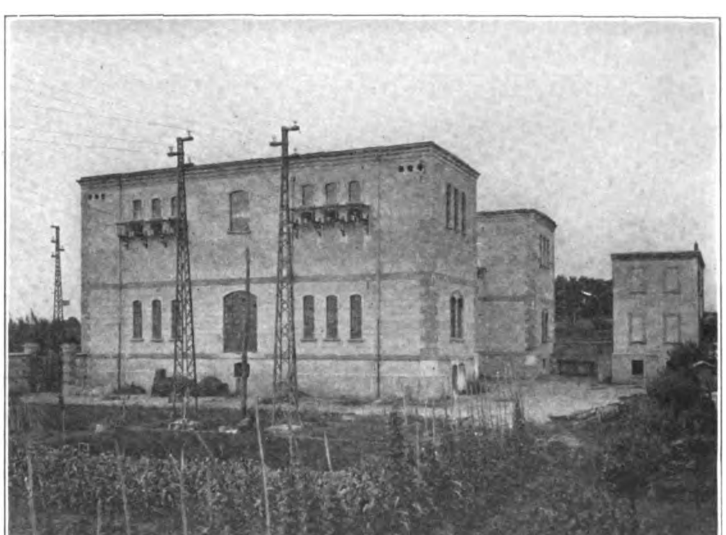


FIG. 18.—STEP-DOWN TRANSFORMER STATION AT LOMAZZO.

TRANSMISSION LINES.

The transmission line (50,000-volt) may be considered the most important in Europe. It consists of two independent lines, each 88.5 miles long. As the line runs over mountains and valleys, the peaks were avoided as much as possible to escape the unavoidable difficulties due to atmospheric discharges. These lines cross three provinces and ninety-four townships, and required the right of way through 6,000 properties, the cost of which averaged about $800 per mile. The lines cross ten railways, one tramway, ten state roads and 120 county roads.

From the main substation at Piattamala the line runs westward through the

Adda Valley to Colico, thence along the shore of Lake Como to Bellano, from which point it runs in a southeasterly direction over the Valsasina Plateau. Palasco, the highest point of the line, is 2,130 feet above sea level. From Valsasina the lines run in the mountains of Lecco in a southwesterly direction and cross the Adda Valley with a span of 720 feet, this being the lowest point of the line (640 feet above sea level). From here until the first step-down station, at Lomazzo, is reached, 84.5 miles distant from the step-up station at Piattamala, the run is practically straight. Eight and one-half miles beyond Lomazzo, at Castellanza, is another step-down station.

The average span is 393 feet. In eighty-seven cases, however, the span exceeded the average, the longest span being 1,280 feet, across the Gravina Valley at Colico. The transmission line consists of two parallel rows of towers, from thirteen to 16.5 feet apart, of latticed-girder construction imbedded in concrete. Each tower is provided with six brackets, three for present use and three for future extension, so that there will be eventually four separate three-phase circuits. The porcelain insulators are supported on pins, fastened to oak and chestnut blocks secured to the steel brackets. Each cable consists of nineteen wires, 2.6 millimetres in diameter, the total diameter of the cable being fourteen millimetres (105 square millimetres area).

The towers are calculated for a wind pressure of seventy miles per hour, allowing a stress in the copper of 8,500 pounds per square inch and on the tower of 17,000 pounds per square inch. Allowance is made for a temperature difference of 120 degrees Fahrenheit. On account of the difference in the spans and frequent changes in direction of the lines, four different types of towers are employed, weighing from 1,250 to 2,500 pounds each. There are a total of 3,100 towers, averag-

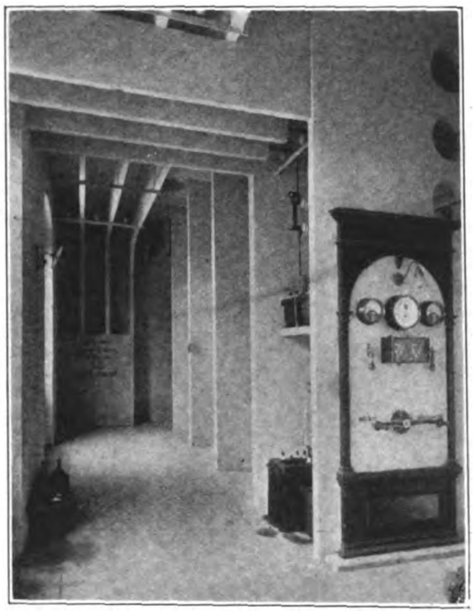


Fig. 19.—Fifty-Thousand-Volt Switch Room at Lomazzo.

ing in price $80 each, including foundation and erection. The two existing lines represent 900 gross tons of copper and 10,000 insulators at $2.60 each, including mounting and wooden blocks. The laying of the cables cost $128 per mile of transmission.

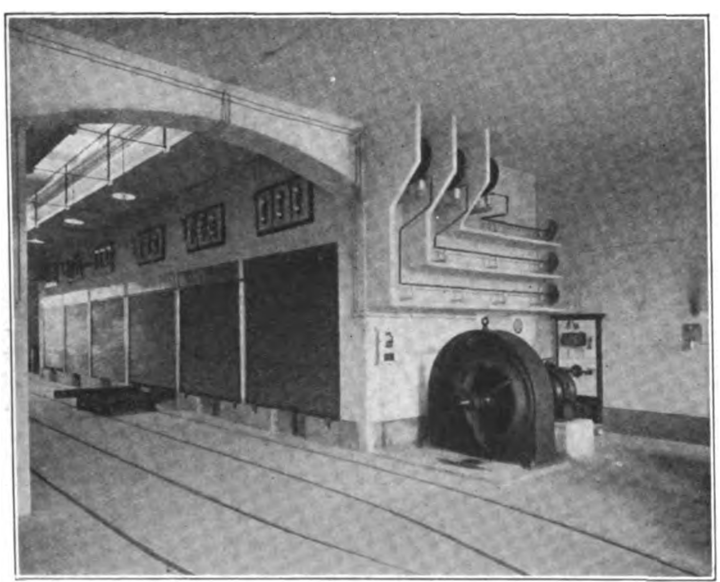


Fig. 20.—Transformer Room at Lomazzo.

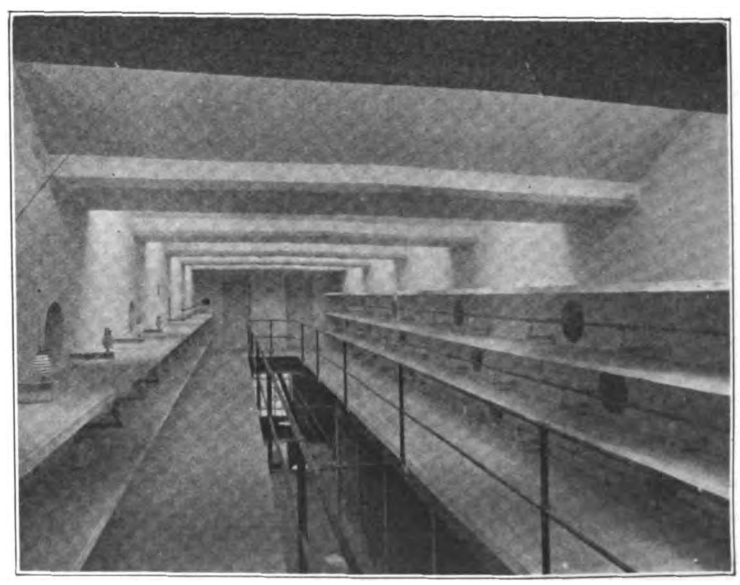


Fig. 21.—Bus-Bar Arrangement at Lomazzo.

The transmission system is divided into six sections, varying from 8.5 to 25.5 miles, and is provided with section switches, arranged so that in case of a break in a section of one line the current may be by-passed over the other line. There is a small station at each section for housing the sectionalizing switches, measuring apparatus, lightning arresters, some of which are of the horn type, some of the coil type and some are also provided with water-flow rheostats as described previously.

At a distance of sixty-five feet and parallel with the high-tension lines, a telephone and telegraph line is carried the entire length of the transmission system for the exclusive use of the plant. There are two wires carried on wooden poles and thirty stations costing $30 each, while the line costs about $380 per mile. Fig. 15 shows the transmission line crossing the railway. Fig. 16 shows the long span over the River Adda. Fig. 17 shows the transmission line crossing the street and the telephone wires, and also a section switch house near Lecco.

TRANSFORMER STATION, LOMAZZO.

This substation is located centrally in the low-tension distributing district. It is built in the form of an I. The wing at one end containing the apparatus for the incoming feeders is eighty-five feet by thirty feet, and forty-eight feet high. The wing at the opposite end is of the same dimensions and contains the apparatus for the outgoing feeders. The middle member of the building, containing the transformers, is fifty-five feet wide by sixty feet long and thirty-three feet high. The over-all dimensions are eighty-five feet by 120 feet.

The two 50,000-volt circuits enter the second floor of one of the wings in a way similar to the outgoing feeders leaving the step-up station at Piattamala. The feeders are similarly protected against electrical discharges, excepting that the water-flow lightning arresters are supplied with water by a centrifugal pump and tank under a head of forty feet instead of a natural head from the mountain stream. The transformers (1,250 kilowatts, 50,000-11,000 volts) are arranged in two rows, similar to those at Piattamala, with tracks in front of the compartments, of which there are six on each side. There are also six three-phase transformers of 5,000 kilowatts each (11,000-20,000 volts). There are at present installed only three single-phase and three three-phase transformers. While the transformers at Piattamala are of the oil-cooled, water-circulating type, those at this station (Lomazzo) are of the forced-air-cooled type, for which two blowers are at present installed. The final equipment demands four blowers, of which two will be kept in reserve. The blowers are motor-driven and discharge through air ducts located beneath the two rows of transformers. The cores of the transformers are not encased. The fronts of the transformer compartments are provided with rolling shutters, and ventilators are placed in the roof. Good results were obtained with these transformers, an advantage being that the cores can be easily inspected. The primary winding is provided with taps so that the voltage may be reduced to 35,000. This was done so that easy regulation might be secured. The tests show that the efficiency at full load is ninety-seven per cent and at half load 96.5 per cent. The pressure loss at full load with a power-factor of cos $\phi = 1$ is one per cent, and with a power-factor 0.8 it is three per cent. The temperature rise is forty degrees centigrade. The high and low-tension sides, respectively, were tested to 65,000 and 17,000 volts, ten minutes' duration. The transformers are capable of standing an overload of twenty-five per cent with a total temperature rise of sixty degrees centigrade. The operation of the blowers is included in the above-named efficiencies.

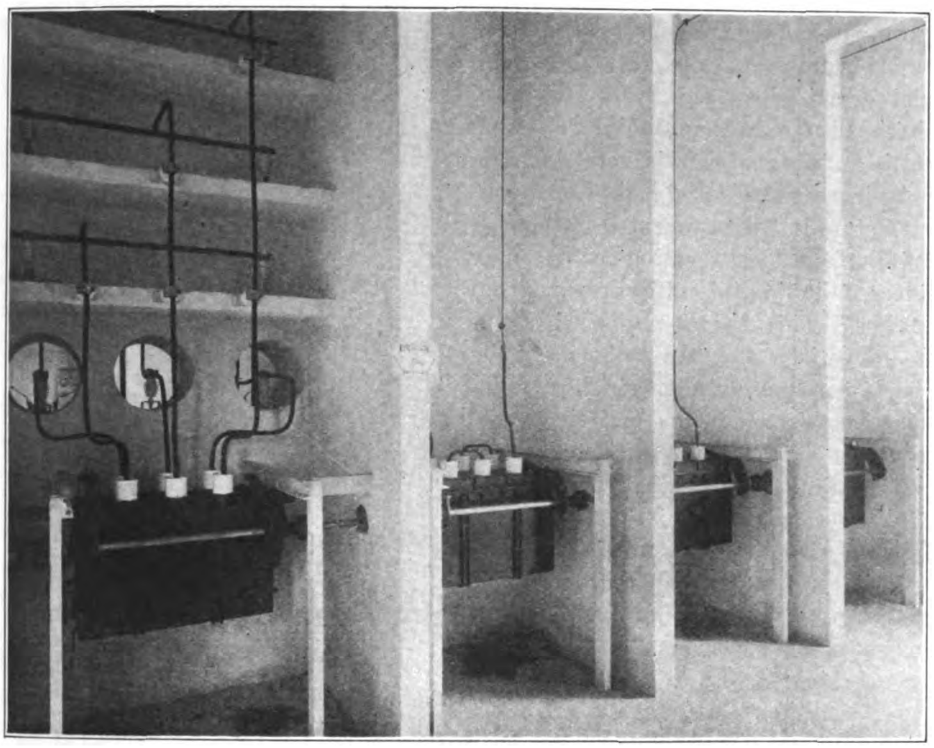


Fig. 23.—Switch Group, 11,000-20,000 Volts, at Lomazzo.

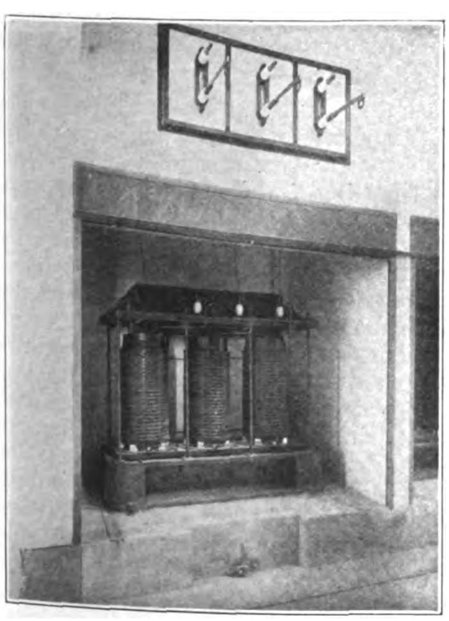


Fig. 22.—Five-Thousand-Kilovolt-Ampere, Open-Type, Air-Cooled Transformer at Lomazzo.

The 11,000-20,000-volt, 500-kilowatt, three-phase transformers have an efficiency of ninety-seven per cent at full load with a power-factor of cos $\phi = 1$, while with cos $\phi = 0.8$ is ninety-six per cent and three-quarters load ninety-six per cent and ninety-five per cent, while at half load it is 95.5 and 94.5 per cent. The drop in pressure is 1.5 per cent with a power-factor of cos $\phi = 1$, and three per cent with a power-factor of 0.8. The temperature rise is fifty degrees centigrade and the overload capacity is twenty per cent for two hours.

The wiring diagram is made so that under normal operating condition the line "A" will distribute 11,000-volt current in the district about Lomazzo, and "B" and "C" will supply Castellanza. The arrangement is such that one bus-bar system may feed either of the outgoing lines, or that the line "A" to Lomazzo may be fed from line "C." Through the line "C" 11,000-volt current may be drawn from the steam-power plant at Castellanza, of the Società Lombarda, which is a reserve for the hydraulic plants at Turbigo and Vizzola. It will be seen that with this auxiliary source of supply, in case of emergency current may be sent through this station (Lomazzo) and through the station at Piattamala to the hydraulic plant at Brusio.

A fourth line of 20,000 volts leads northward to Como, for which purpose the three-phase 11,000-20,000-volt transformers were installed.

The feeders from the 50,000-11,000-volt transformers lead to the three-pole oil switches on the mezzanine floor above the aisle between the two rows of transformers. The feeders to and from the transformers are provided with cut-out switches.

The 50,000, 11,000 and 20,000-volt bus-bars are arranged, according to the space available, in horizontal or vertical rows, and the phases are separated by concrete shelves or partitions. Three bus-bar compartments remain uncovered. The 20,000-volt outgoing feeders are protected like those at the step-up station at Piattamala. Fig. 18 shows the step-down transformer station at Lomazzo, Fig. 19 shows the 50,000-volt switchroom, Fig. 20 shows the transformer room. Fig. 21 shows the bus-bar arrangement, Fig. 22 shows the 5,000-kilowatt-ampere air-cooled transformers, and Fig. 23 shows the 11,000-20,000-volt switch group.

TRANSFORMER STATION, CASTELLANZA.

As previously stated, the Società Lombarda possesses a steam-power plant at Castellanza having an equipment of two 2,500-horse-power engines and two 5,000-horse-power steam turbines, which work in parallel with the above-described hydroelectric plants at Brusio, Turbigo and Vizzola. A temporary transformer station has been erected in the engine room of this power-house containing six single-phase, 1,250-kilowatt transformers arranged in groups of three. The whole apparatus, owing to the small space available, has been located on three floors. The transformers, which are of the oil, water-cooled type, are designed similarly to those at Piattamala, except for a voltage of 11,000-40,000. Taps are provided so that some coils may be cut out to secure a voltage of 35,000. The efficiency of the transformers at full load is ninety-eight per cent and at half load ninety-seven per cent. The drop in pressure at full load and with a power-factor of cos. $\phi = 1$ is one per cent, while with cos. $\phi = 0.8$ it is two per cent. The rise in temperature is forty-five degrees centigrade, using five gallons of water in twenty minutes at fifteen degrees centigrade. They are capable of standing an overload of twenty-five per cent, maintaining the temperature of forty-five degrees centigrade, and using ten gallons of water, or with a rise of temperature of sixty degrees using five gallons of water. The transformers were tested at 65,000 volts for a duration of ten minutes.

Okonite insulation has been used throughout this station.

As the capacity of the steam-power plant is expected to be increased in the near future, an isolated transformer station is now being erected alongside of this power-house which will accommodate eighteen transformers.

The entire installation was put in operation within two and one-half years from the organization of the company, and is giving most satisfactory results; the expectation being that the maximum output will be reached during this year.

The entire plant was installed in accordance with the plans of the "Electricitäts Gesellschaft Alioth, A. G.," Münchenstein, Switzerland, which also furnished the bulk of the electrical equipment.

BOOK REVIEWS.

"Railway Signaling." By a Staff of Expert Signal Engineers, Pittsburg. The Electric Journal. Cloth. 108 pages. Illustrated. 6½ by 9½ inches. Furnished by the Electrical Review for seventy-five cents.

In this book have been brought together various authoritative articles on signals and signaling which have appeared from time to time in the *Electric Journal*. The subjects dealt with include mechanical interlocking, electro-pneumatic interlocking, electric interlocking, the electric train staff system, automatic block system, both direct and alternating currents, and the language of fixed signals. In each case the principle of the system is clearly explained and the apparatus by which it is put into service is described.

"High-Speed Dynamoelectric Machinery." H. M. Hobart and A. G. Ellis. New York. John Wiley & Sons. Cloth. 526 pages. 355 figures. 6 by 9½ inches. Furnished by the Electrical Review for $6.

The authors of this book have performed a very acceptable task in bringing together and discussing the available information concerning one of the most recent developments in the construction of dynamoelectric machinery—the designing and building of high-speed machines suitable for steam-turbine driving. As is pointed out, the previous developments in this field have been very rapid, important innovations having been made within the last few months. A good deal of the material contained in this book has been published before in the technical journals, but there is much that is new, and the whole is arranged in a logical manner. One feature in the treatment is the giving of first place to alternating-current machinery, following this with direct-current dynamos. This has been done for the sake of variety, and, the authors say, in order to depart from a meaningless tradition. In this we do not entirely agree, because the best arrangement of a course in a technical school is that which takes up direct-current machines first; and, moreover, it must be admitted that, neglecting a few early alternators which had little effect upon subsequent design, the first development was in direct-current machinery; and when alternating-current machinery began to be used, the designers depended largely upon their experience with the other type. Possibly, however, this arrangement may be the most satisfactory for the advanced designer. In the introduction it is pointed out that, in spite of the general opinion that the higher the speed the more satisfactory the machine, this does not apply to continuous-current dynamos; and the two following principles are laid down: "When not carried to excess, the lower the speed in revolutions per minute, the more satisfactory will be the results which may be obtained in designing continuous-current dynamoelectric machines." On the other hand, "When not carried to excess, the higher the speed in revolutions per minute, the more satisfactory will be the results which may be obtained in designing alternating-current dynamoelectric machines." From these two follows a third: "For a given rated output the preferable speed will be much lower for a continuous-current design than for an alternating-current design. The book is divided into three parts. Part i, entitled, "General Instructions," contains four chapters taking up matters common to both classes of machinery. Part ii is devoted to alternating-current generators, and Part iii to continuous-current generators. The treatment throughout is practical, the statements being made clear by numerous examples and a free use of curve sheets, which show how the various quantities change under different conditions. Frequent illustrations of actual machines show how the principles have been put into actual practice.

"Wireless Telephony in Theory and Practice." Ernst Ruhmer. Translated by James Erskine-Murray, with appendix by translator. New York. D. Van Nostrand Company. Cloth. 224 pages. Illustrated. 6 by 9 inches. Furnished by the Electrical Review for $3.50.

The appearance of this work is timely, both on account of the present interest in the new method of space telephony and the uncertainty of many engineers as to the precise difference in the *modus operandi* of space telegraphy and telephony. The book divides the subject into two main parts, the first being "Radiophony, or Wireless Telephony by means of Light or Heat Radiation." The second is "Wireless Telephony Proper, or Telephony by Means of Electromagnetic Forces." The first part contains six chapters dealing with the various schemes devised for telephoning without wires, not, of course, including those coming under the second division. In the second part of the book there are thirteen chapters, treating of closed-circuit telephony, electromagnetic induction telephony, spark telephony, accelerated spark rates, multiphase spark discharges, high-frequency alternators, the arc as a high-frequency generator, the Poulsen generator, multiple arcs in air, the application of the arc to telephony, the Duddell phenomenon, forced vibrations, and then a general conclusion. There is an appendix by the translator, referring to recent monographs on high-frequency work, with an account of Fessenden's experiments at Brant Rock. There is also a fairly comprehensive bibliography and two good indices of names and subjects. The book as a whole is logically arranged, though certain chapter divisions are somewhat artificial. The work of various investigators is painstakingly if, at times, arbitrarily, followed up, the result being a popular, instead of a scientific, account. No consistent mathematical treatment is given, except a perfunctory statement of the general charging equation of a resonant circuit which shows nothing not equally well given by the diagrams. In spite of this the book is the best to date on its subject, in English. One criticism may be made of the appendix. In this Dr. Murray refers to Dr. Barkhausen's recent monographs on force oscillations, but makes no reference to Wien's classical paper on "The Reaction of a Resonating System." Nor is this referred to even in the preface. At times throughout the book the personal equation becomes painfully evident, much space being given to the author's own work, and the parallel work of others being dismissed with a casual reference.

SOME CONSIDERATIONS ON THE DESIGN OF A GENERATING STATION.[1]

BY H. RICHARDSON.

Before commencing the design of a generating station an engineer has to consider the characteristics of the various available types of plant and systems of supply, the choice of which should be controlled by area of supply, density and customs of population, staple industries, geographical position, probable future of locality, tendency of its industries, and its relations with adjacent boroughs and localities. The plant to be discussed will be a steam turbo-alternator system with extra high-pressure alternating supply, this giving greater choice of sites. Fig. 1 shows an arrangement which would be suitable for such a station.

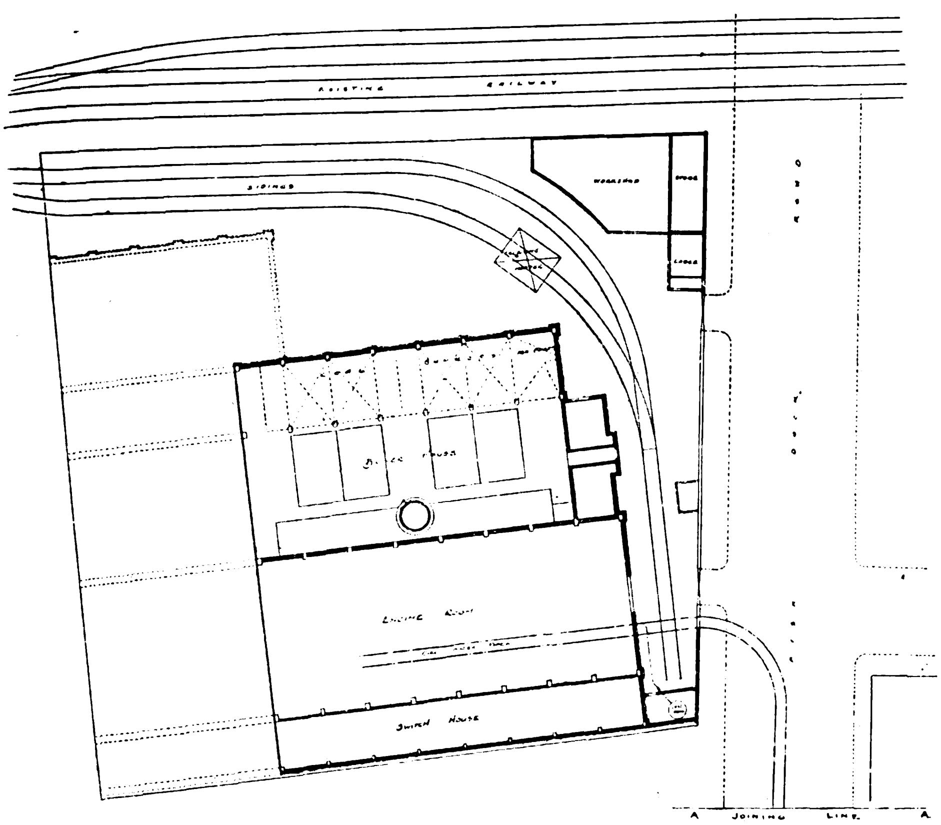


FIG. 1.—ARRANGEMENT OF STATION ON SITE.

In most large towns near rivers or estuaries, the railways run very near the water, therefore sites near the water possess a double advantage. Unfortunately, when such land is to be had at a reasonable price, it is usually found to be filled-in or made-up land, reclaimed within a comparatively recent period. Therefore, viewed from a foundation standpoint, it is always very bad, unreliable and, in many cases, contains the potentialities of chemical actions which will cause the authorities grave distress ere long with regard to pipes, cables, etc., which have been laid in the ground, if they are not specially and expensively protected. The problem of securing foundations giving a maximum of stability with a minimum of cost is, however, an interesting point in connection with such sites, and much could be said thereon.

First of all the cheapest system is the construction of a large floating or raft foundation, the main object of which is to distribute the concentrated weights of the plant and buildings over such an area that the resulting intensity of pressure is less than the safe bearing capacity of the ground. The commonest method was to use a plain concrete raft of considerable thickness, but there are very few cases where this has not developed cracks and unequal settlement of superstructures has occurred. Many such rafts have been reinforced with old tramway rails, but with little improvement.

We now come to piling foundations, and as wood piles, particularly in such grounds as the above, are liable to rapid deterioration, the tendency in view of the experience obtained latterly is to make use of reinforced concrete in the construction of piles. If carefully and properly executed no better foundations can be made, taking into consideration maximum stability with minimum weight and cost.

Among the attached sketches is a plan, Fig. 2, showing the arrangement of the piles and raft for a generating station at present being constructed by the author and for information it may be observed that the cost of the foundation, including the raft, the piles and reinforced foundation for the pipe track and reinforced pump chamber was $29,000. The depth from ground level to rock was thirty feet.

Buildings—The advantages of reinforced concrete construction may be carried beyond the actual piling, as it can be used to make a strong and light raft or floor over the heads of the piles and monolithic with them, forming a very complete and stable foundation for the superstructure. It lends itself to easily and cheaply conforming to the exigencies of the plant as regards differences in level of floors and foundations.

As regards superstructures they may be subdivided into the following classes of buildings:

1. Brick or stone entirely.
2. Reinforced concrete.
3. Steel skeleton with light brickwork filling.
4. Steel skeleton and corrugated-iron walls and roofs.

With regard to the first-named, such a building is unnecessarily heavy and expensive, and is the form generally used when an architect is allowed *carte blanche.* The heavy burden of capital expenditure unnecessarily carried by many stations has undoubtedly been largely contributed to by such useless extravagances, further aggravated in many cases by equally useless and more sinful ornamentation.

In reference to reinforced concrete superstructures, the author is strongly of opinion that they are not eminently suitable for the requirements of electrical generating stations. They are not cheaper than the style of building above referred to, the stability is in no way superior and, while certainly lighter, considerable inconvenience is met with in the fact that once up, the design can not be interfered with in the way of alterations without prohibitive cost.

Coming now to the composite building, consisting of a steel skeleton filled in with light brickwork, this appears at the present time to be the most perfect system of building, provided unnecessary ornamentation such as mentioned in connection with purely brick or stone buildings be eliminated, giving as it does a minimum of cost and weight when considered in connection with its probable life, reliability, strength, adaptability, neatness and appearance. If the insides of the buildings are to be lined for the sake of cleanliness, the author is of opinion that opalite or crystopal tiles are very much

[1] Abstract of a paper read before the Incorporated Municipal Electrical Association, Nottingham, England, June 30 to July 3, 1908.

superior in appearance, cleanliness and expense, to the ordinary glazed brick. In connection with the subject of cleanliness and internal appearance, a plea is here made for the boiler house. In many stations having splendid engine rooms, the boiler houses are unnecessarily dirty, gloomy and apparently neglected, for some unknown reason. This undoubtedly has a depressing effect on the human element of the boiler house, with a derogatory influence on the general efficiency. The author does not admit that under modern conditions there is the slightest excuse for the boiler house to be any dirtier than the engine room. It is by far the most important part of a generating station and should be treated as such, both in design and management.

A very great deal can be said in support of corrugated-iron buildings throughout. As regards their life, it is undoubtedly shorter than that of other buildings, but the question to be considered is whether their life, though short, is not amply long enough. In most cases the steel-skeleton building with corrugated-iron walls is the right form to use if the locality of the generating station does not require esthetic consideration.

Chimneys—The engineer has the choice of three main types, *viz.*, brick, reinforced concrete and steel. All the peculiarities of brick chimneys are well enough known and, provided great care is taken to spend some weeks after the work is finished in gradually heating up the chimney, there is, perhaps, nothing to beat it.

An interesting modern development is the reinforced concrete chimney. The author had occasion to go very carefully into the merits of this form of construction and came to the conclusion that there is a good deal to be said for it, because, owing to the simplicity of form, the before-mentioned disadvantages of reinforced concrete should not have an opportunity of attaining importance.

The author was surprised to find that in comparing steel chimneys with brickwork the result is so very doubtfully in favor of the steel chimney. Dealing with chimneys from 120 to 200 feet high, the steel chimney equals, and in some cases exceeds, in cost of the brick one, if the foundations are excluded, but as so many modern generating stations are built on very bad ground the foundations have to be particularly good in both cases so that the lower cost of foundations for the steel chimney is not in any proportion to its comparative lightness.

In reference to chimneys generally the great importance of a smooth interior is often lost sight of.

Types of Plant—There is very little choice left us under the present conditions in England, and as water power in any quantity is very rare, the case is limited to the consideration of gas or steam-driven prime movers. Being anxious to put in most up-to-date plant, and attain the best possible results in the supply of cheap power, the author was very desirous of using gas engines in connection with a new power station, and with much optimism made most detailed and careful inquiries from owners and engineers who were using such engines of modern types. Some six months were spent over this work as answers had in many cases to be got from abroad. The inquiries were limited to the larger units and latest installations. The results were extremely disappointing in that by a large majority opinions were unfavorable, principally on the grounds of unreliability, cost of upkeep, space occupied, first cost and the inability to meet sudden overloads of short duration. This being so, the question was reduced to the consideration of the reciprocating steam engine *versus* the steam turbine.

On inquiry there seemed to be no doubt as to the superior efficiency of the steam turbine, but in view of the common accusations of high cost of upkeep and liability to breakdown, visits were made to several turbine plants in the country, and the result was distinctly in favor of the turbine on all points, and as regards reliability, the vertical impulse type was

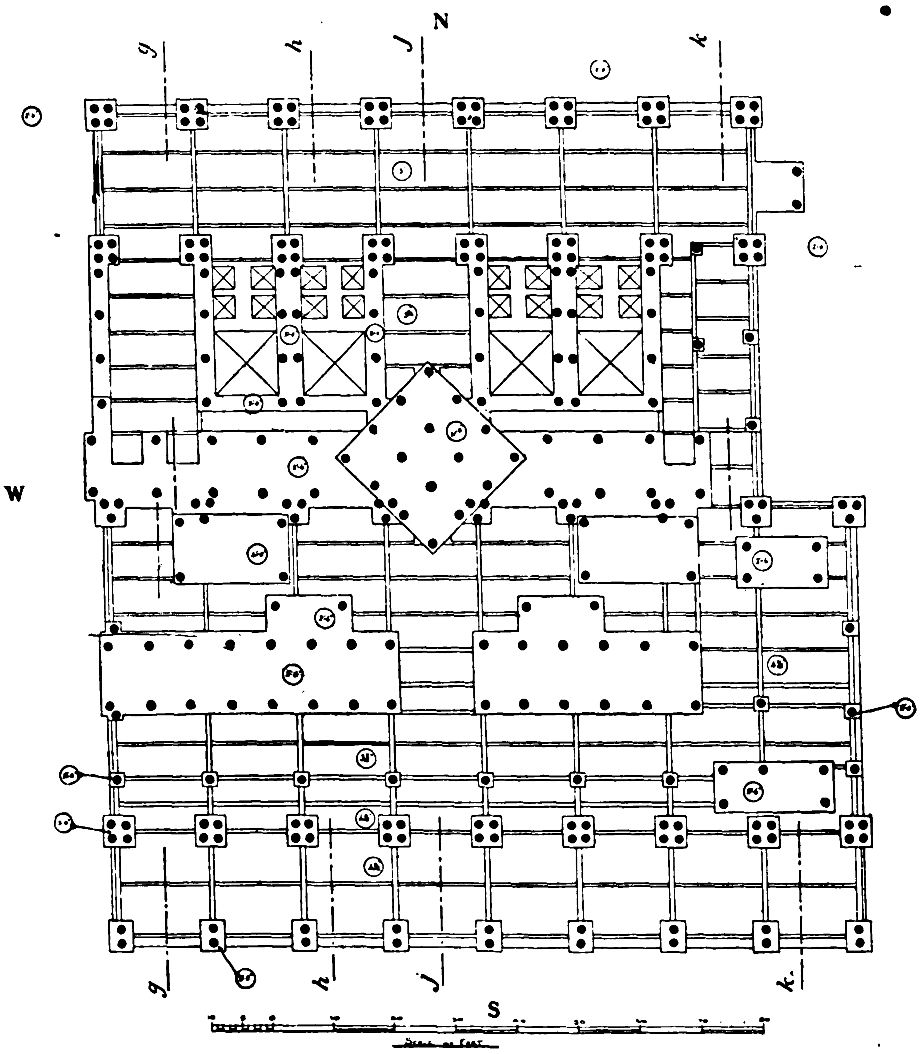


FIG. 2.—REINFORCED CONCRETE FOUNDATION OF STATION.

equal, if not superior, to the horizontal reaction type.

Generation of Steam—Under this head fall, to be considered for the larger electric stations, only two classes of boilers, *viz.*, the shell type (with ample economizer plant) and the water-tube type. Engineers will agree that a well-designed Lancashire boiler is about the best of its type, and in comparing it with the water-tube boiler it appears, in the author's opinion, to fall behind the latter.

The type of boiler should be chosen after careful consideration of the following points:

Size of boiler and space occupied.

Arrangement and size of grate and size

of combustion chamber in relation to the quality of coal dictated by local conditions.

Adaptability to a practical and efficient arrangement of superheater.

Simplicity in arrangement of tubes.

Ease of inspection.

Accessibility and cost of cleaning.

Liability to priming.

Cost of repairs and maintenance.

In view of the above the ease and speed with which standard parts can be got for repairs and maintenance is a serious consideration which should go a very long way in settling the particular plant to be used.

Before deciding the working pressure, the peculiarities of the type of turbine must be taken into consideration. Speaking generally for reaction turbines, a commercially high and quite successful efficiency is obtained with working pressure of from 160 to 200 pounds per square inch, with a minimum of practical difficulties. As regards superheat, however, the author is of opinion that in order to avoid any working difficulties and secure at the same time a maximum reliable efficiency the amount of superheat should be that necessary to attain a working temperature of 550 degrees Fahrenheit.

Much controversy has taken place as to the superiority of separately fired superheaters over those combined with the boilers. While the efficiency of the separately fired superheater is undoubtedly lower than that of a combined superheater, yet it has a great advantage in the possibility it holds out of maintaining a regular superheat at all loads. This is neutralized by the extra space, attention required and multiplication of pipes and valves.

Economizers—The development of the water-tube boiler has undoubtedly rendered the installation of these valuable adjuncts of less importance, and in particular, where cheap coal is being used they have a difficulty in justifying their extra cost. At the same time the author recognizes that in connection with turbine plants, where the condensed water is at such a low temperature, they have their uses in protecting the boilers from the well-known bad effects of a cold feed. Under ordinary circumstances economizers should be put in and careful attention given to their position and size to give the best results from the commercial rather than the strictly technical point of view.

Brickwork Settings—So far as their arrangement is concerned the principal rule to follow is to design the settings as compact, stable and accessible as possible and to shorten the lengths of all flues and passages to an irreducible minimum, giving good sweeping, smooth curves at every change in area or direction. Much trouble has been caused when the flues have been roofed with brick arches by the expansion and contraction of the latter causing the side walls to bulge, loosening the brickwork and sometimes causing the collapse of the lining. Heavy T irons and cast-iron plates get over this difficulty besides providing a smoother surface. To reduce the loss of heat by radiation is an additional reason for compact design. Two practical devices suggest themselves in this connection: One is to build the settings with hollow walls, packing the cavities with a suitable non-conducting substance, and another to face the outside with glazed bricks.

Built-in fittings, particularly dampers, must be carefully designed with a view to freedom from sticking in working, due either to their position, settling of brickwork, expansion or contraction. Instead of being as rough as they often are they should be most carefully fitted. Arrangements should be made to stop the leakage usually considered inseparable from dampers. The best cure for this is the use of butterfly dampers. Expansion being a considerable factor in such fittings sufficient clearance must be left to insure easy working when the boilers are being forced, as the inability to open or close a damper may have very serious effects.

Draft—If mechanical draft is decided upon by any designer, he has to choose between an induced-draft system, and what is called forced draft. If forced draft means brutal treatment of a boiler by forcing a supply of air for overworking an undersized combustion chamber, then the author would have none of it, but would substitute for consideration against induced draft a system of moderate pressure supply designed to control the air for combustion to a boiler within the limits of efficiency and without deteriorating effects. In considering such a pressure draft it is assumed that the air is supplied to a closed ash-pit, and that the pressure above the fire is equal to or very slightly below that of the surrounding air. The difference of pressure necessary to overcome the resistance of the boiler flues and economizer would then be provided by a comparatively short chimney. It is submitted that the pressure draft is superior for the following reasons: In case of any leaks in the settings, the efficiency of the draft will be preserved, and as the difference in gas pressure between the interior of the flues, etc., and the surrounding air is much less, harmful air leakages will be avoided. If the quality of the coal is such as to require frequent opening of the fire-doors to break up clinkers, etc., the inrush of cold air with consequent loss of efficiency and damage to brickwork and boiler will be avoided.

The size and consequent price of the plant is smaller.

Speaking generally of draft the installation of a chimney of a capacity sufficient to deal with the normal full load of the plant is recommended because this method is, after all, the most efficient, simple and reliable, and appears to be cheaper in first cost. The author does not condemn the use of mechanical draft for all circumstances; the above recommendation only refers to the normal conditions while a power station is going easily. During the erection of extensions nearly all power stations are pressed, therefore it is recommended that everything should be constructionally ready for the installation of a pressure or induced draft, not in recognition of the superior economy of such apparatus, but in appreciation of their temporary utility in producing a desirable margin of power.

Coal-Handling Plant—It is only after a power station has attained considerable size that any superiority in the mechanical or automatic handling of coal is made manifest. Quite a number of stations are fitted with such plant, but apart from handiness they do not pay commercially. The question is entirely one of putting the standing charges and maintenance cost of such plant against the saving in labor and probably increased efficiency of the mechanical stoker. As this paper refers to larger stations, they will be considered as necessary, and it will be taken for granted that a railway siding runs into the station premises, with facilities for feeding the said sidings with cars from the wharves if not near enough for transporters.

The first questions to consider are the methods of filling the feed hopper, and the position of the latter relative to the necessary conveyer. A not uncommon difficulty in made-up ground is the limited depth to which one may go with the hopper. If the required depth is likely to be below the water level it is desirable to sink a water-tight cast-iron tank and line the same with concrete. As to the means of emptying the cars there are four methods available, *viz.*, by hand, bottom door emptying, end tipping and side tipping. The choice between the last three necessarily depends upon the type of cars available and the speed of service.

Leaving the worm and belt conveyers out of the question for this work practically limits consideration to the well-known bucket type and the equally familiar scraper type. The author's opinion favors the bucket type in spite of its considerably higher cost for the following reasons: Longer life, neater and cleaner work, less wear and tear, less power used, less noise, increased reliability, less breakage of coal; in short, less total cost in working.

As to the bunkers, although steel bunkers are convenient, light and in more general use, yet a case is clearly made out for the serious consideration of reinforced concrete. An estimate of the probable saving in cost obtained from four known cases approximates twenty-five per cent for equal capacities.

In designing the bunkers special attention should be given to the arrangement of the compartments with a view to storing different classes of coal to be easily drawn from by the engineers at their discretion. Such facilities are great convenience and have a considerable effect on the total economy of the station.

As regards the measuring of coal, the conflicting results obtained where the weighing system is in vogue and the impossibility of tallying, however accurate the machines, decide in favor of the volumetric measuring as against weight measurement. The results thus obtained will compare more consistently. This only refers to boiler-house measurement, and not to the measurement of coal supplied to the station, which, of course, must be weighed.

Mechanical Stokers—The different requirements which must be fulfilled by any satisfactory mechanical stoker are: Low first cost, reliability and simplicity, cost of upkeep, cost of power for working, accessibility and ease in replacing damaged parts, extent of control over rate of combustion, suitability to the type of boiler to be adopted, smokelessness.

After consideration it will be found that the number of stokers that will answer the above requirements satisfactorily is very limited, and so far as use with water-tube boilers is concerned the author favors chain-grate close-linked stokers.

Ash and Soot Handling Arrangements—These should be designed so as to keep ash and soot out of and away from the boiler house proper. The ash basement under the boilers or firing floor is the proper place for dealing with such refuse, and it is quite simple to load it into the conveyer with a minimum amount of scattering or dust. The cleaning of the economizers ought to be arranged for in the same way, giving easy connection with the conveyer. In reference to this matter there will be noted in the accompanying plan, Fig. 3, an economizer arrangement which was intended for use with very small, cheap coal. Specially designed screw conveyers are fitted in sloping-sided compartments, forming the floor of the economizer chamber. This will prevent the annoyance of shutting and cooling down of the economizers for the necessary frequent cleaning and will result in a considerable saving of labor.

Feed Pumps—Where a pump is to work at a full-load rate for long periods the superior efficiency of the electrically driven pump would point to its adoption. Such pumps, however, do not lend themselves easily and economically to regulation over wide ranges and this, combined with their appreciably higher first cost, militates against their use under conditions of variable loads. It is necessary in any case to install one steam-driven feed-pump at least, in a generating station for use in emergencies when electrical power is not available. Probably the best policy to follow is to start the first installment of plant in a station with steam pumps and use electrically driven pumps for the extensions. Although feed-pumps are more frequently located in the boiler house there is a great deal to be said for situating them in the engine room. The arrangement of feed-piping can often be simplified and made more direct and the pumps are likely to receive more attention than they would get at the hands of the firemen. It is important in such cases to

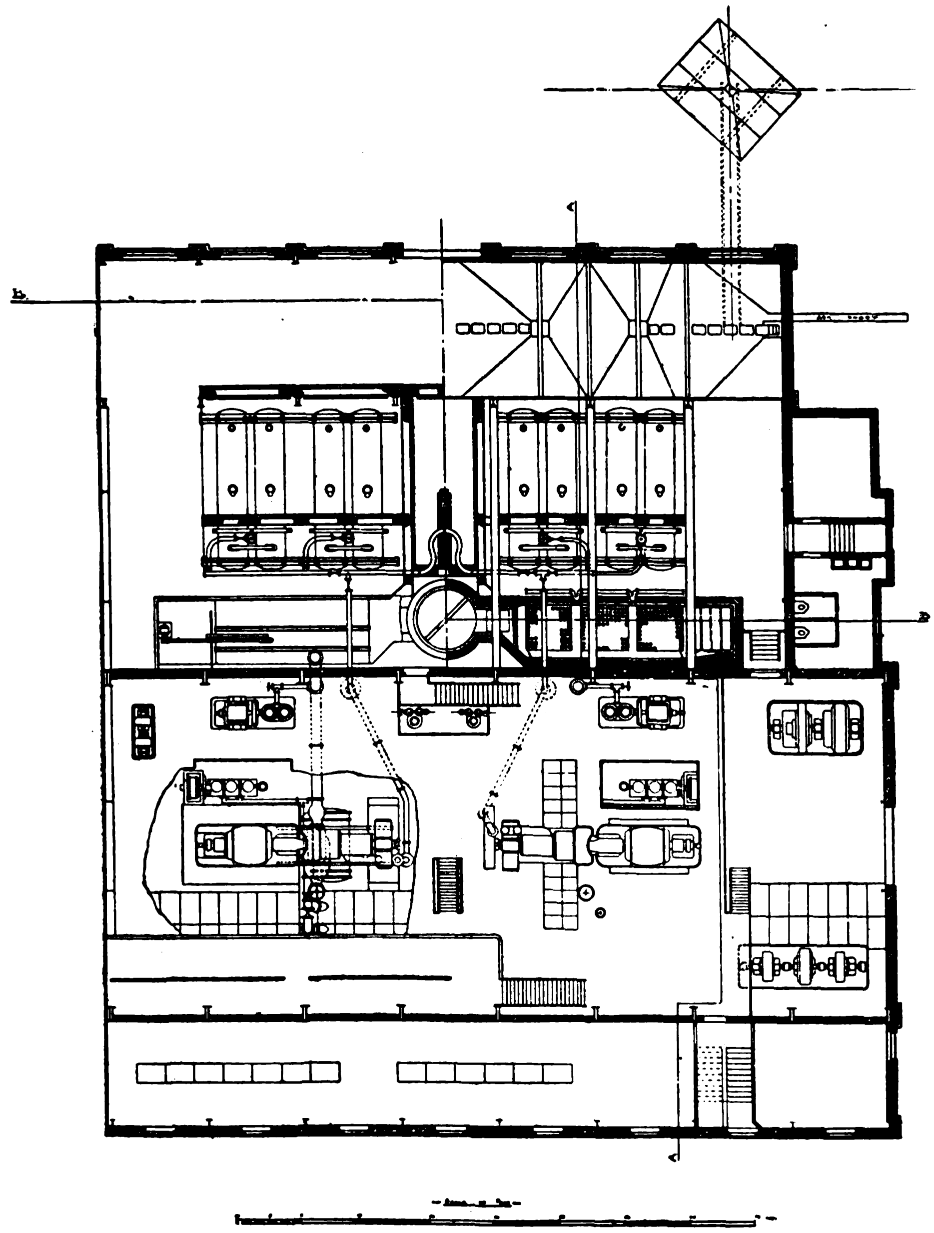


Fig. 3.—Layout of Station Equipment.

arrange for convenient regulation from the boiler house.

Engine-Room Layout—In dealing with the layout of the engine room with turbine plant of the horizontal type, the first thing is to decide whether the axis of the turbines shall be parallel to the length of the engine room or across it. With the larger sizes of turbines of 1,500 kilowatts and above, and a single row of boilers parallel to the engine room, considerable space can be saved by the first arrangement. Before taking the utmost advantage of this, however, it is well to forecast future possibilities in the way of other types of plant, such as vertical turbines, gas engines, etc., as the span and height of the crane may otherwise greatly handicap the choice of plant required for extensions. With regard to the position of the condensing plant, this is now almost universally situated immediately below the turbines, on account of the importance of reducing the frictional resistance to the flow of the exhaust steam, and it also minimizes chances of leakage by diminishing the number of joints. The condensers can either be placed lengthwise with the turbines or across; the former gives a very compact arrangement with the turbines along the length of the engine room. In condensers of the *contra-flo* type, however, the steam inlets are situated eccentrically, and such condensers must, therefore, be placed across the turbine.

With regard to the air-pumps there are two or three modifications to choose from, *viz.*, the simple air-pump or two separate pumps, one for dealing with air and vapor, the other for the water, or thirdly, a vacuum augmenter in combination with the air-pump. The absolute pressures attainable respectively in the condenser decrease in the above order, the extra complications being intended to increase the density of the air and vapor before it is dealt with by the air-pump, which is done by cooling in the one case and by a preliminary compression with a steam jet pump in the other. The practical advantage of the possible increase in vacuum by the use of such methods is rather doubtful except, perhaps, in the case where the available amount of cooling water is limited and its temperature is high.

It will also be found that this apparatus requires to be below the level of the condenser, and that the necessary depth can not always be given owing to complications of sewers and liability of flooding. Facilities for the cleaning and replacement of tubes should not be lost sight of in the design.

Circulating Water-Pipe System—To reduce the power required for pumping the circulating water to a minimum, the outlet end of the discharge pipe should be below the level of the source of supply, so that the arrangement forms a species of syphon. Precautions are necessary to deal with air liberated from the water or leaking in at joints if the top of the syphon is far above water level, otherwise the syphonic action will soon cease. The advantage of the syphonic effect is, of course, limited to about thirty feet (practically it may be found to be much less), and in cases where the water has to be raised to a considerable height, the recovery of power rendered possible by the use of turbines situated near the lower end of the discharge pipe, and driven by the water on its return, merits consideration. As the integrity of the circulating-water system is of such vital importance in a steam-turbine installation, every care should be taken in the laying and jointing of the pipes, and the latter should be specially protected from corrosion if the ground is bad. Trouble has been experienced in cases where cast-iron pipes have been embedded in solid concrete with breakage due, probably, to expansion and contraction with the varying temperatures of the discharge water. A form of pipe which possesses considerable advantages for this work is one constructed of reinforced concrete. Such pipes are cheap and durable, and can be molded practically in any desired shape. In any case substantial foundation must be provided for the pipes to obviate subsidence, and if the ground is soft, piling becomes necessary.

Main Steam and Feed Piping—The author desires to advance a plea for reducing duplication of pipework to an absolute minimum and securing reliability by simplification, thoughtful design, careful erection and the use of the very best materials. The simplification and reduction of the amount of steam piping has its effects on the coal bill, while the reduction in the number of valves and joints is correspondingly beneficial in economy of maintenance. The diameter of the main steam pipes can advantageously be reduced when used for superheated steam. When turbines are used there are additional reasons, as the flow of steam is more uniform and the retention of temperature of superheat is of greater importance than a slight reduction in steam pressure.

Generators—The modern standard designs of generators of the best makers are very similar and their differences do not entail any special features in the design of a station. The question of efficient ventilation has risen into great prominence since the advent of the turbo-generator, and ducts are generally formed in the concrete foundations for this purpose. If possible it should be arranged that these ducts lead from a cool space in which the air is still, dry, free from oily matter and has had time to deposit some of its dust. If air is drawn specially from outside the building, the position of its entrance should be carefully considered in connection with this question of dust, and filters may be used.

Auxiliaries—The use throughout a generating plant of continuous-current motors for driving auxiliaries is recommended in cases where direct current is to be distributed in the locality of the generating station, as it is very convenient to have a storage battery reserve for this class of work and economical adjustment of speed has advantages.

Switchgear—In moderate and large-sized stations the best system is to isolate the whole of the high-tension gear in special chambers, the operation being effected from a gallery overlooking the engine room through the medium of electrical control. The cellular type of board is to be preferred, and as much space as can be afforded should be allowed for the gear. This is a strong reason for arranging the switch chambers along the side of the engine room, rather than across the end; besides this method allows of some simplification in the connecting cables. The bus-bars should be divided by means of section switches so that any part may be made dead for inspection or repair without interference with the supply. Too much thought can not be bestowed in obtaining a safe working arrangement. In a system which is being carried out by the author the doors of the compartments containing the feeder isolating switches are provided with double locks. One key will be kept by the station department and one by the mains department. Whenever any cable is required to be disconnected for testing or repair, the isolating switch will be opened and the compartment locked by both parties. The cable then can not be made alive again except in the presence of both the departments concerned. Facilities for earthing parts of the gear should be provided as a safeguard against their becoming charged by leakage or otherwise, while persons are working on them. It is almost universally acknowledged that oil-break switches are the only type that should be used for breaking high-tension circuits, and their breaking capacity should be chosen with reference to the total kilovolt-ampere capacity of the station on a momentary short-circuit.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Nature of the Gamma and X-Rays.

Some time ago W. H. Bragg expressed dissatisfaction with the generally accepted ether-pulse theory of the γ rays. This theory does not seem to him to account for a number of phenomena observed in connection with the production and action of these rays, and he suggests, in place of it, what he calls the "neutral power" theory. In this, an electron is supposed to be associated with a positively charged particle, so that no external electric or magnetic forces will affect the pair in its motion through space. Working on this theory, he has made an investigation of the secondary radiation produced by γ rays and he believes that all the facts which he has noticed are easily explained by his theory. The investigation has been continued, and he here gives a general summary of his results. When the γ radiation is diminished in quantity, as it passes through matter, β radiation appears in its place, moving at the outset in the original direction of the γ radiation, and subsequently undergoing scattering in the ordinary manner of β rays. The penetration, and therefore the speed, of the β radiation thus produced increase with the penetration of the γ radiation to which it is due. The speed of the radiation does not depend upon the nature of the atom in which it arises. In the case of radium, at least, the speed of the β radiation is nearly equal to the speed of the normal β rays emitted by the radium itself. When very hard γ rays traverse matter, their absorption, and therefore the production of β rays, are almost independent of the atomic structure of the matter. Softer rays are affected by atomic structure. They are more absorbed by light atoms for equal weights of absorbing screens. The softer the rays, the greater is this effect. If there are any secondary γ rays, the ionization which they produce is negligible as compared to that produced by the secondary β radiation. All of these facts can be explained very simply and directly on the "neutral pair" theory; but an explanation on the ether-pulse theory is not easy. On this theory, both the electron and the electron's energy are supposed to be drawn from the atom, the γ ray merely starting the action. This does not account for the direction in which the radiation starts, and the differences in velocity which may be observed. Another difficulty is the insufficient intensity of the γ rays to produce these effects, if they be supposed to spread out in an ever-widening surface. To overcome this difficulty, Thomson and Campbell have suggested that the γ ray does not spread out, but travels as a parallel beam. But this seems rather to complicate the theory of the subject. The "neutral pair" theory seems to the author the simplest and most satisfactory that has yet been suggested, and he points out that this explanation will hold with the X-rays as well.—*Abstracted from Nature (London), July* 23.

Electric Traction on the Brighton (England) Railway.

A brief summary of the particulars of electrical working which will be shortly put into service on the suburban lines of the London, Brighton & South Coast Railway are given here. The section of the line at present being electrified extends from Victoria station to London Bridge, a distance of nearly nine miles. The total length of track is nearly twenty-three miles. At the Victoria station there are five platforms and two through lines, and at London Bridge station there are six platform lines electrically equipped. The improved service will require seven working trains and one spare one, each train comprising two third-class motor-cars, with baggage and motorman's compartments, each equipped with four 125-horsepower motors. The motor-cars will be placed at each end of the train with a first-class trailer in between. A ten-minute service will be given. The time required for the entire run will be twenty-five minutes, including stops, which may be compared with the thirty-six minutes at present taken by the same trains. A new type of car has been adopted which has communicating compartments, enabling passengers to pass from one part of the car to another. The electrical equipment is arranged so that no one can come in contact with any high-tension apparatus. In fact, this is only accessible when the current is cut off and high-tension connections connected to the ground. The overhead conductor for this line is a heavy grooved solid wire, one-half inch in diameter, supported on the double-catenary system. The messenger wires are suspended in massive porcelain insulators, tested to ten times the working pressure. Throughout the entire overhead construction a factor of safety of ten has been adopted. The overhead conductor is divided into sections at each station by means of specially constructed switchgear in fireproof cabins. Thus it is possible to isolate any section of the line to make repairs or to prevent accidents. A complete system of telephone connections exists between the cabins and signal houses. A duplicate feeder system has been supplied throughout the line to insure reliability, and a special system of cables was installed to bring the voltage drop in the return circuit within the requirements of the board of trade. The energy will be supplied to the Brighton Company from the London Electric Supply Corporation through mains connected to the Deptford station. There are four 2,000-kilowatt generating units installed there, one of which it is thought will be sufficient to carry the normal load. Some rather perplexing difficulties were encountered in installing the overhead equipment. At certain points bridges are so low that the overhead conductor could not be more than fourteen feet from the ground. In the station it was necessary to place it twenty-one feet from the ground, because railway employés have to work on the roofs of the trains, which made it necessary to design a special form of collector bow capable of working satisfactorily at high speeds through a range of between twenty-one and fourteen feet. Special devices have also been necessary at the low bridges to prevent accidental contact with the high-tension wires.—*Abstracted from Electrical Engineering (London), July* 23

A Quantitative Determination of the Radium Emanation in the Atmosphere.

About six years ago Elster and Geitel showed that an actively charged wire exposed for a few hours in the air received a radioactive deposit similar in character to the quick-changing radium products. The first attempt to measure the amount of radioactive matter in the atmosphere was made by Eve in 1905. His results varied greatly, being for one determination 82×10^{-12} and for another 287×10^{-12} gramme to a cubic metre of air. Eve has since described a new method of determining directly the amount of radium emanation in the atmosphere, which makes use of the property of cocoanut charcoal to absorb the emanation at low temperatures. This gave results of the same general magnitude, also varying greatly among themselves. It occurred to G. C. Ashman that a good opportunity for quantitative measurement was offered by the fact discovered by Rutherford that the emanation could be condensed at the temperature of liquid air. For this purpose the author drew air from out of doors at ground level, passed it through purifying solutions, then condensed it in a coil of copper tube immersed in liquid air. It was finally collected in aspirators made of carboys of known capacity. Two hundred litres of dry air, free from carbon dioxide, could be drawn through the coil at a moderate rate in six hours. At the end of that time the coil was allowed to heat up, and the volatilized emanation was transferred to a standardized gas electroscope. The results of four experiments varied from 45×10^{-12} to 200×10^{-12} gramme of radium to a cubic metre of air—variations comparable with those of Eve's experiments. Thinking that these variations might be due to incomplete condensation of the emanation, a second coil similar to the first one was joined in series with the latter. Both were immersed in liquid air. Upon repeating the experiment, the emanation from the first coil corresponded to 51×10^{-12} gramme of radium to the cubic metre; while the second coil did not show a trace of the emanation, thus clearly proving that it was entirely condensed in the first coil. This seemed to indicate that the variations in results were really due to variations in the amount of emanation in the air at different times. To determine this point, simultaneous duplicate experiments were conducted, the air being drawn through two coils in parallel at the same time. In one experiment it was found that each of two coils through which equal amounts of air had been passed simultaneously gave results corresponding to 131×10^{-12} gramme of radium, clearly showing that the variations were, as supposed, really those occurring in the atmosphere. The author finds that his mean result is about twenty-five per cent higher than the mean value found by Eve. This may easily be due to variations in the quantity measured. His highest determination was made with air immediately after a heavy rain and a general thaw, following several weeks of freezing weather, with an unusual covering of snow on the ground. Six experiments made at Chicago showed that the average amount of radium emanation per cubic metre of air could be maintained by 1×10^{-10} gramme of radium.—*Abstracted from the American Journal of Science (New Haven), August.*

The Fire on the Lancashire & Yorkshire Railway.

An abstract is given here of the report issued by A. B. Trotter of the British Board of Trade, on the fire which broke out on the trailer of a train of the Liverpool & Southport Railway last April. This fire started after the train had left a station. No one was injured. The fire is divided into two kinds: The primary fire, due to and supported by and in the immediate neighborhood of the electric arc which started it; and the secondary fire, which spread by ordinary combustion when inflammable woodwork had caught fire. The cause of the primary fire is divided into two considerations: The defect, undoubtedly a short-circuit from the positive cable to earth, and the persistence of the electric current after the substation circuit-breaker had automatically opened. The effects of the arc were confined to a distance of a foot or so from the spot where the fire broke out, below the floor and at the point where the cables turned to rise up and pass through the floor. The probable cause of the fire was the main trolley cable which was insulated with pure and with vulcanized rubber taped and braided with fire resisting braidings. These and other cables are bunched in a wooden casing lined with thin uralite. Where they bend upward the uralite is cut away so that the braiding of the cable rests against the wood. After passing through the floor the cables are well taped and compounded; but this protection against moisture is inflammable. Mr. Trotter criticizes the bunching of the cables in a common trough and the cutting away of the uralite so as to expose the wood, and compares this practice with that of the Northeastern Railway, where each cable is carried in a separate iron pipe and the pipes themselves are arranged not to cross each other, and all are carefully grounded to the frame. To prevent the collection of moisture in these pipes, it is recommended that they be sealed up by means of split wooden ferrules driven tight around the cable. The arc which started this fire was very severe, and lasted two or three minutes. Several pounds of iron were melted by it out of the frame. The cause of the persistence of the arc is said to have been the replacing of the circuit-breaker on the converter at the station after it had come out the first time. As the line breakers did not come out, no serious trouble was suspected, and current was still supplied to the car from more distant substations. To distinguish between simple overloads, grounding of the feeders, and arcing of the kind which causes fire, Mr. Trotter suggests that a telephone receiver be connected in an induced circuit and in shunt with as much of the conductor as is available at the substation. It might in this way be possible to distinguish between the variations in current due to running of the motors, the comparative silence due to leakage, and the characteristic roar caused by an arc. The report is concluded by recommending certain changes in the methods of running the cables on the cars so as to protect them from the weather and the planning of the feeders and switching devices with a view to limiting to each section the current supplied to that section, with a reasonable margin for overloads. Such sections should, if possible be of such length that there would be but one train starting on them at a time.—*Abstract from Electrical Engineering (London), July 16.*

Street Railway Earnings.

A director of two of the largest street railway systems in the United States says, according to the *Wall Street Journal:*

"An important lesson learned from the past ten months of business depression has been the demonstrated stability of street railway earnings. Many of the large railroads of the country have shown shrinkage in gross for the year ended June 30 of twenty to twenty-five per cent. Street railway earnings, on the other hand, have in such cases as the traction systems of Boston, Chicago, Philadelphia and St. Louis shown small gains or at the worst slight losses of less than three per cent.

"In the return of prosperity the street railways will start a lap ahead of the railroads."

Edison Companies' Convention.

It is announced by President Alex Dow that the annual convention of the Association of Edison Illuminating Companies will be held this year at the Hotel Aspinwall, Lenox, Mass., on September 15, 16 and 17, with committee meetings on the 14th.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Heavy Traction Gearing.

The development of modern electrical railway systems has involved a continued increase in the size and weight of both cars and equipments in order that the high speeds now demanded in this service may be maintained. As a consequence of these conditions the augmented stresses to which the teeth of motor gearing are subjected, combined with the limited space available, have rendered the strength and wearing qualities of gears and pinions important factors in the cost of operation.

In order to successfully meet these conditions without an excessive increase in cost, the General Electric Company, Schenectady, N. Y., has developed a highly efficient gear which consists of a forged-steel rim or tire mounted on a cast-steel centre so as to form what is practically a one-piece gear, as a pressure in excess of 200 tons would be required to force the rim off the cast centre. This combination not only gives added resistance to wear on the gear teeth, but enables a rim to be replaced when finally worn out, with a minimum of delay and expense.

The success with which this form of motor gear has met in actual service is indicated by the fact that during the past three years it has been installed in original equipments on many of the most important electric railway systems in the United States, among these being the Interborough Rapid Transit Company, the Hudson & Manhattan Railway Company, the New York, New Haven & Hartford Railroad, the West Jersey & Seashore Railway Company, the Scioto Valley Traction Company, etc., in all of which the mileage records show graphically the increase in efficiency obtained by its use.

As a further development along these lines the General Electric Company conducted a series of exhaustive experiments with the object of obtaining great strength with a uniform quality of metal, and it has now developed a pinion having remarkable physical characteristics of tensile strength combined with a high elastic limit. These qualities are obtained without in the least sacrificing the element of toughness so essential to the continued operation of heavy equipments.

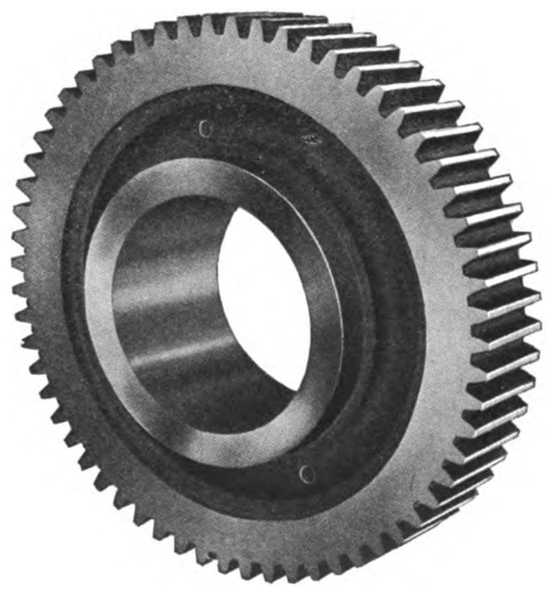
This pinion is known as the General Electric "New Long Life Pinion," grade "F." This special (grade F) steel, after being machined, is treated by a process which avoids any possibility of distortion or internal stress while cooling.

The increased strength obtained by this process insures an ample factor of safety over the stresses to which the pinion teeth are subjected in ordinary service, while the hardness of the steel minimizes the effects of abrasion and thereby reduces the wear from friction. As a result there is a notable saving in the labor cost of renewals, and, in addition, the item of expense caused by interrupted service is materially reduced. There is also obtained a more nearly even wearing of gears and pinions.

This latter point is worthy of serious consideration, as the ordinary cast-steel gear usually outlasts three soft pinions, with the result that during a considerable proportion of its life it is operating with worn pinions and under conditions of low efficiency, which add to the mechanical strain on the motor. In addition to this, the vibration and noise so frequently associated in the minds of the public with electric railway service are largely due to the unequal wearing of gears and pinions. The (grade F) pinion should, under average conditions, last as long as the cast-steel gear and, as a result, outwear three ordinary-grade pinions, with an obvious saving of the cost of two renewals as well as insuring operation at maximum efficiency.

The general appearance and method of assembly of steel-tired gears are shown in the accompanying illustrations. In addition to this standard design, the General Electric Company manufactures the grade "F" steel rim or tire so that it can be mounted on various forms of extended car-wheel hubs or steel flanges to meet special conditions.

Steel Tire Gear Used by Interborough Rapid Transit Company with G. E.-69 Motors.



G. E. Railway Motor Gear, with Steel Tire and Cast Steel Hub.

Thermostatic Magnet Protector.

Appreciating the opportunity which exists for a reliable magnet protective device which would not be dependent upon an electromechanical mechanism, the designers of the thermostatic magnet protector, illustrated herewith, after a long series of exhaustive tests under actual service conditions, finally adopted this form as embodying all the desirable features called for in a protective device of this nature.

The device consists of a spring clip mounted on a metal holder and locked in position by means of a small metallic "button." This button is composed of a special alloy, which will melt at a predetermined temperature, and in melting releases the spring clip, which instantly opens the circuit and cuts the apparatus being protected out of circuit—thus preventing a burnout. It should be understood that this button carries no current and does not act as a fuse, but is dependent for its operation upon the actual temperature of the apparatus to be protected.

The thermostatic magnet protector was primarily designed for the protection of arc-lamp coils, and in this field found its widest application. There are many so-called indestructible magnet coils, but they frequently burn out under actual service conditions and generally do more or less damage to other parts of the apparatus.

By placing the thermostatic magnet protector in series and with the magnet coils, it will be found impossible to damage the coils, as this device will always cut the lamp out of service before a dangerous temperature has been reached.

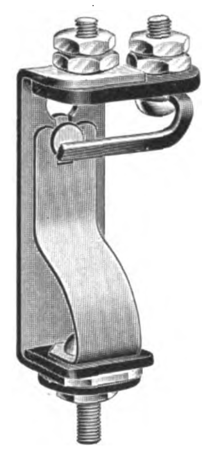
Arc-lamp repairs are expensive, both in material, time and loss of service, and any device which will prevent this expense will be appreciated by users of arc lamps.

The following report, dated June 8, from the Commonwealth Edison Company's laboratory, on the operation of this protective device, is of interest and clearly illustrates the inherent reliability of this new device which is being placed on the market by the Central Electric Company, Chicago, Ill.:

"We have made numerous tests on arc lamps equipped with the thermostat protective device, and find the following conditions:

"The thermostat, situated as it is in the shell of the lamp, is actuated by the temperature of the air surrounding the coil. This air, in the case of the direct-current lamp, is not heated nearly so much by the coil as it is by the resistance spools. In each case the temperature of the air surrounding the thermostat was within two or three degrees of 135 degrees centigrade, as measured by the thermometer when the circuit was opened by the thermostat. In order to find out whether the external temperature of the coil was higher or lower than the internal temperature, the resistance of the coil was measured at the same time that the temperature readings were taken. With the current in the lamp approximately twenty-five per cent above normal, and with the surrounding air at about twenty-two degrees centigrade, it was found that the mean temperature of the coil as determined by the resistance method was approximately eight to ten degrees centigrade lower than the external temperature of the coil.

"To determine the effect of lower external temperatures and wind upon the operation of the thermostat, and the relation of mean coil temperature to external temperature of the coil, under these conditions, a fan was arranged to throw a current of air upon the shell of the lamp. The current in this case was also kept at about twenty-five per cent above normal, and the temperature, by thermometer placed on the outside of the coil, compared with the mean temperature as obtained by resistance method. In this case it was found that the mean temperature of the coil as found by the resistance method was four or five degrees higher than the temperature of the air surrounding the thermostat. With extreme weather conditions it is possible that the difference would be much greater.



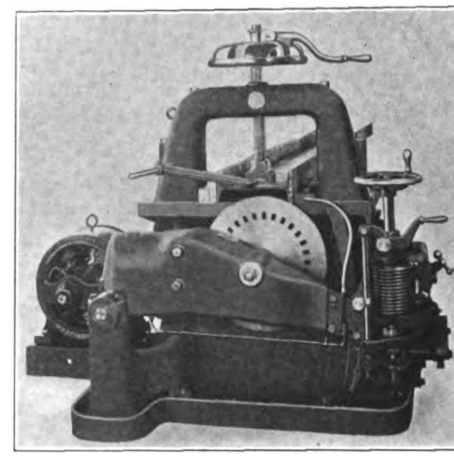
THERMOSTATIC MAGNET PROTECTOR.

"The thermostat will not operate under ordinary operation of the lamp, but will blow within one or two minutes after the temperature of the surrounding air at the plug has reached 135 degrees centigrade.

"On each test made the thermostat has opened the circuit satisfactorily."

Motor-Driven Cold-Metal Saw.

The use of small cold saws for cutting off all sizes and shapes of metal work has become very general in a great variety of establishments, not only because of the utility of the saw itself, but also because



MOTOR-DRIVEN COLD-METAL SAW.

of the fact that individual motors have been most successfully fitted to the saws.

In a great many establishments it would be almost impossible to locate the saw so that it could be conveniently used by the workmen. In the average machine shop one or more saws are required in the stock room or some other equally inconvenient place for mechanical drive. Here the use of a small motor on the saw permits the location to be selected without reference

MOTOR-DRIVEN COLD-METAL SAW.

to any requirements except the convenience of putting work through.

In structural iron works the self-contained unit of motor and saw can be picked up by a crane and carried to any part of the building or yard. Similarly the use of the motor-driven set is found very advantageous in a great many plants.

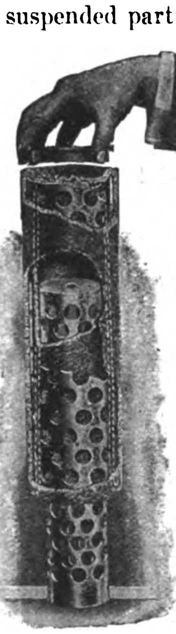
The cold saw illustrated, which is one that does not require a bevel gear, is especially adapted to motor drive. The saw is manufactured by the Lea Equipment Company, of New York city, and is fitted with a Westinghouse shunt motor. The size shown requires a two-and-one-half-horse-power motor and is capable of cutting eight-inch round stock. A Morse silent chain is used to connect the motor to the saw, in preference to gearing, as experiments have shown the former to be more satisfactory.

It is necessary to be able to adjust the speed of the saw in order to cut different metals with maximum efficiency. For instance, experience has shown that the peripheral speed of the saw should be fifty-two feet per minute with a very coarse feed for structural iron, machinery steel and metals of this class. For annealed tool steel a lower speed of but thirty-seven feet a minute is the most efficient. This same speed is also used on Krupp's chrome nickel steel. In order to obtain these speeds, an adjustable-speed motor with speed range of one and one-third to one is used, with a speed-controlling rheostat. It is only necessary to move the handle of the controller to obtain any desired speed.

Feed-Water Filtration.

The accompanying illustrations show the Blackburn-Smith feed-water filter and grease extractor, a device which is installed in the feed line and subjects all entering water to double filtration through separated terry cloths. If an open heater is used the filter is placed between the pump and the boiler, but if the heater is of the closed type the filter is installed between the pump and the heater, in order that the suspended particles will be caught before they can settle on and reduce the efficiency of the heater surface.

This filter is very effective in removing mechanically suspended particles from the water supply, for removing all particles of oil, grease and dirt from the lines, and anywhere that the condensed exhaust returns from steam-heating systems, condensers, drying coils, etc. By removing the scale-forming matter the filter reduces repair bills and also effects a saving in coal bills and bills for water supply. Terry cloth can be cleaned and used over and over again, and the filter costs practically nothing for maintenance.



REMOVING THE FILTERING MEDIUM.

Where muddy water is to be filtered, or where oil or grease is present in large quantities, a better arrangement is to run two or more filters in parallel. Each filter can then be thrown into service or cut out at will, and any filter can be cleaned while the plant is running, and no impurities reach the boiler.

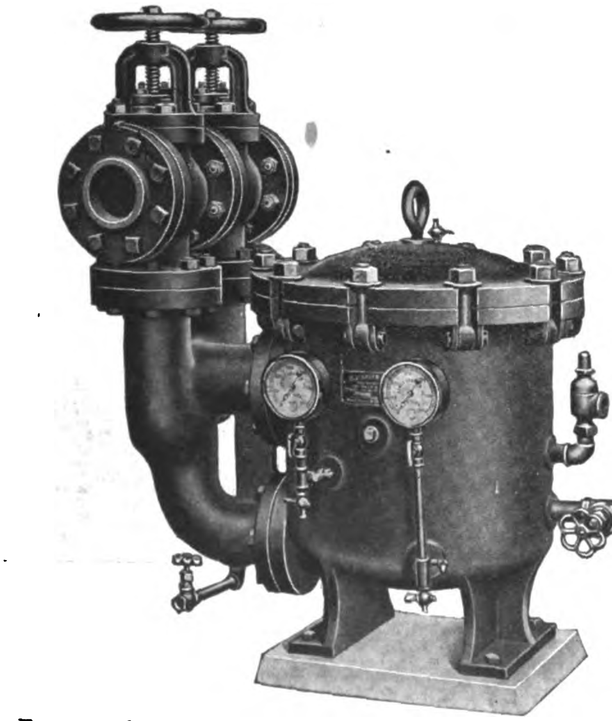
The water passes from the feed pump into the filter inlet, through the upper or filtering chamber, then through the filter cartridges into the pump chamber, and from the pump chamber through the outlet to the heater or boiler.

The water passes through the cartridges with very little friction, but in the course of time, as the foreign material accumulates on the filtering cloth, some resistance will result. When the difference of pressure, as shown by the pressure gauge, increases to twenty pounds per square inch, the filter should be cleaned. A water relief valve automatically prevents the building up of excessive pressure in the pump discharge line.

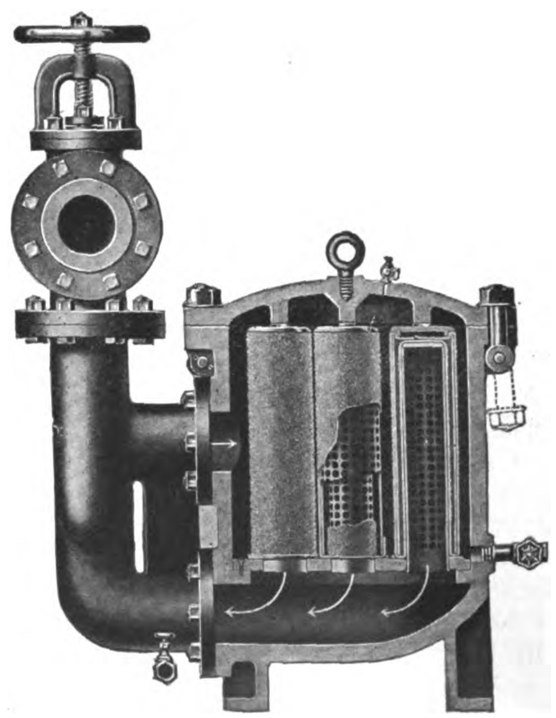
The valve chamber is made right-hand or left-hand, as desired, so that the filter may be set on either side of the line. Both the main valves are in a straight line with the feed pipe.

The number of cartridges in each filter varies with the size of the unit. Each cartridge consists of two concentric cylinders of heavy perforated brass tubing covered with linen terry. The lower end of the inner cylinder is expanded into the partition which separates the filtering and outlet chambers, and the upper end is covered by a perforated brass cap.

The Blackburn-Smith filter is made by James Beggs & Company, 109 Liberty street, New York city.



EXTERIOR VIEW OF CARTRIDGE-UNIT TYPE FEED-WATER FILTER.



SECTIONAL VIEW OF CARTRIDGE-UNIT TYPE FEED-WATER FILTER.

Troy Electrical Company's Iron-Clad Fittings.

The accompanying illustrations show several fittings which have been placed on the market by the Troy Electrical Company, of Troy, N. Y. Fig. 1 shows the new "Teco" iron-clad standard service or entrance switch. This is made in sizes ranging from eight and one-half by four and one-half by four and one-half inches to thirty-one and one-half by ten by five inches, for double-pole, triple-pole and four-pole switches, for open work, for half-inch, three-quarters-inch and one-inch conduit.

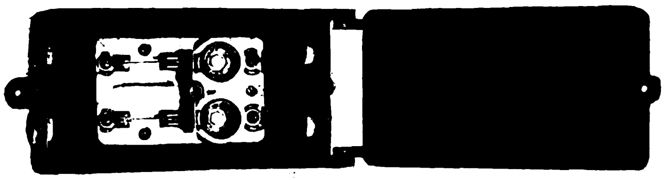


Fig. 1.—"Teco" Iron-Clad Standard Service or Entrance Switch, No. 120.

Fig. 2.—"Teco" Style "D" Union Conduit Fitting.

Fig. 2 shows the style "D" Union conduit fitting. This fitting is made for one-half-inch, three-quarters-inch, one-inch, one-and-one-quarter-inch, one-and-one-half-inch, two-inch, two-and-one-half-inch and three-inch conduit, for two, three and four wires, and with blank bushings and locknuts. The one-half-inch and three-quarters-inch fittings have composition bushings in the head for wire outlets. The one-and-one-quarter-inch fittings have porcelain bushings with one-half-inch holes. The one-and-one-half-inch and two-inch fittings have porcelain bushings with seven-eighths-inch holes. The two-and-one-half-inch and three-inch fittings have one-and-one-half-inch bushings.

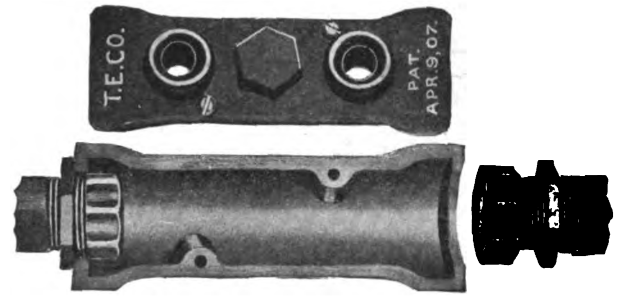


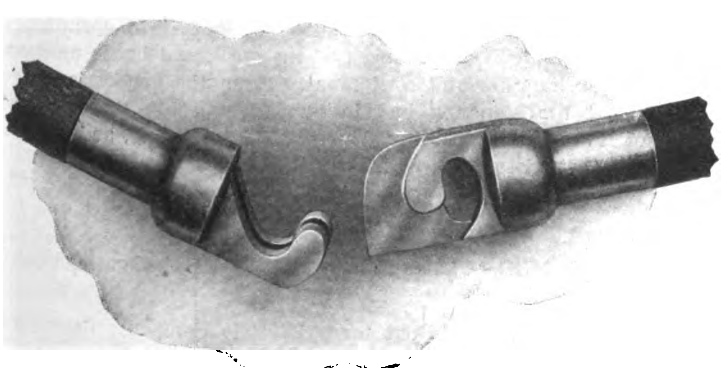
Fig. 3.—"Teco" Style "A" Union Rigid and Flexible Conduit Fitting.

Fig. 3 shows the style "A" Union rigid and flexible conduit fitting. This is made to accommodate one-half-inch and three-quarters-inch conduits, and is fitted with adjustable covers for one, two and three-wire circuits.

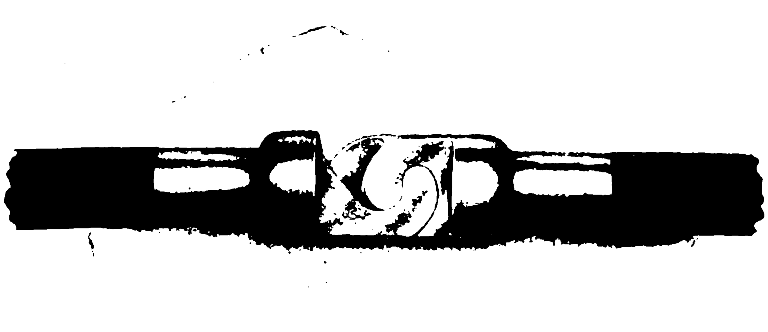
These conduit fittings are especially adapted for open construction, and the style "A" fitting is interchangeable with a "T" or an "X," which makes it an easy matter to add to a line after the work has been finished up.

The Chicago Conduit Rod Coupling.

The accompanying illustrations show the conduit rod coupling which has been placed on the market by the Chicago Conduit Rod Coupling Company, 310 Cuyler avenue, Chicago, Ill. The function of this coupling can be readily understood from the illustrations. The tongue which enters the groove in the other portion of the joint fits tightly against the butt of that casting, preventing end play. It also prevents lost motion in twisting, as there is just enough side play to permit the rods to be used in pipe laid with slight irregularities and changes of direction. The conduit heads are made of malleable cast iron. The thickest part of the casting is at the precise point where the greatest strain occurs. The coupling is so designed that four-foot rods may be connected and disconnected with perfect ease in the smaller manholes. Double rivet holes are provided, giving great pulling strength and also high twisting strain. The tongue is pierced, permitting the attachment of a pulling cable and also facilitating the cleaning of the joint if this should become necessary.



Chicago Conduit Rod Coupling, Disassembled.



Chicago Conduit Rod Coupling.

Alternating Current in New York City.

The United Electric Light and Power Company, New York city, has closed a contract with the Astor estate covering the complete supply of electricity for lighting to a new office building to be erected on Seventh avenue, extending from Forty-third to Forty-fourth street, opposite the New York Theatre. Thirty-four stores will be included in this building. Elevators and pumps will also be supplied with alternating current.

The Hedden Construction Company has placed an order for sixteen hoisting machines to be operated by two-phase alternating-current motors. These hoists will be the first used on the new office building to be erected on the site of the Fifth Avenue Hotel. The current will be supplied from the mains of the United Electric Light and Power Company. Over 800 horse-power in hoists will be used during the construction of this building.

Current Electrical News

DOMESTIC AND EXPORT.

TO GENERATE ELECTRICITY IN WEST VIRGINIA GAS FIELDS—It is understood that a company, to be capitalized at $3,500,000, is being formed to generate electricity at gas fields in West Virginia, to be transmitted to Cincinnati, Ohio. The directors of the Columbia Gas and Electric Company, Cleveland, Ohio, which owns large gas fields in West Virginia, are said to be interested in this enterprise.

TO TEST STATE'S WATER RIGHT—Interests using hydraulic power on the Oswego River at Fulton, Oswego County, New York state, have filed against the state claims aggregating $1,043,940. The state, it appears, has appropriated the water at that point for the new barge canal. The character of the damage is similar to that involved in a claim of the Fulton Light, Heat and Power Company for $3,000,000, which is now pending before the State Court of Claims.

ECONOMIC POWER AND CONSTRUCTION COMPANY GETS TEMPORARY INJUNCTION—Supreme Court Justice George H. Fitts, of Albany, N. Y., has granted a writ of prohibition to the Economic Power and Construction Company, restraining the Public Service Commission until September 28 from holding a hearing on the company's right to operate in Geneva, N. Y. The Economic company claims to have a general franchise in the state granted to it prior to the existing franchise laws and commissions created by the legislature. The company proposes to supply steam heat and electric power to Buffalo citizens as soon as suits now pending in the courts have been disposed of.

TO CONSOLIDATE LIGHTING PLANTS—Plans are maturing, it is reported, for the consolidation by H. E. Huntington and associates of all the power and lighting companies in Los Angeles, Cal., with $50,000,000 capital stock. On September 1 the plant of the City Gas Company, purchased recently by Huntington's Pacific Light and Power Company, will be formally turned over, and the next intended step, it is asserted, is the purchase of the Los Angeles Gas and Electric Company, on which a price of $7,000,000 with a bond issue of $3,500,000 is said to have been set. No figures have been given out regarding the Edison Electric, the largest of all the companies, but it is believed that it is included in the project.

NEW ELECTRIC ROAD—Work is to begin at once near Fredericksburg, Va., on a dam across the Rappahannock River. The work is to be under the direction of W. C. Whitner, hydraulic engineer for the Virginia Passenger and Power Company, who is also president of the Fredericksburg Power Company. Both these companies are controlled by the Gould interests. The Goulds last year succeeded in obtaining a repeal of the law prohibiting a paralleling of the Richmond, Fredericksburg & Potomac Railroad, and announced their intention of building an electric line from Richmond, Va., to Washington, D. C. Application for a charter with this object in view was made, but it was withdrawn, and a charter will be asked for a line to connect with the Richmond & Chesapeake Bay line at Ashland and an electric line which comes from Washington into Virginia and which line is owned by the Goulds. Power developed by the building of the new dam near Fredericksburg will be used to operate the cars on the new line. The dam will involve an expenditure of $50,000, will be of concrete, 800 feet long, twenty-five feet high and will be completed by Christmas. The power to be developed will reach about 12,000 horse-power.

NEW WESTERN ELECTRIC LINE—M. D. Wright, a capitalist of Cœur d'Alene, Idaho, has authorized the announcement that work on an electric railway between Cœur d'Alene and Wallace, ninety-five miles, will begin within four months. The new road will be a branch of the Spokane & Inland Empire Railway system, and will be under its control. The system already operates a line between Spokane and Cœur d'Alene and Hayden Lake. Mr. Wright added: "There is no doubt that the long-talked-of line between Cœur d'Alene and Wallace will be built, and the Hayden Lake line will be built as far as Squaw Bay on Pend Oreille Lake. A junction of the two roads will be at Cœur d'Alene. The Wallace line will follow the Blue Creek route to Catalbo, and from there it will parallel the Oregon Railroad and Navigation line to Wallace. It will almost follow the Washington Water Power high-tension line. The grade will be much better than the Fourth of July Cañon route, there being few and short tunnels, if any. The grade will be about one per cent." Announcement is also made by Jay P. Graves, president of the system, that his company and associates are planning an electric line from Nine Mile Bridge to Miles, thence to Kettle Falls, Wash., 145 miles. This will afford an outlet to Spokane for immense mineral tonnage from the properties along the Columbia River, as well as in the interior of the Colville reservation.

ROCHESTER, CORNING & ELMIRA TRACTION COMPANY—The Public Service Commission for the Second District of New York state has issued a supplemental order in the case of the Rochester, Corning & Elmira Traction Company, providing that the company can issue capital stock to the amount of $380,000, par value, and bonds, par value, to the amount of $1,000,000. The new order is made upon the condition that none of the proceeds of the stock or bonds be used for contingencies, legal or other expenses, organization expenses or working capital, the proceeds of the stock and bonds to be used exclusively for the construction and equipment of that part of the road from Rochester to Conesus Lake; and that any excess above such requirements shall be held until further order from the commission, but no bonds shall be issued or sold until stock to the aggregate amount, par value, of $380,000 shall have been subscribed for by responsible parties, such subscription to be approved to the satisfaction of the commission. The original application asked for an authorization for the issuing of bonds to the amount of $8,000,000 and of the balance of its stock, $3,880,000. The company had previously issued $120,000 capital stock. The order allowed an issue of $4,210,000 in bonds and the full issue of $4,000,000 in stock, a total capitalization of $8,210,000. The commission required as a condition of the order that the $4,000,000 of capital stock must be subscribed by responsible parties before any bonds could be issued. The projectors of the company reported that it was impossible to dispose of the stock and bonds necessary for the construction and completion of the road, but stated that if the company were permitted to construct first that part of its road extending from Rochester to Conesus Lake, a distance of twenty-five miles, and equip and put it in operation, it would be able to sell and dispose of the stock and bonds necessary for such construction and equipment. From the application it appeared that the company had in hand $120,000 in cash, the proceeds of its capital stock issued prior to July 1, 1907, and that the estimated cost of twenty-five miles of road would be $1,350,000.

NEW INCORPORATIONS.

DICKENS, NEB.—North Platte & Dickens Telephone Company. $5,005.

HARRISBURG, PA.—Boyertown Electric Company, Boyertown. $5,000.

DOVER, DEL.—Electrical Corporation Consolidated Company, Wilmington. $1,500,000.

MADISON, WIS.—Farmers' Mutual Telephone Company, Baraboo. An amendment increasing its capital from $6,000 to $12,000.

SALEM, ORE.—Gordon Falls Electric and Manufacturing Company, Portland. $225,000. Incorporators: Charles Coopey, George L. Peaslee and E. Y. Judd.

MILWAUKEE, WIS.—The Home Telephone Company, Durand. $12,000. Incorporators: W. E. Plummer, George Tarrant, A. J. Wallace and Frank Pierce.

ELECTRIC RAILWAYS.

MILWAUKEE, WIS.—The Milwaukee Electric Railway and Light Company has inaugurated hourly service between Milwaukee and Watertown.

DENVER, COL.—The electric service to Eldorado Springs from this city and Boulder has been opened. This completes the entire Denver & Interurban system.

ASHEVILLE, N. C.—Actual work has been begun on the Weaverville Electric Railway, which is to extend from New Bridge Station, on the Rapid Transit Railway, four miles to Weaverville.

CANON CITY, COL.—President S. H. Atwater, of the Kansas & Colorado Railroad Company, has signed contracts for the surveying and grading of the Cañon City division, and work has been begun.

NIAGARA FALLS, N. Y.—The International Railway Company will begin at once the work of extending its Devil's Hole line to the tracks of the Rome, Watertown & Ogdensburg Railroad just below Niagara University.

PORTLAND, ME.—The directors of the Portland & Northern Railroad Company, which contemplates the operation of an electric line from Portland to Bridgton, went over the proposed route of the road recently and made arrangements for the survey.

MEADVILLE, PA.—In the offices of the register and recorder in this city there has been filed a mortgage of $300,000 against the Erie & Cambridge Springs Street Railway Company in favor of A. L. Curtze, trustee, to secure an issue of five per cent gold bonds.

OAKLAND, CAL.—The board of supervisors has decided provisionally to grant permission to A. W. Maltby and Joseph Naphtaly to operate an electric street railway through the Alameda County part of the Alameda-Contra Costa tunnel, back of Claremont. The franchise is limited to five years.

IOLA, KAN.—A deal has been closed whereby the Iola Electric Railway Company, now running cars between Iola and LaHarpe, comes into possession of the Kansas Southern Electric Railway Company, which will build an electric line between this city and Pittsburg, Kan., touching all important cities.

McKINNEY, TEX.—E. M. Hopkins and associates, of Detroit, Mich., who have held several conferences with citizens along the line of the proposed Fort Worth-Bonham Interurban, finding that their proposition would not be accepted by the local citizens, have purchased the right of way of the old proposed line from here to Bonham.

MORGANTOWN, W. VA.—At a meeting of the directors of the Morgantown & Dunkard Valley Electric Railway, held at Blackville, it was decided to start the work of building the first section of the road. This is to be constructed from Granville to Stumptown to the mouth of Wade's Run. J. A. Martin has been selected to superintend the construction of the road.

BILLINGS, MONT.—The survey for the proposed electric line from Columbus to Cooke City has been completed between the former city and Absarokee, and right-of-way men are making arrangements to secure right of way for the road from Absarokee to Cooke City, a free right of way having been assured between Columbus and Absarokee. The city of Columbus has also donated terminal land and raised sufficient to build a bridge across the Yellowstone.

BUTLER, PA.—Butler and Pittsburg capitalists recently went over the route of the proposed new trolley line from Butler to Greenville by way of Queens Junction, Slippery Rock, Grove City and Mercer, and announcement is made that the right of way will be obtained this fall. Two routes are now being considered. The route favored follows the Bessemer & Lake Erie Railroad to Kiester Station and then west to Slippery Rock. The road to Greenville would cost $3,000,000.

PITTSBURG, PA.—Contracts have been awarded for the connection of the Youngstown & Ohio River Railway with the Ohio Valley Scenic route at East Liverpool. Four miles of track will have to be constructed, from East Liverpool north to a point between East Liverpool and West Point. The Youngstown & Ohio River electric road is arranging to haul coal from a large undeveloped field in the vicinity of West Point to make shipping connection with the Erie Railroad at Lisbon.

MEMPHIS, TENN.—Contract for the construction of the first section of the interurban system between Memphis and Lake View, Miss., has been let by the board of directors of the Lake View Traction Company to M. J. Roach. The total cost of the Lake View division, about twelve miles, excluding the electrical equipment and rolling stock, will be about $189,000. The contract calls for the completion of the railroad and track laying on this division by January 1, 1909. Next summer, it is expected, will see the system in active operation.

JANESVILLE, WIS.—Organization of the Cincinnati Construction Company has been completed with the election of H. H. Zigler, Columbus, as president; W. L. Jamison, vice-president; F. D. Jamison, Cincinnati, secretary and treasurer; Joseph Ellis, Janesville, resident manager and assistant secretary. The officers and George P. Stimson, of Cincinnati, constitute the board of directors. Janesville was designated as the headquarters. Behind the company is a syndicate of Ohio capitalists which has built several roads in Michigan. H. H. Zigler, the president, says that he hopes to have the survey complete, the profiles ready and everything ready for application to the State Railway Commission for a franchise by October 1. Then, if the winter is an open one, work of construction on the line to Madison will begin at once.

KANSAS CITY, KAN.—Plans are being perfected for the organization of a trust company in Kansas City. It will be known as the Kansas City Union Trust Company, and the purpose is to finance a system of interurban trolley lines out of Kansas City. The company that is first to build these lines is known as the Interstate Power and Transit Company. The road will run through Topeka and Lawrence, with a road to Coffeyville, through Garnett, Iola, Humboldt and Cherryvale, with branch lines to Parsons and Independence. Later it is proposed to extend the line from Coffeyville to Oklahoma City by way of Tulsa, with spurs to Guthrie, Shawnee and Muskogee. Another proposed extension is from Topeka to Salina and Hutchinson. It is also proposed to build from Parsons to Joplin.

ST. CATHARINE'S, ONTARIO—The projected electric railway across the Niagara peninsula from Dunnville appears to be a practical undertaking. The scheme was introduced some months ago, but fell through even after municipal by-laws had been passed to purchase a $39,000 bond issue to aid the promoters. The president of the company, James A. Ross, of Wellandport, the provincial member, has been working out the new scheme and has enlisted the aid of George Dunstan, of Toronto, and P. T. McGrath, of Worcester, Mass. It is now proposed to build from Dunnville through Wellandport and St. Ann's to Beamsville, where a connection would be made with the Hamilton, Grimsby & Beamsville line. A party of surveyors is now at work. The Dunnville people will not be called upon to finance the bonds, but will be asked for the right of way through certain streets. The proposed road would open up a large section which is now practically shut off from quick communication with the more northerly and easterly end of the district.

BUFFALO, N. Y.—The Public Service Commission for the Second District has given its consent to the Niagara Falls Electrical Transmission Company to grant and transfer to the Buffalo, Lockport & Rochester Railway Company private rights of way for its transmission line in the villages of Middleport, Medina, Albion, Brockport and Spencerport and towns of Greece, Gates, Ogden and Ridgeway, which lie between the city of Lockport and the city of Rochester along the right of way of the railway company, and to the Buffalo, Lockport & Rochester Railway Company to take and hold the same. The Niagara Falls Electrical Company is also permitted to assign and transfer to the Buffalo, Lockport & Rochester Railway Company the municipal consents or franchises of the localities mentioned above. The Buffalo, Lockport & Rochester Railway Company is authorized to take, hold and exercise all the rights conferred or created by these consents. The Buffalo, Lockport & Rochester Railway Company is authorized to use the transmission line constructed by it from South Greece station in the county of Monroe to the substation in the village of Albion, county of Orleans, in and about the operating of its railroads.

ELECTRIC LIGHTING.

TAUNTON, MASS.—The committee on street lights has voted to extend the incandescent lighting system at a cost of about $8,000.

LANDER, WYO.—It is announced that Asmus Boysen, of Chicago, will build another power plant in the cañon of the Pope Agie, above Lander.

PEMBROKE, ME.—The plant of the Pembroke Power Company, which was destroyed by fire last spring, will be rebuilt, work to start at an early date.

STRASBURG, VA.—The Rock Spring Electric Company, incorporated with $25,000 capital, will establish an electric plant and has contracted for machinery.

ALBANY, N. Y.—The Albany Electric Illuminating Company has contracted for the purchase and installation of new street lamps in this city. The amount of the contract is $59,000.

GEORGETOWN, PA.—The township commissioners have awarded a street lighting contract to the Prospect Rock Light, Heat and Power Company. There will be twenty-five arc lamps installed.

SUTTON, MASS.—The Grafton Electric Company has been awarded the contract for street lighting. This calls for sixty-five incandescent lamps at a cost of $14 per year, the contract to run for five years.

WEST CALDWELL, N. J.—The West Caldwell borough council has decided to extend its lighted territory and authorized the lighting committee to execute a contract with the Public Service Corporation to install additional lamps.

MEDFORD, ORE.—Colonel F. H. Ray, of New York, president of the Rogue River Electric Company, formerly the Condor Water and Power Company, on a recent trip West, gave final orders for the enlarging of the plant which is now furnishing electric power to southern Oregon towns.

CLINTON, MASS.—The town of Leominster is said to be considering the feasibility of securing electricity for municipal lighting from the Connecticut River Power Company, and as a part of that scheme the purchase of the Leominster Electric Light and Power Company's plant.

COLORADO SPRINGS, COL.—By an arrangement concluded recently between the United Hydroelectric Company, of Georgetown, and the Central Colorado Power Company, of this city, the former company has been made the sole distributing agent in Gilpin and Clear Creek counties for the latter company.

FREMONT, OHIO—The Fremont Power and Light Company, recently granted a franchise by the city council, has accepted the terms of the grant and announces that work on the new plant will begin at once. The company proposes to harness the Sandusky River and erect a large power plant in Ballville, south of Fremont.

NEWARK, N. J.—The municipal lighting committee has asked the finance committee for $10,000 for preliminary plans for building a municipal lighting plant. The scheme was voted on favorably at the 1907 election, and calls for an expenditure of $1,000,000. The $10,000 is to pay an expert for making estimates and drafting plans.

SHELBURNE FALLS, MASS.—The Shelburne Falls Electric Light and Power Company has purchased of the Lamson & Goodnow Company the strip of land south of the W. C. Thompson Block, and is planning to build a new power station. The company will go ahead with the work at once, and when completed will give both day and night service.

GROTON, VT.—Clark & Davidson, owners of the grist mill at this place, are to put in an electric light and power plant, to supply power to the stone sheds and electricity for street and house lighting. The firm has purchased the old Baldwin mill water rights located at the lower end of the village, and the work of replacing the dam washed out several years ago has commenced. It is expected to have the plant in operation by October 1.

HAGERSTOWN, MD.—The Antietam Electric Light and Power Company, composed of Clarence E. Easterday, Orville E. Shifler and Harry L. Moser, has purchased of John W. Nihiser a portion of the Delemere tract, along the Antietam Creek, for $4,250. The property is valuable by reason of the water power, a large milldam built in the creek being part of the property. The buyers, who recently obtained a contract to light Boonsboro for ten years, will build a power plant at the old Delemere Mill.

PITTSFIELD, ME.—Work will be begun shortly on the building of a 200-foot log dam with concrete bottom at Cleveland Rips in North Anson, on the Carrabasset River, by the Franklin Power Company, chartered in 1903 under the name of the Carratunk Power Company, capitalized at $100,000, to provide Farmington, New Vineyard and ultimately the town of Wilton with electricity for illuminating and manufacturing purposes. It is expected that by October lights will be in operation in Farmington.

OLYMPIA, WASH.—Papers for what is thought to be a rival company to the Skookumchuck Power Company have been filed with the county commissioners by H. P. Schiel and William McArthur. The new company will get power in the Deschutes near Rânier and furnish power in the vicinity of Ranier, Bucoda and Tenino. The Skookumchuck Power Company will get its power about fourteen miles above Tenino in the Skookumchuck. Both companies state work will commence immediately when franchises are granted.

LEGAL NOTES.

RIGHT TO DISTURB WIRES OF STREET RAILWAY SYSTEM—The right to move a building along a public street upon which an electric railway has been lawfully constructed, to the serious interference with the operation of the cars and the wires by which they are operated, is denied in Fort Madison Street Railway Company *vs.* Hughes (Iowa), 114 N. W. 10, 14 L. R. A. (N. S.) 448.

RIGHT TO REMOVE TELEPHONE POLE—The right of the owner of a leasehold renewable forever, which extends to the centre of a private alley, to cut down and remove a telephone pole placed on his half thereof without permission in such a manner as to interfere with his reasonable use of the alley, after giving notice to its owner to remove it, which is not acted upon within a reasonable time, is sustained in Maryland Telephone and Telegraph Company *vs.* Ruth (Md.) 68 Atl. 358, 14 L. R. A. (N. S.) 427.

RIGHT OF CITY TO FIX ADDITIONAL BURDENS UPON TELEPHONE COMPANY—A city which, by ordinance, has permitted a telephone company to erect its poles and wires in the streets, and has thereby invited the company to make investments and expenditures, which it has made in good faith and in reliance on the ordinance, is held, in Plattsmouth *vs.* Nebraska Telephone Company (Neb.), 114 N. W. 588, 14 L. R. A. (N. S.) 654, to have no right arbitrarily to impose by subsequent regulations, without necessity or the demands of public convenience, additional burdens upon the company which are clearly beyond the reasonable exercise of the police power.

RIGHT OF INTERURBAN ELECTRIC RAILWAY COMPANY TO USE OF CITY STREETS—An interurban electric railway company using tracks in a city street for street-car business under a street-railway franchise is held, in Brickles *vs.* Milwaukee Light, Heat and Traction Company (Wis.), 114 N. W. 810, 14 L. R. A. (N. S.) 644, not to take the interest of abutting owners for interurban purposes until it transforms the tracks, roadbed and appliances to interurban uses; neither the passage of a statute authorizing condemnation, nor the continued wrongful use for interurban purposes of the street railway tracks thereafter, being considered an expropriation of their rights.

PRELIMINARY INJUNCTION GRANTED ON ALLEGED TRANSFORMER INFRINGEMENT—Judge Ray, of the United States Circuit Court for the Northern District of New York, has granted a preliminary injunction against the Middleburg & Schoharie Light, Heat and Power Company, in the suit of the Westinghouse Electric and Manufacturing Company against the Middleburg company for infringement of the Stanley patent, No. 469,809. The Middleburg company uses the transformer manufactured by the Pittsburg Transformer Company. The operation of the injunction is suspended until November 15 to permit the Middleburg company to either remove the infringing transformers or to appeal.

PERSONAL MENTION.

MR. A. A. ARLINE, of Dallas, Tex., has been appointed manager of the Orange, Tex., office of the Southwestern Telegraph and Telephone Company.

MR. H. A. EVERETT has resigned as president and director of the Toledo Railways and Light Company. Barton Smith takes his place as director, but the office of president remains unfilled.

MR. J. J. BROOMFIELD, manager of the contract department of the Interstate Telephone Company, has resigned and will be succeeded by F. B. Shalters, who has assumed charge of the Trenton, N. J., office.

MR. CLAUD HAUGH, for ten years inspector of the Waynesboro, Pa., exchange of the Bell Telephone Company of Pennsylvania, has resigned and will devote his attention to the electrical contracting business which he recently established.

MR. W. V. N. POWELSON, it is announced, has resigned as president of the Union Electric Light and Power Company, of St. Louis, Mo., and will be succeeded by Arthur Williams, of New York. Mr. Powelson will engage in engineering, establishing a company in New York to be known as Cooper & Powelson.

DR. WILLIAM M. HABIRSHAW, president of the Habirshaw Wire Company, of Yonkers, N. Y., a widely known man in the electrical field, and one of the most skilful analytical chemists in the country, is very ill at Saratoga, N. Y., his summer residence. Dr. Habirshaw has been an invalid for several years and recently suffered a relapse, from which it is hardly expected he can recover.

MR. D. S. DRAKE, local manager for the Bell Telephone Company at Huntingdon, Lewistown and Saxton, Pa., has resigned to accept a position with the Raystown Water Power Company. Mr. Drake had been with the telephone company for many years and established the Lewistown exchange in 1883. H. E. Provost, of Scranton, succeeds Mr. Drake. The position has been changed, however, to that of contract agent for the three exchanges named.

DR. NEVIL MONROE HOPKINS, assistant professor of electrical engineering at George Washington University, and chief electrical engineer for the United States Navy Department in the consolidation of navy yard power plants, is the author of an entrancing story entitled "The Investigation at Holman Square," which is one of the leading features of the September issue of *Lippincott's Magazine*. Dr. Hopkins is the author of several other detective stories.

NEW MANUFACTURING COMPANIES.

PORTLAND, ORE.—The Columbia Electrical Engineering Company has been incorporated with a capital of $5,000. The incorporators are J. E. Kilkenny, George L. Epps and J. F. Kendricks.

CAMDEN, N. J.—The General Waves Power Company has been incorporated with a capital of $200,000 to act as mechanical and electrical engineer. The incorporators are E. E. McWhiney, G. E. Holmes and F. A. Kuntz, of Camden.

BOSTON, MASS.—The United States Apparatus and Instrument Company, of Fall River, has been incorporated with a capital of $10,000, to deal in electrical and medical apparatus. The directors are: Louis Foster, Boston, president and treasurer; William J. Jones and M. Doherty.

SALT LAKE CITY, UTAH—Articles of incorporation of the Ogden Electric Supply Company have been filed with the county clerk. The concern has a capital stock of $10,000 divided into $1 shares and is incorporated for a period of fifty years. The officers are: President, Charles A. Halverson; vice-president, George Halverson; secretary-treasurer, Lawrence Herdti. These, with O. W. Halverson and Arthur Halverson, compose the board of directors.

GREAT FALLS, MONT.—Articles of incorporation for the Evans Engineering Company have been filed in the office of the county clerk and recorder by the incorporators, Thomas Evans, John Olds, Alfred F. Evans and Fred W. Sewell, all of Great Falls. The company will engage in the manufacture, installing and selling of engines, electrical apparatus and machinery. The capital stock of the concern is set at $35,000, divided into shares of a par value of $10 each. The largest portion of the stock is in the hands of Thomas Evans, who holds 238 shares, the other members holding 114 shares each. Five thousand eight hundred dollars has been subscribed.

ELECTRICAL SECURITIES.

There is very little to say concerning stock market developments, except to reiterate the statements which have been made for the past three or four weeks. In the face of rather slow general improvement in business, prices continue to rise, until it is feared that the present values have over-discounted a considerable gain in the near future. The factors making for the present rise appear to be the great ease with which time loans can be obtained, the indications of a bounteous harvest of every nature of agricultural product, the splendid condition of the freight railroads for handling large quantities of freight at a minimum expense, and the forecast of a continuation of the present form of government for at least the next four years.

ELECTRICAL SECURITIES FOR THE WEEK ENDED AUGUST 8.

New York:	*Closing.*
Allis-Chalmers common	11⅜
Allis-Chalmers preferred	34¾
Brooklyn Rapid Transit	55⅝
Consolidated Gas	139
General Electric	146
Interborough-Metropolitan common	12¼
Interborough-Metropolitan preferred	35⅛
Kings County Electric	122
Mackay Companies (Postal Telegraph and Cables) common	66½
Mackay Companies (Postal Telegraph and Cables) preferred	66½
Manhattan Elevated	138
Metropolitan Street Railway	31
New York & New Jersey Telephone	110
Western Union	57
Westinghouse Manufacturing Company	76

The directors of the Kings County Electric Light and Power Company have declared the regular quarterly dividend of 2 per cent, payable September 1. The books close August 21 and open September 1.

Boston:	*Closing.*
American Telephone and Telegraph	122
Edison Electric Illuminating	—
Massachusetts Electric	47
New England Telephone	112½
Western Telephone and Telegraph preferred	68
Philadelphia:	*Closing.*
Electric Company of America	10
Electric Storage Battery common	39
Electric Storage Battery preferred	39
Philadelphia Electric	9⅞
Philadelphia Rapid Transit	14⅜
United Gas Improvement	88¼
Chicago:	*Closing.*
Chicago Telephone	—
Commonwealth Edison	—
Metropolitan Elevated preferred	45
National Carbon common	68
National Carbon preferred	108

The Oak Park Elevated's daily average of passengers carried, including transfers, for July, was 40,467, a decrease of 3,241. The daily average of passengers carried for July by the Metropolitan Elevated was 131,152, a decrease of 4,627, and by the South Side Elevated 114,362, an increase of 2,429.

DATES AHEAD.

Michigan Electric Association. Annual meeting, Grand Rapids, Mich., August 18-21.

International Association of Municipal Electricians. Annual convention, Detroit, Mich., August 19-21.

Ohio Electric Light Association. Annual convention, Put-in-Bay, Ohio, August 25-27.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Arkansas Association of Public Utilities Operators. First annual convention, Little Rock, Ark., September 17-18.

Old Time Telegraphers' and Historical Association, and Reunion of Military Telegraphers, Niagara Falls, N. Y., September 16-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 6-7.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

TELEPHONE AND TELEGRAPH.

PLACERVILLE, CAL.—It is announced that an extension of the Pacific Telephone and Telegraph Company's line from this city to Lake Tahoe will be undertaken at an early date.

NORWOOD, MASS.—The New England Telephone and Telegraph Company has changed its system from the magneto to the common battery type, and moved into new quarters.

MILES CITY, MONT.—The Rocky Mountain Bell Telephone Company is making preparations for the installation of a telephone system in Miles City, with headquarters in the Miles Building.

ANACONDA, MONT.—Work is progressing rapidly on the Independent Telephone Company's line between Butte and Anaconda, and the company expects to be ready for business in the early fall.

HOUSTON, TEX.—The Southwestern Telegraph and Telephone Company is making a number of improvements to its system in the South End. Later it is intended to establish an exchange in that portion of the city.

ALTURAS, CAL.—The Western Pacific Telephone and Telegraph Company has been incorporated for the purpose of connecting all the towns of Modoc, Lassen and Plumas counties, work to be commenced in the near future.

MILWAUKEE, WIS.—The underground telephone system between Milwaukee and Racine, the first division of the proposed system between this city and Chicago, has been formally opened. The system is now open for general business.

ATLANTA, GA.—The Southern Bell Telephone and Telegraph Company has purchased the Covington Telephone Company, of Covington, Ga., and the two systems will be consolidated as rapidly as the physical work can be accomplished.

MEREDITH, N. H.—At the annual meeting of the Meredith Telephone Company the following officers were elected: President, B. Blaisdell; vice-president, F. W. Storey; clerk, P. A. Ellsworth; treasurer, E. S. Wilard; manager, P. A. Ellsworth; auditors, E. W. Longley; directors, B. Blaisdell, J. F. Beede, B. R. Dearborn, Edmund Page. A dividend of $1.50 per share was declared, payable August 15.

COLUMBUS, OHIO—The Farmers' Independent Telephone Company of Canal Winchester has been incorporated with a capital stock of $25,000. The line is to connect Canal Winchester, Columbus and Lancaster at present, and will extend through the counties of Fairfield, Pickaway and Franklin. The incorporators are McC. Martens, Thomas J. Barr, Thurman T. Courtright, W. F. O'Gara and R. C. M. Hastings.

WATERVILLE, ME.—The Kennebec Farm and City Telephone Company has completed its line from Norridgewock to Oakland village by way of the Ten Lots. All the towns up the Somerset Railway may be reached as far as The Forks, including Norridgewock, Madison, North Anson, Solon, Bingham, Caratunk, Athens, Starks, Mercer, Canaan and Skowhegan. The whole system includes about 800 telephones.

PAVILION, N. Y.—The Pavilion Telephone Company, which was incorporated under the laws of the state, in Albany, a few weeks ago, with a capital of $10,000, is actively at work. It already has available for use about fifteen miles of poles and wires, the property of the Inter-Ocean Telephone Company. The directors are D. C. Higgins, S. O. Hubbard, M. A. Christman, David Morrow, Earl Starr, Horace Bradley and Dean Hudson. The officers are: President, Horace Bradley; vice-president, Earl Starr; secretary and treasurer, D. C. Higgins. There are about 200 subscribers. The company expects to have its lines ready for service in thirty days.

PORTLAND, ORE.—Extensions and betterment of the service are the purposes behind the plan of reorganization that has been adopted by the directors of the Pacific Telephone and Telegraph Company. This includes the redistricting of the company's telephone system into three districts. The southern division will extend from the Mexican line to San Luis Obispo, the central division from San Luis Obispo to the Oregon line, while the third, or northern district, will embrace the states of Oregon, Washington and Idaho. Under the plan of reorganization each of the three districts will have practically a system of its own, with its own respective corps of officers. W. J. Phillips, who for years has been superintendent of the home or central division, with headquarters at San Francisco, has been transferred and will be the superintendent of the northern division.

LUDINGTON, MICH.—The United Telephone Company of Michigan has been organized here with $200,000 capital and with several local capitalists interested. It will take over the property of the Lake Shore Telephone Company now operating in Mason and Oceana counties. The general offices of the latter company will be moved from Hart to Ludington and become the office of the new company. Thomas Bromley, Jr., of Hart, will be the general manager of the company. The officers are as follows: President, W. A. Cartier, Ludington; vice-president, Gardner Sands, Pentwater; secretary and treasurer, Thomas Bromley, Jr.; attorney, A. E. Keiser. C. H. Hood, of Detroit, who has been interested in the organization of the new company, says that $78,000 will be spent in reconstructing the present county service, bringing it up to date, and that a model telephone building will be erected in Ludington.

NEW PUBLICATIONS.

NEW YORK STATE PUBLIC SERVICE COMMISSION, SECOND DISTRICT—The Public Service Commission of the State of New York, Second District, has published circular No. 38, effective August 1, 1908, giving the regulations prescribing the form and governing the construction and filing of freight tariffs and classifications and passenger fare schedules of railroad corporations, and general regulations and rulings. The commission has also published its opinion in the matter of the application of the Elmira, Corning & Waverly Railway, submitted July 9 and decided July 23.

"ON THE CANAL ZONE"—Thomas G. Grier, of Chicago, Ill., well known in the electrical field, is the author of a very interesting descriptive work entitled "On the Canal Zone." During a trip which Mr. Grier recently made to the Isthmus of Panama he took copious notes and a great many photographs. The present volume is the result of this trip. The work is interesting, as it gives a first-hand impression of this remarkable enterprise. While it is not electrical in any way, Mr. Grier has incorporated a minute description of whatever use has been found on the isthmus for electricity either for illumination or power. The book is from the press of the Wagner & Hanson Company, Chicago, Ill., and is dedicated to the memory of Mr. Grier's father, John Alexander Grier, formerly chief engineer in the United States Navy, who spent several years cruising in southern waters.

INDUSTRIAL ITEMS.

THE SACHS COMPANY, Hartford, Ct., will be pleased to send to any one interested upon request its bulletin devoted to electrical protective devices for any voltage.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., in bulletin No. 57 devotes considerable space to a description and price list of the Paiste ground clamp and a blackboard talk on Paiste molding crossovers.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, Chicago, Ill., has been appointed agent for the Crescent Insulated Wire and Cable Company, of Trenton, N. J. The Metropolitan company will carry a large stock of this well-known company's product, enabling it to fill orders from Chicago promptly.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., in the August issue of "Trumbull Cheer," describes the Trumbull "Kappa" switch with high fingers. There is also an illustration of a very interesting special switchboard mounted in an iron box. The Trumbull switchboards are made to any specification.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a revised price list on "Raven Core" rubber-covered wires and cables. This price list, which includes all classes of wire and lamp cord, will be mailed upon request. The company will also be pleased to furnish revised price lists on Columbia incandescent lamps of the Gem, Gem Prismo, tungsten and tantalum types.

THE TUNGSTOLIER COMPANY, 519-521 Citizens Building, Cleveland, Ohio, is preparing some very interesting literature devoted to Tungstolier lighting fixtures. This line comprises an absolutely new design of lighting fixtures, especially developed for use with tungsten lamps. The range of styles is wide enough to afford a selection which will fit in with any requirements. Full information may be secured from the company upon request.

THE CUTTER COMPANY, Philadelphia, Pa., is announcing a competition for twenty-five essays on the use of circuit-breakers. Prizes to the amount of $1,200 will be distributed to the writers of the best essays, and the competition is open to every user of electricity who is acquainted with the I-T-E circuit-breaker and its wide field of usefulness. The conditions of this competition will be mailed on receipt of request addressed "Essay Competition," The Cutter Company, Philadelphia, Pa.

THE NERNST LAMP COMPANY, Pittsburg, Pa., announces that H. H. Sturtevant, of Zanesville, Ohio, proprietor of the largest department store in southeastern Ohio, has placed an order with the Ohio Electric Railway Company for a complete installation of Westinghouse-Nernst lamps, to replace electric arc lamps. This was at once the first order for the new Westinghouse-Nernst units to be placed in the Cincinnati territory of the Nernst Lamp Company, and the first fruits of the new business-getting campaign of the Ohio Electric Railway Company.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, has ready for distribution literature describing the "Point-Tite" roof cement for tinners' and slaters' use, and the "J-M" roof coating, which is made primarily of pure asphalt dissolved in pure linseed oil. This coating is suitable for all kinds of roofing work, metal work, and wherever protection from the elements is required. One gallon will cover 100 square feet. Another leaflet which the company is distributing is devoted to the advantages of a "Built-Up" roof covering. This describes the asbestos roofing, which is built up of sheets of pure asbestos fibre. These sheets or layers are individually waterproofed and cemented together with the company's asphalt compound.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has issued a bulletin describing its railway despatching systems and a bulletin describing the new Kellogg railway pole telephone, with supplements giving a description of Kellogg railway systems in successful operation. Some of the advantages of the Kellogg train-despatching system are the safety, care and rapidity of train handling, the selective signaling of any or all stations, and the elimination of the service of telegraphers. Another bulletin just issued by this company is devoted to its standard line of common battery telephones. In addition to the handsome illustrations and complete text, there is a special description of the new Kellogg "short back-board" wall instruments, the "steel hotel set," and the new indestructible desk stand.

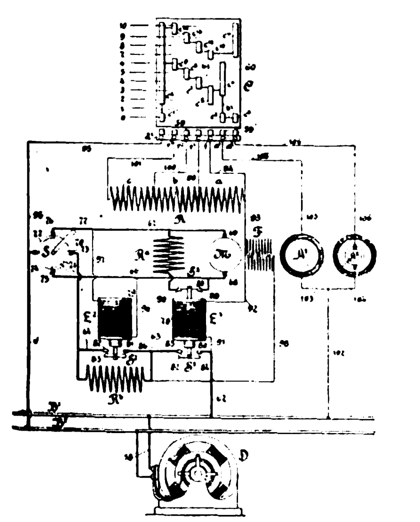
THE BLAKE SIGNAL AND MANUFACTURING COMPANY, 246 Summer street, Boston, Mass., is to be felicitated over the very complimentary paragraph which appeared in the issue of the *Evening Capital*, of Annapolis, Md., of August 1. Under the caption, "Official Route of Red Men—Washington, Baltimore & Annapolis Selected to Transport Next Tuesday's Crowd," the following statement appears: "In selecting the route the officials were impressed with the high degree of safety to which the single-track section between Naval Academy Junction and Annapolis has recently been brought by the installation of the Blake signal system. . . . A demonstration of the working of the Blake system on the single track convinced them that the Annapolis branch was equally as well protected against accident as the double-track portion of the road."

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is distributing bulletins Nos. 3,128, 3,129, 3,130, 3,131, 3,132 and 3,906. These bulletins are devoted, respectively, to single-phase induction motors, frame 24 FA, one-twentieth horse-power, full load, automatic start; single-phase induction motors, frame 28 LA, one-sixth horse-power, full load, automatic start; single-phase induction motors, frame 32 FA, one-eighth and one-sixth horse-power, condensed type, full load, automatic start; single-phase induction motors, frame 28 JA, one-fifteenth horse-power, full-load start type, for intermittent service; single-phase induction motors, frame 28 JB, one-fifteenth horse-power, full-load start type, for intermittent service; family sewing-machine motors for Singer No. 66 drop-head machines, for alternating and direct currents. In the issue of the ELECTRICAL REVIEW for July 25 the ratings of these machines were incorrectly given.

Record of Electrical Patents.

Week of August 4.

894,818. ELECTRODE FOR THE EVOLUTION OF OZONE FROM OXYGEN OR ATMOSPHERIC AIR. John R. Craig, Jr., Glasgow, Scotland. A dielectric plate is placed edgewise between two discharging electrodes.



894,878.—VARIABLE-SPEED TRANSMISSION.

894,820. TELEGRAPHY. Patrick B. Delaney, South Orange, N. J. A transmitter having an elastic vibrator which is released when the sending key is closed.

894,826. MULTIPLE CLUSTER SOCKET. Charles D. Gervin, New York, N. Y., assignor to John H. Dale, New York, N. Y. An insulating block containing a plurality of socket shells.

894,836. RECEIVING TELEGRAPHIC AND TELEPHONIC IMPULSES SIMULTANEOUSLY. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. A telegraph receiver is shunted by a telephone receiver circuit containing condensers and a repeating coil.

894,866. DRY BATTERY. George M. Wheeler and Henry Wilhelm, Brooklyn, N. Y. The containing shell is made up of a plurality of tubularly folded sheets, one of which is of zinc.

894,878. VARIABLE-SPEED TRANSMISSION. Henry H. Cutler, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company. The change in speed is controlled by means of magnetic clutches.

894,886. AUTOMATIC CUTOUT FOR INDICATING MEANS. Albert B. Herrick, Ridgewood, N. J. A plurality of registering fingers which are brought successively into action by the handle of the instrument.

894,910. AUTOMATIC MAGNETIC CIRCUIT-BREAKER. William M. Scott, Philadelphia, Pa. An adjustable retarded circuit-breaker mechanism.

894,931. TROLLEY CAR FOR ELECTRIC MOTOR VEHICLES. Riccardo Arno and Luigi Negro, Turin, Italy. A current-collecting trolley carriage, the driving motor of which is disconnected when the main vehicle stops.

894,944. INDUCTION-CURRENT GENERATOR. Martin Fischer, Zurich, Switzerland, assignor to the firm of Actiengesellschaft "Magneta" (Electrische Uhren Ohne Batterie & Ohne Contacte), Zurich, Switzerland. Current impulses are generated by an oscillated armature.

894,945. MAGNETIC INDUCTOR. Martin Fischer, Zurich, Switzerland. Current impulses are generated by a revolving armature.

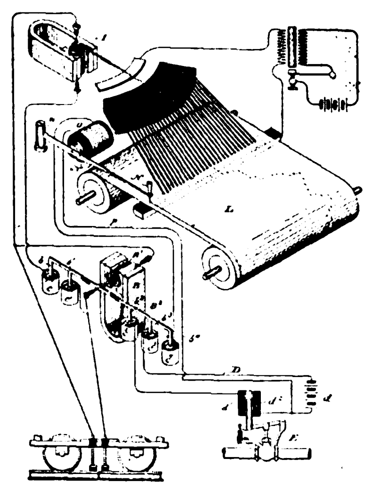
894,950. DYNAMOELECTRIC MACHINE. William T. Hensley, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The commutator lead is perforated and slips over a lug on the commutator segment.

894,951. COMMUTATOR. William T. Hensley, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The commutator segment is perforated and slips over a lug on the lead.

894,952. RAIL BOND. Albert B. Herrick, Cleveland, Ohio, assignor to the Electric Railway Improvement Company, Cleveland, Ohio. A rail bond built up of conducting plates cemented together.

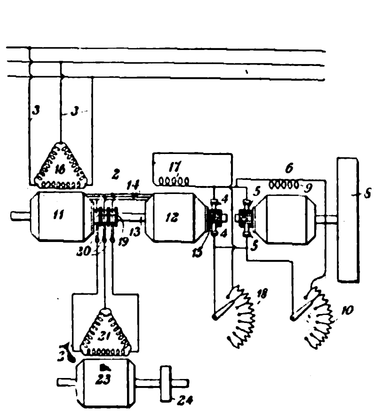
894,964. ELECTRIC RAILWAY. Joseph Mayer, Rutherford, N. J. A hinged pole supported on a double pantograph.

894,979. LOAD EQUALIZER FOR ELECTRIC CIRCUITS. John S. Peck, Manchester, England, assignor to T. H. Given, H. S. A. Stewart and E. M. Herr, Pittsburg, Pa., receivers of Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa. A combination of a rotary converter having two mechanically and electrically connected rotors and independent stator windings.



894,886.—AUTOMATIC CUTOUT FOR INDICATING MEANS.

895,006. MECHANISM FOR RECOVERING, TRANSFORMING AND CONSERVING ENERGY. Léon Dion, Wilkes-Barre, Pa., assignor to the Americus Electrohermetic Company, Wilkes-Barre, Pa. The waste water of the house is utilized for driving a small battery-charging set.



894,979.—LOAD EQUALIZER FOR ELECTRIC CIRCUITS.

895,012. MOTOR-CONTROLLING DEVICE. Fletcher D. Hallock, Wilkinsburg, Pa., assignor to T. H. Given, H. S. A. Stewart and E. M. Herr, Pittsburg, Pa., receivers of Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa. A motor-starting rheostat with regulating field resistance.

895,034. ATTACHMENT FOR PHOTOGRAPHIC PRINTING APPARATUS. Hervey H. McIntire, South Bend, Ind. A number of elements each mounted on an independent universal support.

895,035. ELECTRIC RAILROAD SIGNAL. Arthur W. McMaugh and Robert Welch, St. Catharine's, Ontario, Canada. A sectional centre-rail system.

895,070. TROLLEY POLE MOUNT. Edwin H. Burnes, Amsterdam, N. Y., assignor of one-third to Phœbus H. Alexander, Amsterdam, N. Y. A rotating trolley base.

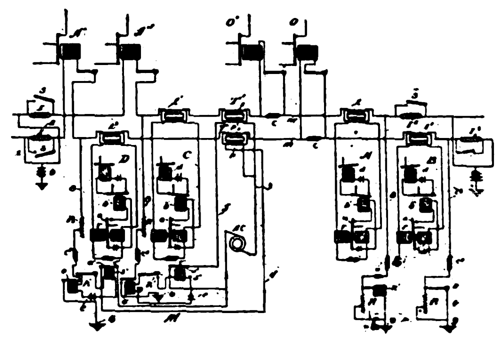
895,100. ALTERNATING-CURRENT METER. Emanuel Morck, Charlottenburg, Germany. An induction meter having two magnetic branch circuits.

895,135. CONTROLLING SYSTEM FOR LIFTING MAGNETS. Reuben I. Wright, Cleveland, Ohio, assignor to the Electric Controller and Supply Company, Cleveland, Ohio. The lifting-magnet winding is in shunt with the motor circuit, means being provided for automatically inserting resistance.

895,144. APPLICATION OF ELECTROLYSIS TO SCOURING AND SQUEEZING MACHINES. Jean M. J. Baudot, Roubaix, France. The fabric is passed between electrodes which liberate an alkaline product.

895,159. METHOD OF PRODUCING AMALGAMS OR ALLOYS. Courtland F. Carrier, Jr., Elmira, N. Y. An electric current passes from a common electrolyte to a plurality of independent bodies of fluid metal.

895,166. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company. A supervisory signal is associated with each end of the cord circuit.



895,350.—MULTIPLEX TELEGRAPH SYSTEM.

895,199. APPARATUS FOR RELEASING HORSES. Charles C. Rich, Mount Vernon, N. Y., assignor of one-half to Harry J. Douglas, Mount Vernon, N. Y. A gravity-operated electrically controlled release gear.

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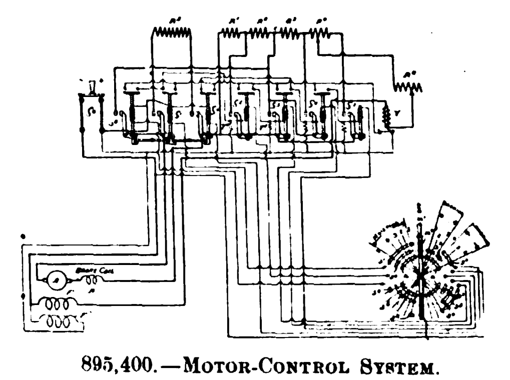
895,251. TROLLEY CATCHER. George Gessert, Edwardsville, Ill. Rotatable wire guards project above the trolley wheel.

895,314. AUTOMATIC COLLAPSING AND RE-ERECTING TROLLEY POLE. George S. Thomson, Dunedin, New Zealand. A pivoted trolley pole supported by an arm which falls when the wheel leaves the wire.



895,400.—MOTOR-CONTROL SYSTEM.

895,321. TROLLEY GUARD. Charles H. Yarrington, Waterbury, Ct. Wire guards attached to the trolley wheel.

895,339. TROLLEY. Leon W. Campbell, Woonsocket, R. I. A ball-bearing wheel.

895,350. MULTIPLEX TELEGRAPH SYSTEM. Amor W. Douglas, Albuquerque, N. Mex. An alternating-current telegraph system.

895,374. MEANS FOR PERFORATING SLIPS FOR TELEGRAPHIC SIGNALING AND OTHER PURPOSES. Maximilian Kotyra, Paris, France. The punches are operated by electromagnets.

895,378. REVERSIBLE AND COLLAPSIBLE TROLLEY POLE FOR ELECTRIC VEHICLES. John Lindsay and Robert Lindsay, Dunedin, New Zealand. A trolley pole is hinged at its centre.

895,400. MOTOR-CONTROL SYSTEM. Charles D. Gilpin, Cleveland, Ohio, assignor to the Electric Controller and Supply Company, Cleveland, Ohio. An automatic motor-accelerating switch.

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CONTENTS

MATHEMATICS FOR ENGINEERS.

In an abstract given elsewhere in this issue are a number of sensible remarks on the teaching of mathematics for engineers which have been taken from a longer discussion of the subject by Mr. Charles F. Scott. The problem is not simple; indeed, it is almost as complicated as that of laying out an entirely satisfactory course in any branch of engineering. One is always confronted with the question of how much time should be given to theory and how much devoted to application. We have on the one hand those who contend that the practical side of the subjects only should be taught, and on the other those who believe that each subject should be taught for itself alone. Mr. Scott holds rather to the first opinion in regard to mathematics, but he admits that the engineering student should be able to understand certain higher branches of mathematics, even though he can not, or does not, actually use them in his work.

While we agree on the whole with Mr. Scott's views, in certain respects we differ from him. In the first place, Mr. Scott says mathematics is a tool from the standpoint of the engineer; its value depends on the skill with which he can use it, and he is not concerned with the process by which the results are obtained. This is rather misleading, as there can hardly be a satisfactory use of any tool if the user does not comprehend the principles upon which it works. There is no absolute necessity for the engineer to be able to construct his tool. He may leave that to a specialist. But he must know how and why his tool does work. It is because so many college graduates do not understand the higher mathematics in this way that they do not make more use of them. The fault, no doubt, is at times due to the methods of instruction, but it must be admitted that not all engineering students are capable of becoming experts in the use of the calculus, for example, in the short time allotted to this subject in the engineering course.

It is fortunately true, as Mr. Scott points out, that at this time by far the greater number of engineers can get along satisfactorily with arithmetic, and occasionally a little elementary algebra, but they would be better equipped if they could use the higher branches with ease and certainty. We may work up to this stage in time; we were not all of us made fair arithmeticians in a generation. But it is the duty of the college to advance the professions as rapidly as possible, hence the instructors who are content to teach nothing more than they themselves were taught are not doing their whole duty. The higher branches not only are useful tools for the engineers who are skilled in them, but it becomes essential for the engineer to be able to follow their methods understandingly if he is to put to use recent developments in scientific knowledge. A notable instance of this is the development of wireless communication. The "wireless" engineer should, to-day, not only understand but be able to apply mathematical processes which are seldom taught in an engineering course.

But while asserting the necessity for advanced mathematical instruction we must not be understood as advocating the use of the higher branches in teaching science. There is danger, when such methods are employed, of laying too much stress upon the method and neglecting the thing. This is too often the case in teaching physics: the students are not given a physical conception of the principle or law—hence it means nothing to them and is of little use.

Mr. Scott says what is required of engineers is common sense, but common sense is nothing more than logical reasoning from fully understood principles; and it is no less common sense if the reasoner follow a line of thought less frequently used by others but familiar to himself. There can be as much common sense in the use of the calculus as in simple addition. But to-day this is the exception rather than the rule, because by far the greater number are more skilled in addition. And we need common sense in the teaching of science, not an obscuring of facts under a mathematical scaffold.

The trouble in teaching mathematics, as in nearly all other subjects, is the necessity of laying out a line of instruction suitable for the average student, but which will also point the way for the brilliant man to go further. The best plan, in all cases, seems to be to lay a thorough foundation of scientific principles and elementary mathematics. Upon this as high a structure of applications and advanced sciences as the time allows may be erected. The proportioning of this structure will depend upon the opinions of the instructors, but the foundation should never be weakened in the slightest, since it must bear not only the beginning of the structures which are made at the college, but the entire building which the man himself must complete. It should never be necessary for him to go back and strengthen or alter his foundations.

ELECTRICAL TRANSMISSION FOR MARINE PROPULSION.

In the issue of the ELECTRICAL REVIEW for April 4, 1908, we discussed an electrical method of propelling ships which had been proposed by Mr. Henry A. Mavor, and had been discussed before by the Institution of Engineers and Shipbuilders, of Scotland. In this system the propellers of the vessel are to be driven by induction motors, and variations in speed are to be secured by mounting the stator so that it can revolve, thus reducing the actual speed of the motor without changing the relative speeds of rotor, stator and motor. This method, while not efficient for continuous running, introduces fairly good starting conditions, and is allowable for short maneuvers, such as docking and getting under way. Under normal running conditions the stator is fixed, and the speed can then be varied only by varying that of the prime mover, unless conditions warrant the losses which will be caused by allowing the stator to revolve, absorbing the energy thus developed in friction.

Now another method of ship propulsion by means of the electric motor has been proposed and discussed by a second British society, the Institution of Marine Engineers. In this case Mr. William Durtnall, after describing the various other methods of ship propulsion by means of the electric motor, dwells at some length upon the system which he thinks offers the greatest prospect of success. In brief, he uses squirrel-cage induction motors, direct-connected to the propeller shafts, and obtains his variations in speed by means of the stator windings, which are arranged so as to develop magnetic fields having three or more different arrangements of poles. In this way a corresponding numbers of speeds is obtained, and the system will operate at all of them efficiently, though it is probable that at the lower speeds conditions may not be quite as favorable as at the higher. It would seem likely also that the motors thus constructed would be larger and heavier than those designed for the highest speed only; so that unless conditions are such as to make it essential to be able to run at two or more speeds, a less inefficient, but lighter, system might, on the whole, be better.

However this might be, it is rather interesting to note the good case which Mr. Durtnall makes out for his system as compared with the direct steam-turbine drive. As has been pointed out before, the advocates of such systems of propulsion hope to gain by driving both the steam turbines and the propellers at those speeds which give the best results. Unfortunately for the marine engineer, a large slow-speed propeller is the most efficient, while a high-speed steam turbine is the most economical of steam. Thus, in modern practice it has been necessary to sacrifice at both ends; and although turbine-driven steamers have certainly shown creditable performances, they do not do as well as they would do were it not for these limitations. This condition offers the electrical engineer an opportunity to install a system of transmission which is efficient and which will permit both the turbine and the propeller to run at their best speeds. By so doing a large saving in steam consumption is expected. For instance, Mr. Durtnall thinks that a steamer driven by four propellers, each requiring 1,000 horse-power, would require generating equipment with an output of about 3,250 kilowatts. The propellers would run at 250 revolutions per minute, and the turbines at 1,500. With steam at 150 pounds pressure, and 150 degrees Fahrenheit, it is estimated that the consumption of steam per kilowatt-hour would be thirteen pounds per shaft horse-power-hour. If the turbines were direct-connected to the propeller shafts, the steam consumption would be about twenty-two pounds per shaft horse-power-hour. Thus, in the first case, the total hourly consumption of steam would be 52,400 pounds, and in the second 88,000 pounds, a saving effected by the electric drive of forty-one per cent, and consequently an equal saving in requisite boiler capacity. At lower speeds savings nearly as good would be made by the electric equipment.

Such saving in steam, and therefore in coal, is important, but would not be allowable at too great sacrifice in weight. To determine this it is estimated that the electric equipment, including motors, generators and steam turbines, would weigh about 184 tons, while the direct-connected steam turbine would weigh only 148 tons, a difference in favor of the latter of thirty-six tons. But this is more than offset by the saving in boiler capacity, which, according to the steam consumption given above, would be 180 tons, the steam turbine requiring 440 tons of boilers, while the electric equipment requires only 260 tons. The net saving in weight will therefore be 144 tons. This, taken together with the saving in coal, which, from the foregoing, figures out at 1.6 tons an hour, or 230 tons for a six days' sail, shows the marked superiority of the electrical drive.

These conclusions should not, of course, be accepted without question. Other marine engineers might figure out considerably less advantage in the electrical drive, if indeed they did not throw it entirely the other way. Mr. Durtnall's conclusions are nevertheless interesting and worthy of careful consideration by marine engineers. While he has discussed only the steam turbine, it is not unlikely that an equally good case could be made out for an internal-combustion engine, as the electrical transmission would eliminate the handicap of this type of prime mover.

POSITIVE ELECTRICITY.

If we accept the views of the new school of electro-physicists we are fairly familiar with the character and importance of the electron, or, as some would have us believe, the negative particle of electricity. According to J. J. Thomson and others, the smallest charge of electricity which has been isolated is negative in sign, and is always associated with what appear to be particles of matter having a mass of about one-thousandth of that of the hydrogen atom. Since this mass can not be dissociated from the charge, or the charge from the mass, it has been asserted that the two things go together; in fact, what appears to be matter may be merely an effect due to the electric charge itself.

According to this theory, a positive charge or corpuscle, as Thomson calls these minute material particles, is necessary; but the positive charge has never been liberated—that is to say, it is apparently always associated with particles of matter comparable in mass with the hydrogen atom, and therefore one thousand times as large as the electron or negative corpuscle. Recent experiments by Thomson indicate the possibility of the existence of positive corpuscles, but these were still associated with large masses. A peculiarity of these positive charges was their appearance at points where they were not expected. When searching for the negative charge, one naturally looks between the two electrodes and expects to find this charge on its way from the cathode to the anode. By analogy one would therefore look for the positive charge in the same place and expect to find it moving in the opposite direction; but it has never been detected there. If it was the positive charge which Dr. Thomson noticed in certain of his experiments, this particle behaves in an erratic way, for it was found to be traveling in what seemed to be the wrong direction and in the wrong place. The particles which he noticed were traveling away from the cathode in the space beyond the anode. It was suggested that it was because of this unexpected behavior that the positive particle had not been detected before.

M. Jean Becquerel makes the most recent claim of having captured, or at least separated, the positive electron. M. Becquerel is following in the footsteps of his illustrious father, who first called attention to the then obscure phenomenon now known as radioactivity. The son has held certain ideas about the electrical theory, and devised experiments to test their accuracy. He has particularly desired to isolate the positive electron, and in a recent issue of *Comptes Rendus* asserts that he has done so.

The experiment upon which this claim is based consists in passing an electrical discharge through an exhausted tube contracted along its central portion. The anode is in one of the larger sections at one end, and the cathode is in the other, placed close to the contracted neck. The cathode plate is itself perforated to allow the canal rays from the anode to pass through it and penetrate into the other enlarged portion of the tube. These canal rays, it will be remembered, are rays which are neutral and hence are not deviated by a magnetic field. When they pass into the second portion of the tube and the surface of the latter is earthed by any means at all, this spot becomes a secondary cathode, and a phosphorescent patch appears there. This patch has an orange color, but if the hand be approached to it, the secondary cathode rays which give rise to it are driven over to the opposite wall of the tube, while a whitish patch is formed in front of the hand; and by bringing up a magnet to this patch it is found to be deflected with ease. A more elaborate tube, in which a secondary cathode was introduced in a side extension, gave the same results, but more markedly.

The conditions under which this experiment was conducted seem to be rather complicated, as there is a mixture of X-rays, cathode rays, canal rays and apparently a general mixture of every kind of electric discharge procurable within an exhausted tube.

This condition, however, seems to be necessary since, according to the author, the cathode ray is necessary to drive the positive particle out of the neutral canal ray. It is to be hoped that he will give us shortly further results of his investigation. He may perhaps devise some simpler way of ejecting the positive corpuscle from its kennel, and of studying its peculiarities of character. Certainly, if we admit the existence of the negative electron, it is hard to deny the existence of a corresponding positive charge; and our inability to dissociate this from large masses of matter is simply because we have not yet found out how. If M. Becquerel has been successful, he will have advanced our knowledge another important stage. Confirmation of his work by other investigators under other conditions is greatly to be desired.

THE TEST-METER METHOD OF TESTING SERVICE METERS II.

BY JOSEPH B. BAKER.

TESTING BY READINGS ON CONSUMER'S METER.

Of the special features of this form of test meter, next in importance to the composite field-winding—whereby the accuracy of the test meter is increased on light loads by increasing its torque, as above described—is the time-saving device for making the actual test observations by what the inventor terms the "sight method." The object of the composite field construction is to attain accuracy in testing equal to the inherent accuracy of the indicating-instrument method; and the object of the following described "sight method" of using the test meter is to attain a speed of making tests superior to the speed which it is practicable to attain by the indicating-instrument method under the largely adverse conditions of testing on consumers' premises. The method has also the advantage of doing away with the use of stop-watches.

It will facilitate the explanation of the above-mentioned device to assume that the test meter is connected for equal torque with the consumer's meter, *i. e.*, that at the given load the test meter means the same number of revolutions in a given time as the consumer's meter would make if accurate. The device referred to operates by virtually—not, of course, actually or mechanically—superposing the test-meter disc on the disc of the consumer's meter in such a way as to enable the tester to observe the actual angular amount by which the latter's disc lags behind, or advances ahead of, the test-meter disc. The device consists of a circular paper scale with its circumference divided into ten equal scale divisions, each of which is again divided into ten divisions, making 100 scale divisions in all, mounted on a circular brass plate which is slotted from circumference to centre so that it may be supported in a horizontal position on the frame of the consumer's meter,[1] the shaft of which passes through the centre of the circular scale—of course, without touching. A light pointer is fixed on the shaft so as to sweep over the scale. With both consumer's meter and test meter connected to the test load, it is obvious that if the former meter were as accurate as the latter its disc would neither lag behind nor advance ahead of the latter's disc; so if the pointer were observed at any instant to be passing over a given scale division A, it would at the end of a given number of revolutions still be found to be passing over A. If, however, the consumer's meter were slower than the test meter, at the end of the given number of revolutions the pointer on its shaft would be observed to be passing over some other point, B, back of A; and the number of scale divisions from B to A would indicate the percentage error of the consumer's meter, the corresponding meter efficiency being represented by 100 minus the lag divided by 100.

The general expression for percentage accuracy, in terms of disc revolutions, is the ratio

$$\frac{\text{Actual revolutions of the meter under test}}{\text{Allotted revolutions of same}},$$

the denominator of which would be determined by the disc constant and indicating-instrument readings on the load. Inasmuch as in the application of the method any desired number of revolutions may be "allotted" to the meter under test, counting up to that number by the observer at the test meter, the use of a slide rule may be avoided by selecting an integral number, which will facilitate making the division mentally, *e. g.*:

Allotted revolutions of meter under test = 10 (counted at test meter).

Actual revolutions of meter under test = 10.55.

$$\text{Ratio} = \frac{10.55}{10} = 1.055,$$ showing the meter under test to be 5.5 per cent fast.

In actual practice, in order to cover the use of the test meter with higher torques than the torque of the consumer's meter (as in testing on light load) the number of revolutions of the test or "standard" meter varies according to the torque of the test meter. The following description of the actual conduct of a light-load test by a team of two men, a tester and a helper, will serve to make clear the general method of reading the accuracy of the meter under test directly in percentage of the standard.

The meter is first tested on light load, and should, if accurate, make one complete revolution in exactly the same time in which the standard makes a certain definite number of revolutions, found by reference to a "table of revolutions." The helper is stationed at the standard, and, observing a white mark on the disc, in a short and sharp tone of voice gives the word "on" at the beginning and the word "off" at the end of this allotted number of revolutions of the standard. The tester is stationed at the consumer's meter, and at the words "on" and "off" notes carefully the respective positions of the pointer on the circular scale.

Mr. Mowbray states that a telephone device was added to the test meter in order to make this general method practicable for one man to handle instead of two. This device, which is attached to the form of test meter shown in Fig. 1,[1] consisted of a telephone receiver connected to a special contact on the commutator of the test meter, and giving a click for every revolution of the test meter's armature. The tester noted the clicks while observing visually the revolutions of the consumer's meter and would thus determine whether the latter were "fast" or "slow." It was found, however, that when the difference in rate of the two meters was very great, the method was inferior to the audible count of a helper stationed at the test meter, the two-man method being less confusing, especially when it was modified by the helper's audibly announcing only every third, sixth, etc., revolution of the consumer's meter. The telephone system was used for about a year, but was superseded by the method of starting and stopping the test meter electrically, described herein, which has now been in use over two years and has been adopted as the standard in the Mowbray and other test meters now being manufactured.

The percentage accuracy is at once determined by noting the number of scale divisions passed over by the pointer—*i. e.*, the number between A and B—counting around the scale in the direction of revolution of the pointer. For example, if the pointer were observed, from the word "on" to the word "off," to pass over eighty-five small divisions, the accuracy of the meter would be eighty-five per cent. The result may be expressed in a different way by saying that the number of small divisions which the pointer may need to complete one revolution is the per cent slow, and the number by which it may exceed one revolution is the per cent fast.

From the foregoing it will be noted that these methods of directly reading the error of the consumer's meter not only save the time required, in the indicating-instrument method, to reduce the result by slide-rule or pencil computations—*e. g.*, for direct-current testing, the multiplying together of indicated volts and amperes to obtain watts, the reducing of the revolutions of the consumer's meter to meter watts, and the dividing of the meter watts by instrument watts to obtain the per cent accuracy of the consumer's meter—but also save the time consumed in taking several sets of instrument readings necessitated, under conditions of varying voltage or varying load, or both, by the swinging of the instrument needles. It is obvious also that where the voltage or load varies considerably, the test meter, which actually integrates the load passing through the consumer's meter, provides a more accu-

[1] This method of testing is, of course, only applicable to meters the covers of which may be removed ("unsealed meters").

[1] Page 236, Vol. 53—No. 7.

rate reading of the load with which to compare the consumer's meter than even an impracticably large number of sets of instrument readings.

METHOD OF READINGS ON TEST METER.

An alternative method of testing, applicable to sealed meters, uses a pointer and scale attached to the standard (see Fig. 1), and is described in the article referred to in the footnote, page 236.[1] In this method the tester is stationed at the standard and observes the revolutions of its pointer, and the helper is stationed at the consumer's meter. The present forms of "Mowbray type" direct-current and alternating-current test meters, requiring but one man to perform the tests, are based on this method.

In the application of the method the procedure is the converse of that described for unsealed meters. The revolutions of the meter under test are counted and applied as the numerator of the ratio:

$$\frac{\text{Allotted revolutions of the test meter}}{\text{Actual revolutions of same}} = \text{Percentage accuracy.}$$

As the denominator would in some cases be a fractional number, a slide rule is required to make the computations quickly—only one setting of the slide rule being necessitated, however. The following example—leading to the same result as in the example of the method by readings on consumer's meter—may be given:

Allotted revolutions of test meter = 10 (counted at consumer's meter).

Actual revolutions of test meter = 9.48.

$$\text{Ratio} = \frac{10}{9.48} = 1.055$$

This form of test meter is stated to be inexpensive in first cost—consisting as it does of regular stock meter parts, and of special parts which may be made in the meter department's laboratory or machine shop—as compared with the cost of high-grade indicating instruments—voltmeter and shunt ammeter.

Japan's Electric Wire Trade.

The modern development of the electrical business in Japan has resulted in such a large demand for electric wire that the annual sale of the article amounts to about 8,000,000 yen. Of this 5,000,000 yens' worth is imported from abroad. It is admitted that the imported wire excels the home-made in quality and is generally used in warships, steamers, and also for underground work. The art of electric-wire manufacture has, however, made rapid strides in Japan of late years, and this, coupled with the ample supply of cheap copper, has reduced the cost of production with the result that the wire is offered at a price considerably lower than is charged for the imported article.

[1] Vol. 53—No. 7.

Railway Electrification Plans on the Continent.

Electrification of railways is daily attracting increased attention in a number of countries; the eventual transformation is regarded as a matter which can not be indefinitely postponed, and for which, in any case, it is advisable to prepare by investigating the natural resources and conditions bearing upon the problem and making preparatory trials, so as to pave the way for the introduction of the new order of things whenever it may be found expedient to do so. The subject, says *Engineering*, London, July 17, naturally, is rather more advanced in those countries where sufficient water power is available for the generation of electricity, but it is not confined to such localities.

Sweden is likely to assume a distinct lead as regards electric traction on railways on a comprehensive scale, for the state railways of that country have taken up the subject. Both in Norway and Denmark, also, electric railways are under consideration, and in the latter country several electric lines are likely to be taken in hand in the immediate future. Of much greater interest, however, is the preparatory work proceeding in Austria and Germany, where the respective states appear to be anxious to see the question advanced through rational and exhaustive investigations.

A distinguished member of the Imperial and Royal Austro-Hungarian Railway Board, Ober-Baurat Baron von Ferstel, recently delivered an interesting lecture on the subject, as far as it concerned Austria, at the Austrian Society of Engineers. This lecture has attracted much attention on the Continent. He first dealt with the class of railways which particularly called for electrification, and the different advantages and savings arising from it. The increasing cost of coal, he said, was an important reason for adopting electric traction; the price has risen sixty-four per cent within two years, and for the present year Austrian railways would require 730,000 tons of imported coal from German-Silesia, the Saar and the Ruhr district, and from England, the inland coal mines supplying some 640,500 tons. Matters in Austria resemble in this respect the conditions in Italy, Switzerland and Sweden, where the dearth of inland coal has an important bearing on the case for the introduction of hydro-electric power on the railways.

The consideration is emphasized, as far as Austrian Alpine railways are concerned, by the fact that the cost of transport is exceedingly high, in some cases almost equal to the cost of the coal; hydroelectric traction would seem, therefore, for more than one reason, a natural and desirable substitute for steam. Moreover, in Austria, as elsewhere, a fear has arisen that several comparatively young industries may seize upon so much water power that the state will be left in the lurch; hence the extensive purchasing of waterfalls by the Swedish State, and legislation, already effected or still under consideration, in various countries, to secure, if not a monopoly for the state, in any case a power to control and regulate the disposal of the waterfalls. This, at least, is the case of Norway, Italy and Bavaria.

In Austria the legal position of water rights appears to be regulated by a dozen and a half different territorial laws, which the speaker thought it would take a long time to adapt or alter in favor of a general state scheme. It was therefore advisable to secure the requisite waterfalls as soon as possible, prior to which, however, the question of which waterfalls were the most suitable would have to be investigated. Many of the rivers in question carry a very variable quantity of water, which, of course, is a drawback. As an instance, the speaker mentioned the Isonzo, which may have a flow of anything from a minimum of eight cubic metres per second up to more than 100. This river presents exceedingly favorable conditions of fall—over 500 feet—yet the minimum quantity of water only represents 8,000 horse-power. Its average flow of 24.5 cubic metres per second would yield 38,000 horse-power; but this would certainly necessitate the construction of a reservoir capable of holding 115,000,000 cubic metres, and of this the natural conditions will not allow. Reservoirs of this size are under consideration for other purposes at the present moment, and Baron von Ferstel mentioned the projected reservoir close to the town of Zurich as an example. It is here proposed to dam up the Sihl in a mountain valley six miles in length, rendering possible the storage of 96,500,000 cubic metres of water; the valley in question is somewhat thickly populated, and, of the total calculated cost of $2,400,000, two-thirds would be spent upon the purchase of property. The Austrian State Railways are planning a somewhat smaller reservoir for the Isonzo, based upon an average supply of fifteen cubic metres per second, and capable of holding some 48,000,000 cubic metres.

A question of importance, almost equal to that of the best possible exploitation of the various falls separately, is the proper selection, or combination for working purposes, of different falls and their power stations, in some cases, perhaps, in conjunction with steam-driven central plant; as an example, the speaker mentioned the Villach-St. Lucia-Trieste Railway, which has a hydroelectric power station at Karceit and a steam-driven station at Trieste.

Another question of importance is the possible utilization of the excess current, at times of plentiful water supply, for other purposes, such as electrochemical or metallurgical work.

The investigations carried on in Austria cover all the railway lines worked by the state railways, irrespective of their being owned by the state or by private concerns. The aggregate mileage of the railways in question amounts to 2,500 miles. In Austria the electrotechnical studies of the question, and those referring to the traffic, are so far being carried on apart from the investigation of the water-power question. In order, however, to be fully prepared with all particulars of power requirements for the different districts, and from the different waterfalls, the whole of the system of railways has been divided into 150 sections. The clubbing together of the different sections likely to come within the area of any one water-power central station will be comparatively easy and will allow of various alternatives. It is claimed that never has the electrification of a comprehensive railway system been more carefully prepared than in this case. The comparative details for steam and electric traction have been made out in as exhaustive a manner as possible. Experts in various industrial branches are also being consulted as regards the system to be chosen.

The survey of the waterfalls likely to come within the limits of this great scheme—numbering about forty—is being proceeded with and will be pushed ahead energetically during the present summer. So far plans appear to have been completed with regard to some twelve power plants, referring to a length of valley of some fifty-five miles, between the Boden Lake and the Kufstein streams; these twelve falls have an aggregate height of fall of 5,500 feet, averaging 460 feet for each station, with an aggregate minimum constant power of 41,100 horsepower.

Within the German Empire experimental electrification of railways has, of course, been carried on for several years; but the more comprehensive schemes of electrification at times put forward, as, for instance, a Berlin-Hamburg electric railway, have so far been allowed to remain in abeyance. Of late different plans of electrification have assumed more definite shapes, and, as in Austria, the whole question is now being officially investigated and reported upon, and, as far as can be foreseen at present, it is possible that the next few years may witness important developments in this direction.

Among the German states it seems probable that Bavaria will take the lead on account of the natural conditions of the country, which is rich in water power, but poor in coal. The Ministry for Public Traffic has recently prepared an exhaustive and instructive report on the question of electrification of the Bavarian state railways, advocating a classification of the state railways into two groups, of which one comprises such lines or systems of lines which, on account of the nature and extent of their traffic and their proximity to cheap water power, are well suited to electric traction. The State Railway Board is prepared to point out the requisite waterfalls as soon as the Department of the Ministry for the Interior, which deals with the water power of the country, is ready to take action in this connection. With regard to the second group of lines the adoption of electric traction may not be found expedient for some time to come and the water power, upon which this second group of railways will have to rely, is in the meantime to be placed at the disposal of industrial concerns, but only on such conditions as regards the nature and duration of the concessions and the state's option of purchase, that the state railways, when it may be found necessary, from time to time, will be able to acquire such falls or power stations. The state railways are expected to act in a spirit tending to advance the industry of the country. Military considerations also appear to have to be consulted with regard to such Bavarian railways as may, or may not, be chosen for electrification; this side of the question will, on the whole, be allowed to stand over for the present, but it may be said that the military authorities have raised no objections to some lines, of minor importance from a military point of view, being promptly electrified in order to obtain experience which should be of great value in the further development of the question. The report itself is divided into three sections, of which the most interesting is again divided into parts dealing, respectively, with the power required, the choice of system of electric traction and the economy of the proposed change. The first question to be settled was the ratio of the maximum power required to the average power. The mean figure arrived at is 3. But the actual ratios vary very much on different railways, on some of which electric power has already been adopted. Thus on the Salgburg-Berchtesgaden line the average demand is 550 horse-power, but the maximum is 2,950 —5.37 times larger than the average. On the Munich-Augsburg line the ratio is 2.58; on the Munich-Partenkirchen line we have 21,500 horse-power maximum, against an average of 5,700 horse-power —a ratio of 3.78. The calculations for the total power required by all the railways of the kingdom have been based on the assumption—derived from actual data, of course—that the requirements per ton-kilometre are 41.75 watt-hours by passenger trains, 27.2 by goods trains, and 33.4 watt-hours on local lines. That the goods trains consume less power is ascribed to the fact that they travel more slowly, and that the conditions are more favorable than is the case with passenger trains. Power is to be supplied from a great number of feeder stations. In allowing for the power capacity of these stations, ten per cent has been added to the actual figures to meet losses arising from unforeseen stoppages and delays; fifteen per cent more for the conversion of mechanical into electrical energy; twenty-five per cent more for line loss in voltage, assuming main conductors at 50,000 volts and working conductors at 10,000 volts. Making these allowances, it is thought that 142,000 horse-power would suffice on an average, and that three times that figure, 426,000 horse-power, might be required as a maximum, to deal with the whole railway traffic. Since, however, the conversion will probably occupy a good many years, and will not be completed before 1920, a further forty-two per cent has been added to these figures to meet the presumable growth of traffic during this period. Thus about 600,000 horse-power would have to be provided. It is estimated that the running waters of Bavaria offer at present still 300,000 horse-power available. When use is made of the Alpine lakes, however, and notably of the Walchensee, it will be possible to meet the maximum demand by hydroelectric installations without any difficulty. It is pointed out that the lakes could be utilized as feeders for rivers, which would not, in that case, have to be furnished with special reservoirs of their own.

As regards the choice of system, the

report sums up in favor of single-phase current. It is not considered that direct current could profitably be supplied to heavy locomotives by a third rail over distances of more than 3.5 kilometres and at a pressure exceeding 1,000 volts; the third rail would, moreover, be too dangerous at the railway stations and crossings. Three-phase currents are objected to because the motors, unless fitted with complicated mechanism, would always run at the same speed, and because they necessitate three wires and complicated switches. Single-phase current is thought to be the most suitable, though it may not be so economical for long-distance transmission as three-phase currents. The question of the recovery of the electric power on down grades has not escaped attention. Such recovery is possible, though it has not proved simple with the three-phase system, and a slight alteration would also make it possible with the Winter-Eichberg single-phase series short-circuit motors, to which it is not directly applicable. The inquiry has demonstrated, however, that only about 2.3 per cent of the absorbed energy could be recovered from the trains running down inclines, and this factor would not be decisive, therefore, as to the selection of the current system.

The cost estimates refer to special lines, some of which are already worked by electricity, notably various mountain railways on which a more elastic and more rapid service can be maintained with electric than with steam power. In some cases, for instance, on the Munich-Innsbruck line, the electric project has already assumed definite shape, and the estimates also take into consideration the necessity for relaying telegraph and telephone lines. Other items included are: Attendance on the locomotives, materials, working expenses and maintenance of locomotives, permanent way, conductors, etc. The estimates and the general conclusions are favorable to the adoption of electric power, and it is, moreover, pointed out that we must be prepared for rising prices for fuel, and that water power will hence become relatively cheaper. The lines where electric traction could forthwith be adopted comprise the Salzburg-Bad Reichenhall-Berchtesgaden Railway, and the Garnisch-Partenkirchen Railway to the Tyrolese frontier at Scharnitz and at Griesen, for which purpose an extraordinary grant is being asked. Next in consideration there come the following railways: Munich - Garnisch - Partenkirchen, Tutzing - Kochel, Weilheim - Peiszenberg, Munich - Tölz, Holzkirchen - Schliersee, Holzkirchen-Rosenheim, and the local line of Munich-Gauting. The most convenient power stations for the above lines will be the Saalach station at Bad Reichenhall (4,000 to 5,000 horse-power) the station at Lechbruck (about 20,000 horse-power), and last, but not least, the Walchensee station, which, when completed, will produce about 50,000 horse-power throughout the twenty-four hours, and at its earlier stages from 25,000 to 30,000 horse-power.

Owing to the relative cost of coal and water power the southern and southeastern parts of Bavaria are particularly suitable for the use of electric power; the freight charges on coals are very high, while water power, on the other hand, is cheaper there than further north, owing to the proximity of the Alps. In consequence it may prove economical to adopt electric traction in Southern Bavaria, even on lines with a comparatively small traffic.

In *Engineering*, Vol. lxxxv, page 660, reference was made to extensive plans of electrification on the Prussian railroads, and it would seem that the project then mentioned is not an isolated one. The department in question has urged all the different railway boards to consider the subject of the introduction of electric traction, wherever electric current can be obtained so cheaply that the railways may be relied upon to produce as good returns as at present. Among the railway boards which have gone in seriously for electrification is the one at Essen. The first line to be electrified will be the Osterfeld-Heissen-Hattingen, its passenger traffic being first dealt with in this way, and an electric railway through the Eifel, intended for the goods traffic between the Ruhr district and the Saar district and Lorraine, is also planned. The latter, however, on account of its great cost, is likely to stand over until some experience has been gained on the former line. The question of cost naturally has a deterrent effect, as, for instance, in connection with the local railways in and about Berlin, the electrification of which has often been advocated, but the cost, estimated by some at $100,000,000, has hitherto stood in the way.

The aggregate length of the Leipsic Bitterfeld-Magdeburg and the Leipsic-Halle Railway is just 100 miles, and these railways will be used for making exhaustive preliminary trials of electric traction, both as regards passenger and goods traffic.

Pennsylvania Railroad Prepares for Electrification.

A party of Pennsylvania Railroad engineers and several members of the operating department spent last Saturday studying the electrical equipment of the New York Central, with a view to getting data to be used in the final adoption of plans by the Pennsylvania Railroad for the electrification of the New York terminal and the tunnels in which the trains are to run under the Hudson and East rivers. The Pennsylvania men were conducted over the New York Central electrical zone by Superintendent Whaley and a number of his assistants.

The Pennsylvania experts will pay visits to other cities in the near future, to make a further study of railroad electrification.

The electrification of the Pennsylvania's New York terminal and its approaches will be one of the largest contracts of the kind ever attempted by a railroad. It is expected that the electrical features alone will cost in the neighborhood of $20,000,000.

Lowell & Fitchburg Bondholders' Committee.

At a meeting of the bondholders of the Lowell & Fitchburg Electric Company, of Lowell, Mass., the following were elected a bondholders' protective committee: James W. Green, chairman, and C. F. Allen, of Gloversville, N. Y.; H. S. Scofield, of Troy, N. Y.; W. H. Emhardt and Julius Christensen, Philadelphia.

The committee has formulated a bondholders' agreement to be accompanied by a deposit of the bonds, and authorizing the committee to levy an assessment on the bondholders of not to exceed two per cent of the face value of the bonds, to be used for the purpose of placing the road in position to become part of a through line between Lowell and Fitchburg, Mass. Holders of $450,000 of the total of $550,000 of bonds have signified their intention of becoming parties to the bondholders' agreement.

International Association of Municipal Electricians.

The thirteenth annual convention of the International Association of Municipal Electricians was held at Detroit, Mich., August 19, 20 and 21. Headquarters were established at the Hotel Pontchartrain.

Chicago Street Railway Affairs.

Rehabilitation of Chicago's street-car system has progressed far in advance of the requirements laid down in the franchise ordinances. One-half of the three-year rehabilitation period passed August 1, and a report which is being prepared for the board of directors of the Chicago City Railway Company shows that much more than half the work has been done. The ordinances require the city railway company to reconstruct sixty miles of electric road and thirty miles of cable lines within the specified period. Approximately seventy-five miles have already been reconstructed, and by the close of the present year an additional ten miles of new track will be laid. All the new track is laid with 129-pound steel rails at an approximate cost of $50,000 a mile. With the laying of new tracks the company has had to pave the street between the rails with granite blocks. In the last two years more than seventy-five acres of paving has been laid. Within certain districts the ordinances provide that the overhead wires be replaced with lead-covered underground distribution feeders, and this work is being carried out simultaneously with the laying of the new tracks and the building of car barns and distributing substations. To prevent electrolysis the company is installing auxiliary bare copper wires for conducting the return current back to the power-houses and substations. Twenty-one miles of this copper wire was installed last year and 23.3 miles up to August 1 of this year. An additional thirteen miles will be added during the remainder of this season. In 1907 thirty-one miles of new trolley wires, with the necessary spans, were put up, and forty-eight miles up to August 1 of this year, with a proposed addition of thirty-one miles by the end of the season. Since the rehabilitation work began the company has built car barns at the following points: Seventy-seventh street and Vincennes Road, 347 feet by 504 feet, with six bays of five tracks each and a capacity of 260 cars; Cottage Grove avenue and Thirty-eighth street, barn 336 feet by 487 feet, with a capacity of 225 cars; under construction a barn at Sixty-ninth street and Ashland avenue, 265 feet by 485 feet, with a capacity of 191 cars, and another at Archer avenue and Rockwell street, 310 feet by 400 feet, with a capacity of 210 cars. The capacity of the substations at Forty-second street and Wabash avenue and at Sixty-third street and Wentworth avenue has been increased and a new substation is being built at Forty-eighth and Honore streets. A large storage battery is to be built in the downtown district to furnish power in emergency cases in the event of a breakdown at any of the generating stations. In addition to the work enumerated the company has added to its equipment in the workshops and in the car barns.—*Railway and Engineering Review.*

Jurisdiction of the Public Service Commission Over the Hudson & Manhattan Railroad Company.

Counsel to the Public Service Commission for the First District, state of New York, has rendered an opinion concerning the powers and jurisdiction of the commission over the Hudson & Manhattan Railroad Company. The counsel is of the opinion that the commission has jurisdiction over the company and that orders concerning reports of accidents, records of stockholders, information as to car motors, and others, must be complied with. The fear has been expressed that if reports are rendered, conflicting orders may be given by the state and by the federal authorities. The company is to be assured that the commission will act within its jurisdiction in issuing any of its orders. The opinion adds:

"Inasmuch as these orders of the commission do not directly regulate interstate commerce, and, in fact, hardly even indirectly affect it, but are simply regulations upon the instruments of interstate commerce made in reliance upon the reserved police power not granted to Congress and not incompatible with any ruling that Congress has made under its power to regulate commerce, and as they certainly have less effect upon commerce than many other regulations of states heretofore upheld by the courts, like harbor regulations and laws concerning pilots, the orders would seem to me to be in aid of commerce and not an interference with it, and should be obeyed."

The International Conference on Electrical Standards.

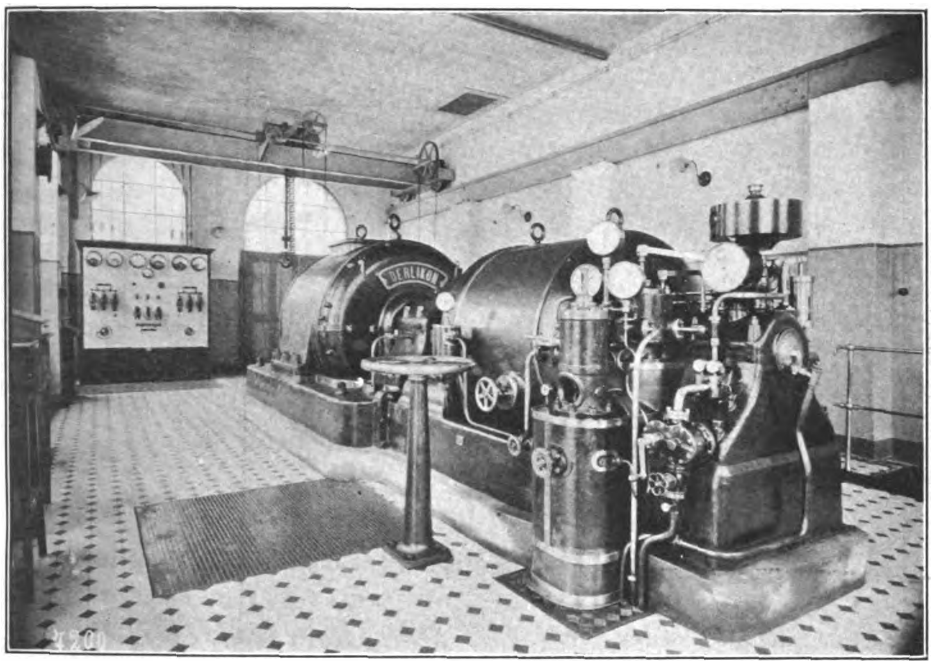
The president of the Board of Trade has appointed Lord Rayleigh, Professor J. J. Thomson, Dr. R. T. Glazebrook, Sir John Gavey and A. P. Trotter to be the British delegates to the International Conference on Electrical Units and Standards, which is to assemble in London on October 12. W. Duddell and M. G. Collins, of the Board of Trade, will act as secretaries to the British delegates, and F. E. Smith and C. W. S. Crawley as assistant secretaries.

Electrical Power in Australian Mines.

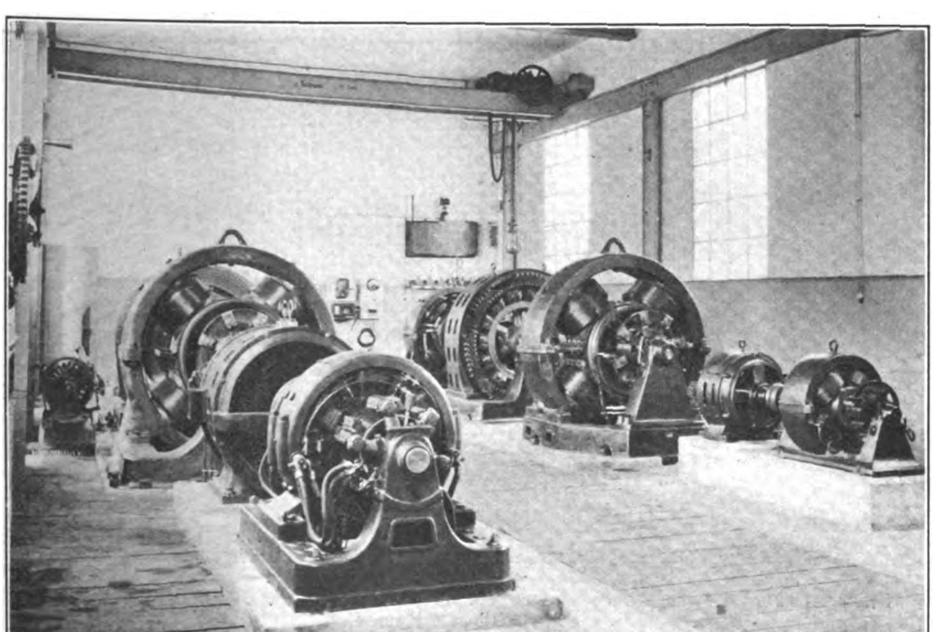
The *Australian Mining Standard* states that following the success of the earlier portion of the electrical equipment of the Mount Lyell mines, a contract has been placed for an electrically driven air-compressor with a capacity of 2,000 cubic feet of free air per minute and a final pressure of eighty pounds per square inch. This represents the application of electricity for compressing purposes on a far larger scale than anything previously undertaken in Australasia. Some new pumping plant is also on order. The North Lyell mine was the first in Australia to install an Ilgner main electrical winding plant. The new compressor will be of the two-stage type, manufactured by Messrs. Thompson & Company, of Castlemaine (V.), and will be driven at a constant speed of 144 revolutions per minute by an A.E.G. three-phase induction motor, 350 horse-power, 3,000 volts, mounted direct on the shaft between the high and low-pressure cylinders. As the output of the compressor can not be economically altered by varying the speed of the motor, an automatic mechanical device will be provided, which will cause the compressor to run light immediately a predetermined maximum pressure is reached in the receiver, and again run fully loaded as soon as the receiver pressure has fallen a few pounds below normal. The motor will be controlled by a liquid starter. The new pumping plant consists of four Pearn treble-ram electric mine pumps, each with a capacity of 6,000 gallons per hour, against a vertical head of 400-450 feet. The whole of the castings, valves, valve seats, plungers, etc., coming in contact with the water will be made of high-grade gun metal to resist the excessive corrosive nature of the mine water. Two of the pumps will be placed about 700 feet below the top of the shaft, and the other two 450 feet lower. The pumps in each chamber will be placed over the well and will be automatically stopped and started by A.E.G. patent float controllers. The motors driving the pumps will be of the three-phase slip-ring induction type, having a normal rating of twenty-five horse-power at 525 volts, but will be capable of running continuously, if necessary, at thirty horse-power. The efficiency of the pumps is guaranteed at eighty per cent and that of the motors at eighty-nine per cent.—*Electrical Engineering (London).*

Seebach-Wettingen 15,000-Volt Single-Phase Traction System, Switzerland.

FOR the last few years the Swiss engineers have been experimenting with single-phase traction, and particularly with that of the Oerlikon system. As early as 1901 the Oerlikon company made the proposition to electrify the Seebach-Wettingen line. Before receiving their franchise the company made experiments on a line between Oerlikon and Seebach and later on as far as Affoltern. To hinder matters there is a law prohibiting 15,000-volt lines from being run alongside railroad tracks and telephone systems.



INTERIOR OF POWER PLANT, SHOWING OERLIKON THREE-STAGE TURBINE—SEEBACH-WETTINGEN SINGLE-PHASE RAILWAY.

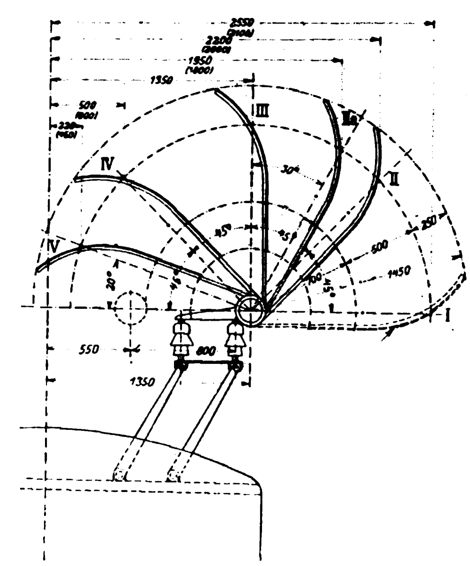


INTERIOR OF SUBSTATION—SEEBACH-WETTINGEN SINGLE-PHASE RAILWAY.

In the summer of 1904 the Oerlikon company had in operation locomotive No. 1, running at 5,000 volts, fifty-cycles. Because of the difficulties experienced in the operation of No. 1 the company built another, No. 2, to operate at 15,000 volts, fifteen cycles. This locomotive was put in operation November, 1905, and the results of the experiments carried on were such that locomotive No. 1 was reconstructed on the lines of No. 2. By the end of 1907 the whole line from Seebach to Wettingen, twelve miles, was put in operation, jointly by the Oerlikon company and Siemens-Schuckert Werke.

The section from Seebach to Regensdorf, about four miles, is equipped with the Oerlikon trolley, and from Regensdorf to Wettingen, about eight miles, with the Siemens-Schuckert trolley. There are at present three locomotives in operation, which are equipped with both systems, so that they can operate on the two systems.

There are seven stations situated along the line and no grades of any account.



OERLIKON COLLECTING DEVICE IN DIFFERENT POSITIONS — SEEBACH-WETTINGEN, SINGLE-PHASE RAILWAY.

The smallest radius of the track is 980 feet. The rails are used as a return circuit.

POWER PLANT.

Power is supplied from the plant of the Oerlikon company at Oerlikon, for which purpose an additional 700-kilowatt turbo-generator was installed. The steam turbine is of the Oerlikon type, three-stage, direct-acting, and is placed with the generator on a common bed-plate. The turbine is connected to a revolving-field generator by a needle coupling, and is provided with a jet condenser located in the basement. At the end of the generating room there is a switchboard with three panels, equipped with the necessary instruments for throwing the current on the transformer station, Seebach-Wettingen, or for manufacturing purposes. As all the equipment of the plant was 230 volts and fifty cycles, the generator adopted in this plant is the same.

SUBSTATION.

The experiments were carried on at fifty cycles, which, however, proved unsatisfactory, and fifteen cycles was adopted. The energy received from the power-house as three-phase, fifty-cycle current is transformed through motor-generator sets. The substation erected near the power-house has the following equipment: Two motor-generator sets of 700 and 500-kilowatt capacity. Each consists of a fourteen-pole, 230-volt, fifty-cycle synchronous motor with 100-volt excitation coupled on one side to a four-pole, 700-volt, fourteen to fifteen-cycle generator with 100-volt excitation. On the other end is coupled a 750 to 850-volt, 350-ampere, direct-current generator, which operates in connection with a storage battery.

The fields of the generators are regulated by two Thury regulators. When the generators are operating in parallel the regulators are mechanically interconnected by gearing and shafting.

The exciter current for the synchronous motors is furnished by a fifty-horse-power, fifty-cycle, 100-120-volt motor-generator set.

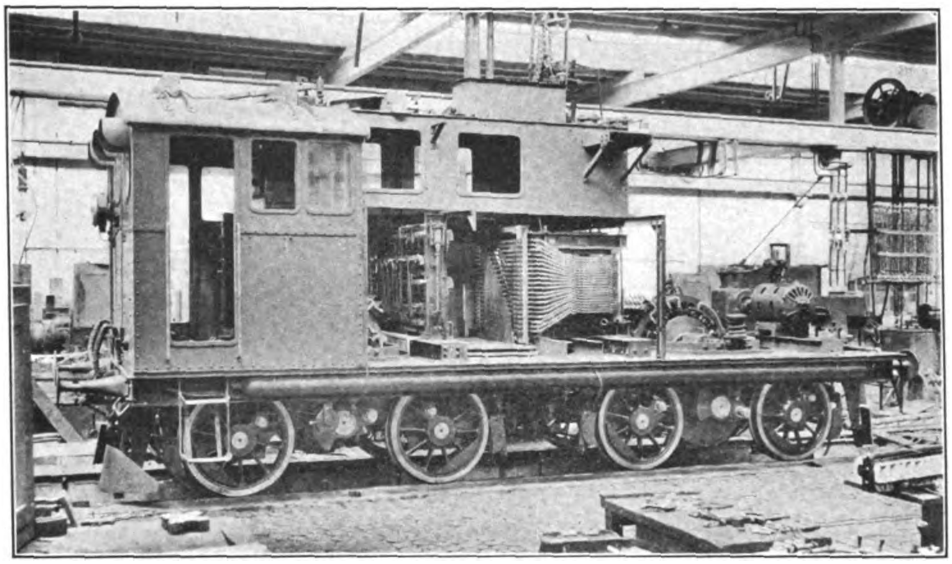
A 120-horse-power booster outfit operates in connection with the storage battery. The booster has two commutators which, when they feed the storage battery, operate in series, but when operating under normal conditions are switched in parallel. The booster is operated by a three-phase induction motor fed from the three-phase power-house supply. The regulation is done in two ways: either by a Thury regulator receiving current from the trolley line or by means of a Siemens-Schuckert converter with a differential excitation, operated by a chain drive from the shaft of the 700-kilowatt motor-generator set. The converter furnishes thirty amperes at thirty-eight volts.

The storage battery, located in a separate building, consists of 375 cells and has a capacity of 592 ampere-hours. For a period of five minutes it can give 1,200 amperes or 1,800 for one minute.

On one end of the substation is the transformer compartment in which are located four 250-kilowatt single-phase transformers to step up the 700 volts from the motor-generator sets to 15,000 volts for the trolley. There is also a 450-kilowatt, three-phase transformer receiving 30,000 volts from Hochfelden, stepping it down to 210 volts for the motor-generators, in case the power-house supply should fail.

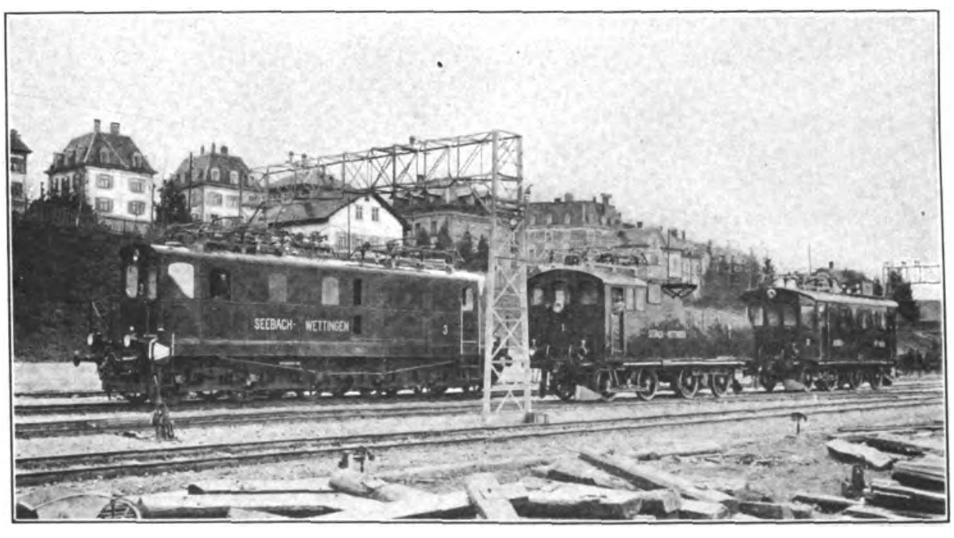
OERLIKON TROLLEY SYSTEM.

The Oerlikon trolley system is installed from Oerlikon to Seebach where it joins the main line to Regensdorf. At Seebach the wire is suspended by catenary construction from bridges with eight spans of 165 feet and 200 feet. The trolley is hung sixteen and one-half feet above the rail by steel wires about twenty-three feet apart. From Seebach to Regensdorf the trolley wire is carried on poles at the side of the track by means of semi-rigid sists of an automatic adjustable arm mounted on the top of a four-bar linkage. By referring to the illustration herewith it will be seen that the arm may occupy any position from I to V for a fixed position of the linkage. From positions I to V gives a sweep of 7.5 feet. By shifting the linkage an additional 2.5 feet is



LOCOMOTIVE NO. 1, REMODELED—SEEBACH-WETTINGEN SINGLE PHASE RAILWAY.

construction mounted on cast-iron caps fastened to insulators which are mounted on the brackets of the poles. The line is divided up into several sections. At the end of each section is a horn section switch carried on a steel pole, which also carries a semaphore. The switch operates by gained. The trolley may hang directly overhead or eight feet to one side of the centre line and the current may be drawn from the top, side or bottom of the trolley wire, thus securing great flexibility, for which the system is noted. Under ordinary conditions the trolley is at the side



FROM LEFT TO RIGHT, LOCOMOTIVES NO. 3, NO. 1 AND NO. 2—SEEBACH-WETTINGEN SINGLE-PHASE RAILWAY.

hand or automatically from the railroad station, for which purpose a pilot wire is carried on the wooden poles.

The Oerlikon collector is placed on top and to one side of the locomotive. It con- of the track, to facilitate erection and repairs. The collecting arm is held in contact with the trolley by a spring device which may be operated by hand or electropneumatically. When not in operation the collecting arm is held flat on top of the car.

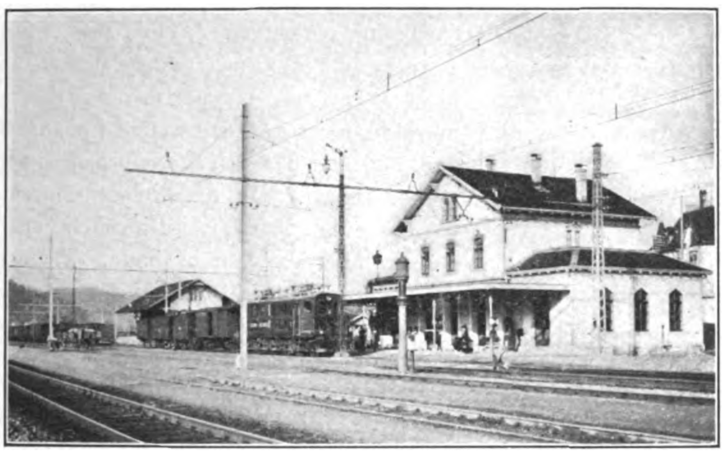
The arms are made of seamless, drawn steel tubes about 7.5 feet long and slightly bent at one end. There are two such arms to one collecting device.

SIEMENS-SCHUCKERT TROLLEY.

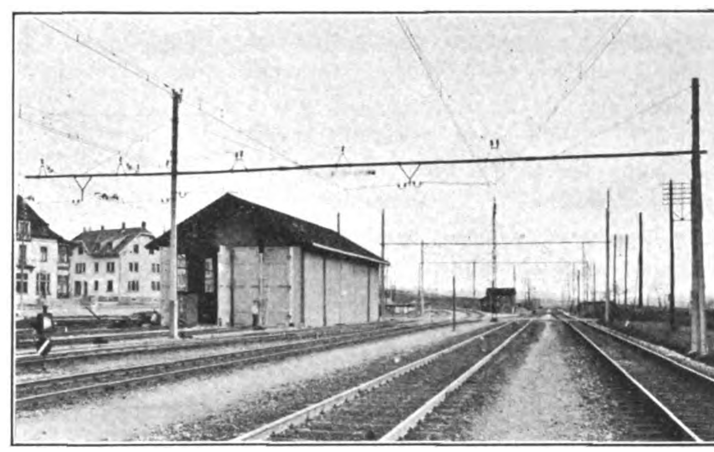
The Siemens-Schuckert trolley system starts at Regensdorf, ends at Wettingen and overlaps the Oerlikon trolleys for a distance of 1,300 feet, so that the change from one system to the other is made with- on pairs of channels spanning, in some cases, seven tracks. The overhead trolley line, with its complete catenary, is divided up into sections in order to keep them taut. The spans, in the sections where the wires overlap, are 375 feet long. For a distance of thirty-five or forty-five feet, in the middle of such a span, the wires are parallel and about five inches apart. The ends of each section are led from the centre of the track to side poles, where they are provided with a tension arrangement. locomotives No. 1 and No. 2, of the Oerlikon make, have only one pantograph, while No. 3, of the Siemens-Schuckert make, has two.

The poles on the line are placed between 160 and 170 feet apart. In some cases, for experimental purposes, the span was lengthened to 330 feet.

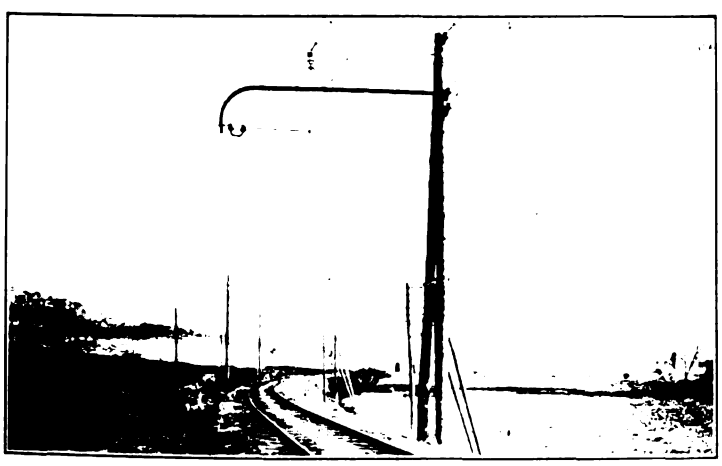
At sidings and locomotive barns the trolley wire is provided with circuit-breakers so that power may be supplied to the sidings when necessary.



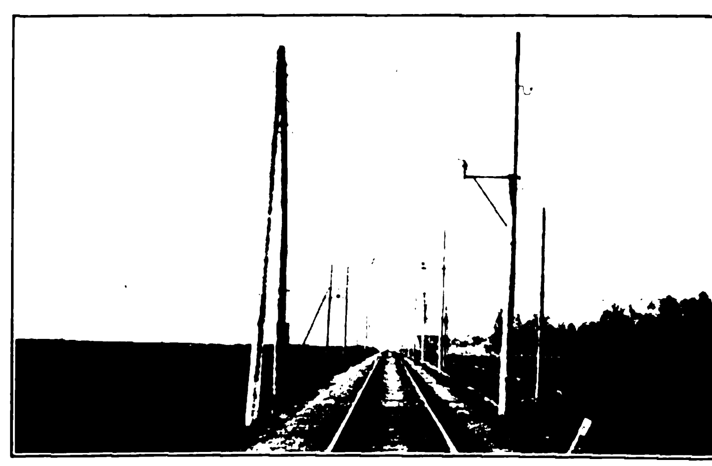
CATENARY SUSPENSION AT RAILROAD STATION AT WETTINGEN; ALSO LOCOMOTIVE NO. 3.



OVERHEAD CONSTRUCTION SPANNING TRACKS AT RAILROAD STATION, WETTINGEN.



INSIDE AND OUTSIDE POLE ARRANGEMENT—SEEBACH-WETTINGEN SINGLE-PHASE RAILWAY.



AT JUNCTION OF OERLIKON AND SIEMENS-SCHUCKERT SYSTEMS—SEEBACH-WETTINGEN SINGLE-PHASE RAILWAY.

out interruption. The trolley wire is suspended by catenary construction 19.5 feet above the rails. Between Otelfingen and Wuerenlos, for a distance of 0.6 mile, the trolley is only fifteen feet above the rail. The catenary wire, a steel cable thirty-five square millimetres, rests on cast-iron caps carried on insulators, and carries an auxiliary catenary by suspension wires 19.7 feet apart. From the auxiliary catenary the main trolley is hung by clamps from nine to ten feet apart. On the main line, the trolley is carried on side poles, while at stations it is carried The weights in the above arrangement are 600 pounds; as the sheaves have a ratio of one to two, there is a continuous pull on the line of 1,200 pounds. The sections are dead-ended at one end.

A tension arrangement is located at each station and midway between stations, so that the sections are about one mile long.

The Siemens-Schuckert collecting device is a sliding-bow pantograph arrangement. The contact piece is a removable U-shaped piece of aluminum pressed against the trolley by flat springs. The

The rails are used as a return circuit and are well bonded. Every mile and a quarter they are specially grounded by large copper plates.

STATIONS.

From Wettingen to Seebach there are seven stations along the line, on the average about two miles apart. The section switches are controlled from the stations and the keys to the switches are in the possession of the station master. At Kempfhof, owing to heavy street traffic, the sliding gates are electromechanically connected to the overhead trolley so that when the trolley is alive the gates are closed. This was done at the request of the public service commission.

LOCOMOTIVES NO. 1 AND NO. 2.

There are at present three locomotives in operation. No. 1 is illustrated herewith. This machine was built in 1904 for experimental purposes and was known as "the converter locomotive." It was later changed over into a single-phase locomotive. The converter was rated on the alternating-current side as a 650-horse-power, 700-volt, asynchronous motor and on the direct-current side as a 400-kilowatt, 600-volt generator with a speed of 1,000 revolutions per minute. Overhanging one end of the driving shaft was a 150-volt, direct-current generator which was connected to the direct-current side of the converter. This generator acted as a booster or a bucker so that various voltages could be applied to the driving motors, which were shunt wound. The line voltage was stepped down from 15,000 to 700 by two 250-kilovolt-ampere air-cooled transformers. It was found out during experiments that it would be advisable to change the equipment to single-phase, fifteen cycles, because, owing to the peculiar operating conditions (the frequent stops during which time the converter had to remain in operation), the current consumption was comparatively high, although otherwise the equipment was very satisfactory and highly efficient.

The body of No. 1 rests on two four-wheel swivel trucks, each having a 200-horse-power motor mounted between the axles. There is no king pin; the theoretical swiveling point is controlled by levers. The motor is geared to a separate driving shaft from which the drivers are operated by means of a crank-pin and connecting rod. The brakes, one for each wheel, are operated pneumatically or by hand. The total weight has been reduced from forty-eight to forty tons, due to change of equipment.

The body of locomotive No. 2 is built on the same lines as No. 1 except that it has a cab at each end for the motorman and weighs forty-two tons. It is equipped similarly to locomotive No. 1 with an Oerlikon rod collector and a Siemens pantograph collector, both having hand and electropneumatic control.

The current is led from the trolley to four transformers connected in series-parallel. Each transformer group has a capacity of 250 kilovolt-amperes. They are wound for 15,000 to 700 volt transformation, are air-cooled, and are located in the centre of the car. In the cabs, at each end, are two controllers, one for controlling the motors, the other for controlling the transformer taps.

The motors are series wound with interpoles of 250-horse-power capacity each. They make 650 revolutions per minute normally and 1,000 maximum. With a gear ratio of one to 3.08 and drivers of 39.5 inches, a speed of about thirty-six miles an hour is attained. On grades of 0.8 to one per cent a speed of twenty-four miles per hour is attained, while on short stretches of 1.2 per cent the same speed can be maintained. These values are calculated for a train weighing 250 metric tons. Tests have shown that the motors can operate just as well on twenty-five cycles.

HORN SECTION-SWITCH AND DEAD-END OF ONE TROLLEY SECTION — SEEBACH-WETTINGEN SINGLE-PHASE RAILWAY.

Each locomotive has a six-horse-power, motor-driven air-compressor operating at 140 volts. The compressors supply air at pressures between seventy-five and 105 pounds. The operation is automatically controlled by the air pressure. The air is used for operating the various apparatus, such as bow collectors, etc. Current for these motors is drawn from special taps on the transformer, which also has taps for lighting and heating.

LOCOMOTIVE NO. 3.

Locomotive No. 3 rests on two six-wheel trucks; the king pins are 19.7 feet apart. The trucks are of the same design as those of the famous Marienfeld-Zossen experimental locomotives, built by Siemens-Schuckert Werke, who also supplied locomotive No. 3. This locomotive is designed for a six-motor equipment although at present only four are mounted. Each motor has a capacity of 225 horse-power, eight poles, artificially cooled and geared to the drivers through a gearing with a ratio of one to 3.72. The design of the housing is seen in the accompanying illustration. The length over all is forty-five feet. The car is equipped with two Siemens-Schuckert collectors and one pair of Oerlikon collectors. The two transformers, of 500-kilowatt capacity each, are located in iron compartments with removable doors and are wound for 15,000, 288, 330 and 378-volt transformation and are oil-cooled. On the high-tension side there are overload circuit-breakers, operated automatically or by hand. There is provision in the high-tension compartment for the three motors of each truck, three contactors for speed control and two for controlling direction of current. The contactor compartments are placed in three tiers.

This locomotive, equipped with four motors, has a weight of sixty-eight tons, and a tractive effort of 10,300 pounds for an hour; the maximum is 17,200 pounds. When equipped with six motors the weight is seventy-five tons and the tractive effort 15,600 pounds for one hour; the maximum, 25,740 pounds.

EFFECT OF HIGH-TENSION LINES ON TELEPHONE LINES, ETC.

On the experimental section of this line, in 1904, for a distance of 2,500 feet, the 15,000-volt, fifty-cycle line ran parallel to the telephone systems. When the high-tension system was operated at fifty cycles, the operation of the telephone lines was impossible. The trouble was remedied by changing the frequency from fifty to fifteen cycles. Experiments show that even thirty cycles have little or no effect. The voltage, 15,000, remained the same. Oscillograms of the motor show that the current and voltage curves, although sinuous in character, are very ragged. This trouble was corrected by changing the slot spacing and putting the poles on the skew. The former trouble was experienced on locomotive No. 1 while the latter appeared on No. 2 after fifteen cycles was adopted.

It might be of interest to state that between December 3 and January 6 only three interruptions occurred: One insulator broke, a trolley wire slipped out of its end clamp, and a short-circuit in a substation. Encouraged by the success of this road the Swiss engineers propose to build 3,500 to 4,000-horse-power locomotives for further electrification of other trunk lines.

Decimal Classification for Indexing Electrical Engineering Data.

To the Editor of the Electrical Review:

About three years ago Mr. L. C. Marburg and the writer devised a decimal classification for indexing electrical engineering data, which we give below for the benefit of any one who may be interested. The index is constructed in accordance with the plan followed in Dewey's "Decimal Classification," and is, in fact, merely an extension of division 621.3 in that work.

For convenience the figures 621.3 representing the division "Electrical Engineering" in Dewey's index, have been omitted, but could be used if found desirable. The writer has found it convenient to use the letter "E" as a prefix when some distinguishing mark was necessary.

Considerable time and thought was spent on the classification and careful attention given to the introductory remarks in Dewey's work. Any one interested in the subject should procure this book, which is published by the Library Bureau.

In a number of the classes, the subdivisions have been carried to only two places, and classes 7 and 8, owing to the authors' unfamiliarity with the subjects, have not been subdivided at all. Further extension would, of course, be required should extensive use be made of these portions.

The index has been used by the writer with extremely satisfactory results for nearly three years, and during the past year has been also very successfully used for indexing drawings in a manufacturing establishment.

It is scarcely necessary to enumerate the many advantages of a decimal classification, as this has been so thoroughly accomplished in the book above referred to.

H. L. Van Valkenberg.

3318 Arch Street, Philadelphia, Pa.

August 1.

000—*General:*
- 001—Dictionaries, Periodicals, Etc.
- 002—History, Biography.
- 003—Essays, Lectures, Addresses.
- 004—Societies, Education.
- 005—Executive, Works Management.
- 006—Law, Finance.
- 007—Statistics, Costs.
- 008—Patents.

010—Electrical Theory.
020—Units and Measurements.
030—Commercial Testing.
040—General Data, Tables, Curves.
050—Nomenclature, Notation, Abbreviations.
060—Standardization, Underwriters' Rules, Classification.
070—Contracts, Specifications, Reports, Drawings, Catalogues.
080—General Descriptions.
090—Miscellaneous.
100—*Materials:*
110—Conductors.
- 111—Wires and Cables.
- 112—Bars, Rods, Sheet Metal (except for resistances).
- 113—Resistance Wire.
- 114—Resistance Bars, Rods, Sheet Metal.
- 115—Raw Materials.
- 116—Graphite and Similar Material.
- 117—Liquid Resistances.

120—Insulators.
- 121—Line Insulators, Strain Insulators.
- 122—Bus-Bar and Cable Supports, Knobs, Etc.
- 123—Bushings, Tubes, Washers.
- 124—Rods, Blocks, Heavy Sheets, Plates.
- 125—Cloth, Paper, Fuller Board, Tape.
- 126—Hose, Tubing (Flexible).
- 127—Insulating Compounds.

130—Iron and Steel.
140—Other Metals.
150—Lumber and Other Materials.
160—Manufactures.
170—Oils, Paints, Varnishes, Etc.
180—Marble, Brick, Cement, Etc.
190—Miscellaneous.
200—*Power-Generating and Transforming Apparatus:*
210—Direct-Current Generators and Motors.
220—Alternators and Synchronous Motors.
230—Induction Motors.
240—Alternating-Current Commutator Motors.
250—Rotary Converters.
260—Motor-Generator Sets.
270—Transformers, Reactance Coils.
- 271—Oil-Insulated, Self-Cooled.
- 272—Oil-Insulated, Water-Cooled.
- 273—Air-Cooled.
- 274—Instrument and Testing Transformers.
- 275—Auto Transformers.
- 276—Reactance Coils.
- 277—Constant-Current Transformers.
- 278—Induction Regulators.

280—Storage Batteries, Primary Batteries.
290—Miscellaneous.
300—*Auxiliary Apparatus:*
310—Switchboards, Diagrams.
- 311—Systems of Connections, Circuit Equipment.
- 312—Panel Switchboards, Instrument Boards.
- 313—Switch Cabinets and Panel or Tablet Boards.
- 314—Switch Pedestals, Control Stands, Instrument Stands.
- 315—Bus-Bar and Switch Structures.
- 316—
- 317—
- 318—Switchboard Details.

320—Switching Apparatus, Cutouts, Trolleys, Relays.
- 321—Switches (Open Type).
- 322—Circuit-Breakers (Open Type).
- 323—Oil Switches.
- 324—Instrument, Pilot, Control Switches, Etc.
- 325—Relays.
- 326—Fuses, Fuse Holders.
- 327—Trolleys, Contact Shoes.
- 328—Terminals, Connectors, Junction Boxes.

330—Regulating Apparatus, Control Systems, Diagrams.
- 331—Railway Controllers, Control Systems.
- 332—Motor Controllers.
- 333—Alternating-Current Starters (Transformer Type).
- 334—Starting Rheostats.
- 336—Resistances.
- 337—Regulators.

340—Measuring Instruments, Diagrams.
- 341—Ammeters, Voltmeters, Wattmeters (Indicating or Recording).
- 342—Power-Factor or Phase Meters, Frequency Meters, Synchronizers.
- 343—Integrating Meters.
- 344—Galvanometers, Balances, Dynamometers, Electrometers, Oscillographs.
- 345—Bridges, Potentiometers, Standards, Standard Cells.
- 346—Meters for Magnetic Measurements.
- 347—Ground Detectors.

350—Magnets, Clutches, Electric Brakes.
- 351—Electromagnets.
- 352—Permanent Magnets.
- 353—Magnetic Clutches.
- 354—Crane or Elevator Brakes.
- 355—Railway Brakes.

360—Lamps (Arc, Incandescent, Etc.).
- 361—Arc Lamps, Arc Lighting Systems.
- 362—Incandescent Lamps.
- 363—Nernst Lamps.
- 364—Vapor and Vacuum Tube Lamps.
- 365—Searchlights.
- 366—
- 367—
- 368—Lamp Fixtures, Etc.

370—Heaters, Furnaces, Welding Machines.
380—Lightning Arresters, Choke Coils, Static Interrupters, Condensers.
390—Miscellaneous.
400—*Power Generation and Transmission:*
- 401—Operation and Management.
- 402—Statistics, Costs.
- 408—General Descriptions.

410—Station Design and Construction.
420—Station Operation.
430—Steam Engines, Boilers, Etc.
440—Water-Power Systems and Motors.
450—Gas and Other Engines and Auxiliaries.
460—Electrical Apparatus, Operation and Connections.
470—Transmission and Distribution, Systems, Operation of Lines, Protection, Surges.
480—Line Construction and Wiring.
- 481—Overhead Lines.
- 482—Subways.
- 483—Conduits.
- 484—Submarine Lines.
- 485—Interior Wiring, Interior Conduits.

490—Miscellaneous.
500—*Transportation:*
- 501—Operation and Management.
- 502—Statistics, Costs.
- 507—History.
- 508—General Descriptions.

510—Railway Power Distribution and Supply Systems.
520—Trolley Line Construction, Third Rail, Etc.
530—Track and Road Bed.
540—Locomotives and Motor-Cars. Design and Equipment.
550—Service Performance of Locomotives and Motor-Cars.
560—Train Resistance.
570—
580—Electric Automobiles.
590—Miscellaneous.
600—*Industrial Applications:*
610—Elevators, Hoisting and Conveying, Mill Service.
620—Machine Tool Work.
630—Pumping and Ventilating.
640—Various Industries.
650—Marine Work.
660—Illumination.
670—Heating, Welding.
680—Electrochemical Applications.
690—Miscellaneous.
700—*Telegraphy and Signaling:*
800—*Telephony:*
900—*Miscellaneous:*

Long-Distance Wireless Telephony.

Dispatches from Paris announce that Lieutenants Colin, Jeance and Mercieri, the inventors of the wireless telephone apparatus which recent tests have shown to accomplish remarkable results, achieved a notable success with their new instruments on August 15. Communication was established between Paris and Raz de Sein, Department of Finisterre, a distance of about 310 miles. The transmitted words were faint, but could be plainly distinguished. The officers are confident that they can make improvements in the apparatus enabling the exchange of conversation up to 600 or 700 miles.

THE NATURE OF THE VOLATILE MATTER OF COAL AS EVOLVED UNDER DIFFERENT CONDITIONS.

BY HORACE C. PORTER AND F. K. OVITZ.

In connection with the fuel investigations being conducted by the Technologic Branch of the United States Geological Survey, a special effort is being made to determine the chemical and physical structure of coal. The chemical investigation is being pursued along three special lines: (1) The chemistry of combustion in the furnace; that is, determining the chemical composition of the hydrocarbons given off during the process of combustion; (2) the hydrocarbons which are given off at different temperatures, starting with a normal temperature and determining the nature of the hydrocarbons given off at each of a series of successively higher temperatures from the normal to the temperature of the ordinary furnace, and (3) the hydrocarbons existing in the coal at normal temperatures to be determined by solution and subsequent analytical methods.

A paper presented by Dr. Horace C. Porter, at the June meeting of the American Chemical Society, of which the present statement is an abstract, relates to the second of these three lines of investigation. Dr. Porter is in charge of the chemistry of the distillates of coal under the United States Geological Survey.

The statement is in part as follows:

It is a familiar fact to retort coke-oven and gas-works operators that the volatile products of coal are largely affected both in quantity and character by the conditions of temperature and rapidity of the rise of temperature in the coal, and by the conditions to which the products are subjected after leaving the coal. The usual laboratory determination of volatile matter serves almost universally as a more or less valuable indication of the coal's adaptability to industrial uses either for combustion, destructive distillation, or gasification. The method for this determination is, however, an arbitrary one and does not duplicate closely that of any industrial operation, nor is the character of the volatile matter produced by the laboratory method known with any degree of certainty. Furthermore, the results by the laboratory method are very sensitive to varying conditions and the influence of such variation on the character of the volatile products has not heretofore been the subject of extended study.

The importance of the rôle played by the volatile matter in all industrial applications of fuel is generally recognized. There are more heat units in the volatile matter in proportion to its weight than in the fixed residue. Pittsburg coal of thirty per cent volatile matter and seven per cent ash has thirty-six per cent of its heat value in its volatile matter, as shown by comparing the heat values of coal and coke. When coal is fired under a boiler, either by hand or mechanically, it first undergoes a process of distillation, and both the quantity and quality of the volatile products and the relative ease of their liberation are concerned very largely in the boiler efficiency and the production of smoke.[1] It is reasonable to suppose that coals of different origin may yield volatile gases carrying different percentages of tarry vapors and heavy hydrocarbons, and may on that account differ in smoke-producing tendencies. A knowledge of the chemical reasons why coals smoke in varying degrees, and why high-volatile coals are hard to burn with maximum efficiency is a necessary preliminary to the taking of intelligent steps toward improvement in these respects.

The gas producer for bituminous and low-grade fuels is coming more and more into favor. Here also the volatile matter in the fuel plays a very important rôle, since at the top of the fuel bed a process of distillation is continually going on. A certain proposed new type of producer will utilize high-volatile fuels, such as bituminous coal, lignite, peat and wood, by passing the hot gases from the producer through the raw fuel in a series of preliminary chambers, thus distilling the valuable hydrocarbon gases (as well as ammonia) out of the fuel before it is charged into the producer itself.

Attention need hardly be called to the pre-eminent importance of the volatile matter of coal in the illuminating gas and by-product coke oven industries. It is of interest to note, however, the increasing favor accorded by the gas industry to the vertical gas retort as most successfully operated by the Bueb system at Dessau, Germany, and to explain that one advantage of this process lies in avoiding decomposition of certain valuable gases in passing over heated surfaces, as occurs in the ordinary processes, although at the same time a higher gas yield is obtained by using higher temperatures in the retort itself.

PURPOSE OF THE INVESTIGATION.

The purpose of the investigation described in this paper has been: (1) To throw light on the nature of the volatile products from coal, and on the manner in which they are affected by the conditions prevailing during their formation or to which they are subjected after formation; (2) to contribute, in the interests of smoke abatement, some data on the comparative amount and character of the gases and vapors distilled from different coals at low temperatures, a subject intimately concerned in the production of smoke; (3) to prove experimentally that the volatile product of coal is to some extent incombustible, and that the proportion of inert volatile varies in different coals; and finally, (4) to show that the oxygen of coal is in many cases evolved in the volatile matter very largely in combination with carbon as CO and CO_2 as well as with hydrogen as water, thereby explaining in great degree the discrepancy found in these cases between the determined calorific value and that calculated by Du Long's formula.

DETERIORATION IN HEATING VALUE AT ORDINARY TEMPERATURES.

In connection with a series of experiments not yet completed, on the deterioration in heat value of various coals during storage under different conditions, a liberation of gas in remarkably large quantities was found in certain cases. About twenty-five pounds of bituminous coal of buckwheat size was stored in a five-gallon glass bottle closed with a rubber stopper, which was provided with glass tubes for removing gas samples. The bottles stood in the laboratory at a temperature ranging from twenty degrees to twenty-five degrees. In some of the bottles the coal was immersed in distilled water and the interstices well filled with water by attaching a partial vacuum for about one hour. About 400 cubic centimetres of air remained above the surface of the water.

The gas liberated during these experiments consisted almost entirely of methane with a very slight amount of CO_2 and no more than doubtful traces of CO and heavy hydrocarbons. No hydrogen could be detected by the palladium fractional combustion method. Whether this gas may properly be considered as volatile matter due to decomposition of the coal, or whether it is held in the coal as such by occlusion or absorption can not be decided without further study. The fact that the oxygen of the air surrounding the coal was rapidly absorbed without

(Presented with the permission of the Director United States Geological Survey.)

[1] William Kent, Steam Boiler Economy; D. T. Randall, Bull 334, U. S. Geol. Survey, "The Burning of Coal Without Smoke in Boiler Plants," page 11; L. P. Breckenridge, Bull 15, Univ. of Ill. Engineering Experiment Station, "How to Burn Illinois Coals Without Smoke," page 7.

forming CO_2, indicates a change of composition in the coal. It is reasonable to suppose that a larger quantity of gas escaped between the mining of the coal and the starting of the experiments than was measured during the experiments. The measurement of quantity of gas formed is, therefore, of little value. The gas pressure in the case of one coal immersed reached at one time seven inches of mercury.

TABLE I—ANALYSIS OF COAL USED IN EXPERIMENTS.

	Moisture.	V. M.	F. C.	Ash.
Connellsville, Pa.	1.10	30 67	60.35	7.88
Zeigler, Ill.	7 67	30 88	54 82	7 63
Sheridan, Wyo.	9.15	39.95	42.92	8.00
Pocahontas, W. Va.	.35	20.93	75.51	3.21

TABLE II—AVERAGE RESULTS OF TEN GRAMMES AIR-DRIED COAL. (TEN MINUTES' HEATING.)

Coal.	Highest Temperature in Coal.	Tar.	Water.	Gas (Ccs.).	Gas Composition. (Calculated to undiluted gas.) CO_2.	Illum.	CO.	CH_4.	C_2H_6(a).	H_2.	N_2.
10 minutes heating at 500 degrees:											
Connellsville, Pa.	335	......	......	8	30.0	......	6.5	6.5	7.0	......	50.0(b)
Zeigler, Ill.	325	......	......	90	14 8	......	5.3	8.0	......	......	71.9(b)
10 minutes heating at 600 degrees:											
Connellsville, Pa.	441	4.9	3.2	190	6.3	8.2	5.9	36 9	23 7	2.0	17.0(b)
Zeigler, Ill.	440	6.8	13.0	173	15.7	7.0	14.4	19.0	22.2	2.8	18.9(b)
10 minutes at 700 degrees:											
Connellsville, Pa.	562	11.0	3.5	583	3 0	7.2	5.4	44.1	17.7	18.5	9.1
Zeigler, Ill.	545	7.8	14.0	471	8.5	5.1	13.7	59.6	......	1.1	12.0
Sheridan, Wyo.	580	8.2	18.5	1,020	28 8	3.7	20.0	18.6	6.8	15.1	7.0
Pocahontas, W. Va.	599	4.2	1.9	675	1.9	4.4	3.9	44.4	16.1	28.5	.8
10 minutes at 800 degrees:											
Connellsville, Pa.	687	12.6	4.5	1,375	1.5	5.5	6.9	24.9	12.1	33.1	16.0(b)
Zeigler, Ill.	680	9.8	18.9	1,251	3.8	3.8	16.0	27.7	6.1	33.7	8.9(b)
Sheridan, Wyo.	......	7.9	19.1	1,780	19.8	2.7	21 4	14.1	4.0	30 0	8.0
Pocahontas, W. Va.	......	6.5	2.4	1,590	1.2	3.4	4 8	24.4	11.6	48.2	11.4

(a) Includes all higher paraffin hydrocarbons calculated as C_2H_6. (See description of gas-analysis methods above.)
(b) Includes small amount of air.

TABLE III—ABSOLUTE QUANTITIES OF SMOKING AND NON-SMOKING PRODUCTS IN TEN MINUTES' HEATING (TEN GRAMMES COAL).[1]

Designation of Coal.	Temperature. Furnace.	Coal.	Smoking Products. Tar. (Per Cent.)	Gas (Ccs.). Illum.	Ethane, etc.	Total.	Non-Smoking Gases (Ccs.) CO_2.	CO.	CH_4.	H_2.	Total.
Connellsville, Pa.	500	335	......	......	0.6	0 6	2.4	0 5	0.5	......	3.4
Zeigler, Ill.	500	325	......	......	......	......	13.5	4.7	7.2	......	25.4
Connellsville, Pa.	600	441	4.9	16	46	62	12	11	71	4	98
Zeigler, Ill.	600	440	6.8	12	39	51	28	25	33	5	91
Connellsville, Pa.	700	562	11.0	42	103	145	18	31	256	78	383
Zeigler, Ill.	700	545	7.8	24	......	24	40	64	281	5	391
Sheridan, Wyo.	700	580	8.2	38	69	107	294	204	190	154	842
Pocahontas, W. Va.	700	599	4.2	30	109	139	13	27	300	192	532
Connellsville, Pa.	800	687	12 6	76	166	242	21	95	343	458	917
Zeigler, Ill.	800	680	9.3	47	76	123	47	200	346	420	1,013
Sheridan, Wyo.	800	......	7.9	48	72	120	355	381	254	534	1,524
Pocahontas, W. Va.	800	......	6.5	54	186	240	19	77	390	691	1,177

[1] Compiled from results in Table II.

VOLATILE MATTER AT 105 DEGREES CENTIGRADE.

A series of experiments conducted primarily for direct weighing of moisture driven off from coal at 105 degrees yielded results, incidentally, which showed the extent of the loss of substances other than moisture, principally CO_2 in small percentages.

VOLATILE MATTER AT 500 DEGREES TO 1,100 DEGREES CENTIGRADE.

In studying the nature of the volatile matter at the medium and higher temperatures (500 degrees to 1,100 degrees centigrade) two sets of experiments were run using a different apparatus in each. In one a small sample (ten grammes) was heated in a platinum retort suspended in an electric resistance furnace maintained constant at the desired temperature, the gases evolved being collected by displacement of water in a bottle. No attempt was made in this set of experiments to duplicate the methods or results of industrial practice. The apparatus was designed with the idea of maintaining definite and controllable conditions which would yield results comparable with each other in experiments on different coals. The other set of experiments was run on a somewhat larger scale, heating 400 grammes of coal in a cast-iron retort resting in a cylindrical electric-resistance furnace, the tar, water, ammonia, CO_2 H_2S, and gas being collected in appropriate absorption apparatus and measured. Owing to the heavy nature of the retort and the large sample of coal the temperature in the coal could not be varied as easily in these experiments as in those using the platinum retort. Accordingly one set of conditions was adopted approximating as nearly as possible those of industrial by-product coke-oven practice, and a number of typical coals compared under these conditions. The object was rather to compare the different coals with each other under this set of conditions, than to determine absolutely the industrial by-product yields; and further to determine the composition of the volatile matter from different coals under these conditions.

SERIES OF TESTS ON TEN GRAMMES OF COAL IN A PLATINUM RETORT.

The series of tests on ten grammes of coal in a platinum retort, at various temperatures, is not yet completed but has yielded sufficient results to show their approximate agreement with those obtained on 400 grammes of coal and also to indicate the composition of the gas produced from different coals in the early stages of heating at low temperatures. A thermo-couple was inserted in the retort so as to determine the temperatures under the surface of the coal itself. The tests were run in an atmosphere of nitrogen which was passed through the retort until the exit gases contained less than one per cent oxygen. The tar was collected in two six-inch tubes of absorbent cotton heated to 100 degrees centigrade and also weighed on the neck of the retort. The water was collected in a five-inch $CaCl_2$ U-tube, and always contained a slight amount of light oil driven over from the tar, causing an error of one per cent or less.

SMOKE FORMATION AND THE COMPOSITION OF LOW-TEMPERATURE GASES.

(During Early Stages of Heating)

From the results given in Table II and in different form in Table III, it may be seen that the low-temperature gases are high in illuminants and the higher homologues of methane, and low in hydrogen. Comparing the four coals at 700 degrees (565 degrees in the coal) where the gas begins to be formed in considerable amount, the Connellsville is the richest of the four coals in illuminants and heavy hydrocarbons and the Pocahontas the highest in hydrogen. The high CO_2 and CO from the Illinois and Wyoming coals accord with other experiments on these coals. The tar at 700 degrees is greater also in the Connellsville coal. The smokeless character of the Pocahontas coal may be connected more or less with the presence of considerable hydrogen in its gas at low temperatures, since the low ignition point of hydrogen tends to assist in the burning of other gases present.

From Table III the bearing of these results on smoke formation may be seen. The smoke-producing constituents of the volatile matter are here considered as including tar, and the heavier hydrocarbon gases; benzene, ethylene and homologues of methane (calculated as C_2H_6). While at 440 degrees (in the coal) the Illinois coal (and probably also the Wyoming) has produced more smoky gases than the eastern coals, at 565 degrees and higher the Connellsville produces much more. This accords with the finding in practice of greater difficulty in burning coals of the Connellsville type without smoke.

CONCLUSIONS DRAWN FROM EXPERIMENTS MADE.

1. Some coals liberate gas during storage, of a composition similar to that of natural gas, and some coals rapidly absorb oxygen from the air during storage without forming CO_2.

2. During drying in air at 105 degrees centigrade some coals lose appreciable amounts of CO_2, and most coals take up oxygen to a considerable extent, but none of those tested showed any considerable formation of combustible gases.

3. The nature of the volatile products distilled from several coals at low temperatures in the early stages of heating vary in different coals in accordance with their smoke-producing tendencies.

4. The volatile matter of coal comprises a considerable proportion of non-combustible matter varying with the type of coal.

5. A modification is suggested of Du Long's heat value calculation for coal based on experimental results showing the distribution of oxygen between hydrogen and carbon.

Fifty years ago this month—August 5, 1858—the first telegraphic messages were exchanged *via* submarine cable between Europe and America, marking a new era in communication and establishing the confidence of the world in the genius and perseverance of Cyrus West Field and his associates.

Dr. Wm. Martin Habirshaw.

At a meeting of the board of trustees of the Habirshaw Wire Company, held on August 17, the following minutes and resolutions were unanimously adopted:

"On Saturday, August 15, 1908, at Saratoga Springs, New York, William Martin Habirshaw died in the seventy-fourth year of his age.

"From early manhood Dr. Habirshaw occupied an honorable and distinguished position in both the business and scientific world.

"After retiring from the United States Navy, where he served as an engineer, he began his career as an analytical chemist, and soon rose to the front ranks in his profession. He became a member of the Chemical Society of London, and of other scientific organizations both here and abroad.

"At an early date he perceived the commercial possibilities of electricity and organized and became president and general manager of the India Rubber and Gutta Percha Insulating Company, a pioneer in this line. His sterling honesty and exceptional scientific ability gave the company a high standing. Its title was recently changed to that of the Habirshaw Wire Company, and he continued to maintain a most active interest in the affairs of the company up to the time of his death.

"For the past five years he had been a sufferer from a disease which he knew to be incurable. During this long period he faced the inevitable with calmness and bravery. His honesty, hospitality, loyalty and exceptional scientific attainments drew around him a large circle of friends to whom his death will come as a deep personal loss, in which we, his close associates and fellow members of the board of trustees of the Habirshaw Wire Company, fully share.

"*Resolved,* That, as a mark of respect for the character of William M. Habirshaw, and as an expression of our loss in his death, the works and general offices of the company be closed on the day of his funeral, Wednesday, August 19, 1908.

"*Resolved,* That a copy of these minutes and resolutions be sent to his family."

New Haven to Build Subway Through New York City.

At a hearing before the Public Service Commission for the First District of the state of New York, on August 12, Charles H. Mellen, president of the New York, New Haven & Hartford Railroad Company, stated that officials of the New Haven system were ready to operate a comprehensive subway rapid transit system from The Bronx to lower Manhattan, New York city. If necessary, the New Haven road will organize a subsidiary company both to build and operate such a system.

Mr. Mellen's declaration was brought out by a question as to whether or not the New Haven road's officials really intended to construct either the New York & Portchester or the New York & Westchester Railroad lines. Both of these systems are now controlled by the New Haven road. Mr. Mellen explained that his idea was that the New Haven Railroad management would organize a separate company for the purpose of operating a comprehensive rapid transit subway line in Manhattan and The Bronx. He stated that negotiations had been carried on with representatives of the elevated and subway systems, and that these negotiations would be renewed.

Prosperous Connecticut Tramway.

According to advices from Hartford, Ct., the directors of the Bristol & Plainville Tramway Company have voted a fifty per cent stock dividend. This means that there will be an increase in the capital stock from $250,000 to $375,000 and that the holders of the stock will get their *pro rata* share without a cent of extra outlay.

The company was organized in 1895 as a consolidation of the electric light and the tramway business of the town. When some outside parties tried unsuccessfully to buy the control of the company two years ago the leading stockholders got together and pooled their holdings for five years under trustees, and that has three years more to run. The president of the company is Miles Lewis Peck.

BOOK REVIEW.

"Drawing Instruments." Walter G. Stephan, M.E. New York. McGraw Publishing Company. Cloth. 112 pages. Illustrated. 5 by 7½ inches. Furnished by the Electrical Review for $1.

In this little work the author gives a number of useful suggestions for the selection, proving and care of drawing instruments of all kinds. He considers not only the drawing pen, the tee square and scale, but the more elaborate devices as well and describes a number of useful little appliances which the draftsman will find convenient. There are a few words also on the planimeter, pantograph and other similar devices.

THE NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

ITS GROWTH AND WORK.

In the year 1901 the electrical contracting business had hardly risen to the dignity of a recognized position in the building trades of the country, and almost any one with a screw-driver or pair of pliers advertised himself as an electrical engineer and contractor.

This condition made the reputable contractors feel that something was necessary to improve the trade conditions, and they believed that such improvement could only be brought about through an organization that was national in its character.

With this end in view a meeting was called in Buffalo, N. Y., on July 17, 1901, to discuss the advisability of forming a national organization composed of electrical contractors.

It was evident from the attendance at and interest in this meeting, that such an organization was believed to be a necessity throughout the country.

Many delegates who attended this first meeting represented a number of contractors from the cities in which they did business and consequently were unable to take definite action at the time of the meeting.

The sentiment, however, was so strongly in favor of an organization that the National Electrical Contractors' Association was formed at this meeting with a membership consisting of thirty-one contracting concerns.

From then until the present time there has been a steady growth, and the organization now has a membership covering practically the whole country and including a large proportion of the electrical contractors. The object of the organization is to improve the conditions in the contracting trade in every possible way, and working with other national organizations in the electrical field it has brought about the recognition of the electrical contractor and made the electrical contracting business a recognized factor in the building industry.

The association has a board of directors composed of prominent electrical contractors throughout the country, and this board is at all times ready to take up any question that the membership deems important.

The special work of the organization requiring constant attention is handled through committees.

One of the most important subjects which confronted the contractor was the question of wiring rules and the inspection of electrical work.

A committee was appointed in 1902 to take up this subject, and the work of this committee resulted in the organization being allowed the privilege of the floor at the meetings of the Underwriters' National Electric Association, and also a membership in the National Conference on Standard Wiring Rules.

The policy of the organization has been to make rules more definite and strict, in order to raise the standard of electrical construction work. Also, to bring about a uniform interpretation and enforcement of the rules as embodied in the National Electrical Code, and much progress has been made along these lines.

The matter of legislation for the licensing of electrical contractors is another matter of great importance to the trade, and the National Association has advocated the passage of proper license laws, both by state and municipal government.

The committee dealing with this subject has collected and is still collecting valuable data, which are furnished to any of the members who desire to take up the question of such laws.

Another subject that early occupied the attention of the association was the difficulty in figuring electrical wiring installations on account of the different symbols in use by the different architects and engineers.

Feeling that a uniform set of symbols would be of great benefit not only to the contractor but also to the architect and engineer, a committee was appointed to take up this subject.

The work of this committee resulted in the adoption of a set of standard symbols which have been adopted by the American Institute of Architects and several departments of the United States Government.

The use of these symbols saves the contractor much annoyance and lots of time in making estimates, and prevents many misunderstandings.

Along this line a committee is now working on the subject of uniform specifications, and will undoubtedly report a draft of such a specification at the next meeting.

The question of labor, which is, of course, important to any organization composed of parties interested in the building trade, has been carefully considered by a standing committee appointed by the association for this purpose.

This committee has collected a great deal of data on the subject, which are available for the use of the members at any time.

In addition to this the ability to obtain information and assistance from all sections of the country is of great benefit to members of the national association.

The question of buying and selling material is one that is always important to a business organization, and a standing committee to consider this subject was one of the first committees appointed by the association.

From the start the organization has felt that the proper regulation of buying and selling conditions could only be accomplished through concerted action by the manufacturers, jobbers and retailers, or in the electrical business, the contractor.

The association is working along these lines and believes that eventually a condition will prevail that will be satisfactory to all parties interested in the electrical industry.

Believing that improvement always results in co-operation in any line of business, the organization has a special committee which is a part of the Co-operative Electrical Development Association, and it is believed that working with this organization will result in benefits to the contractor as well as to the electrical business in general.

In connection with the work of the national association, a publication was started in 1901 called *The National Electrical Contractor*.

It seems an almost self-evident fact that under existing business conditions, organization is necessary in every line of trade, and considering the broad lines on which the National Electrical Contractors' Association was formed, and the extremely moderate fees for membership, it should be supported by every reputable contractor in the country, who is interested in the advancement of the business.

Reconstructing the Hauser Lake Dam.

On July 28 construction forces of the Stone & Webster Engineering Corporation began clearing the site of the Hauser Lake dam, preparatory to the work of erecting a new structure. The contract for this work was signed with the Missouri River Power Company on July 11. It provides for the construction of the Hauser Lake dam, together with a second dam and power plant of 30,000 horsepower at Wolf Creek, on the Missouri River, a few miles below Hauser Lake. Both plants will supply Helena and Butte, Mont.

It will be remembered that quite recently the Hauser Lake dam was destroyed as the result of extreme high water in Wolf Creek.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

ONEIDA RAILWAY COMPANY.

The report of the Oneida Railway Company, Oneida, N. Y., for the quarter ended June 30 shows gross of $73,029; expenses, $44,061; net, $28,968; other income, $52; charges, $5,540; total income, $29,020; surplus, $23,480.

UTICA & MOHAWK VALLEY RAILWAY COMPANY.

The report of the Utica & Mohawk Valley Railway Company for the quarter ended June 30 shows gross of $273,162; expenses, $157,277; net, $115,884; other income, $3,186; total income, $119,071; charges, $81,859; surplus, $37,212; an increase of $31,599 over the same period of last year; cash on hand, June 30, $79,640; profit and loss surplus, $538,789.

NEW YORK & NEW JERSEY TELEPHONE COMPANY.

The report of the New York & New Jersey Telephone Company for the six months ended June 30 shows gross of $4,514,512; expenses, $3,245,354; net, $1,269,158; interest, $78,117; surplus, $1,191,041; dividends, $883,225; surplus, $307,816; an increase of $15,690 over the same period last year.

SYRACUSE RAPID TRANSIT RAILWAY COMPANY.

The report of the Syracuse Rapid Transit Railway Company for the quarter ended June 30 shows gross of $321,736; expenses, $184,168; net, $137,568; other income, $1,112; total income, $138,680; charges $103,937; surplus, $34,743.

THE MEXICAN TELEPHONE AND TELEGRAPH COMPANY.

The report of the Mexican Telephone and Telegraph Company for the three months ended May 31 shows gross of $93,194; expenses, operating, $37,706; maintenance, $13,776; net, $41,712; construction, $20,812.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

The report of the associated Bell companies, not including the long-distance lines, of the American Telephone and Telegraph Company for the month of June and six months ended June 30 shows: For June—telephone revenue, $10,012,700; general operating and maintenance expense, $7,388,300; net, $2,624,400; sundry earnings, net, $151,800; total net earnings, $3,076,200; interest, $644,700; available for dividends, $2,431,500. From January 1 to June 30—telephone revenue, $58,827,400; general operating and maintenance expenses, $43,424,700; net, $15,402,700; sundry earnings, net, $2,509,400; total net earnings, $17,912,100; interest, $3,902,600; available for dividends, $14,009,500.

CANADIAN GENERAL ELECTRIC COMPANY.

The report of the Canadian General Electric Company for the year ended December 31, 1907, shows profit on operation of $722,433; interest written off, etc., $368,206; balance, $354,227; dividends, $488,000; deficit, $133,773; previous surplus, $69,035; profit and loss deficit, $64,728. On April 1, 1908, a quarterly dividend of one and three-quarters per cent was paid on the $4,700,000 common stock, and a semi-annual dividend of three and one-half per cent on the new preferred stock, reducing the annual rate on the common stock to seven per cent.

W. R. Brock, president of the company, says: "The company has continuously, for the past nine years, paid a dividend of ten per cent, but the directors have considered it prudent to make the reduction (to seven per cent) in view of the present uncertainty of trade conditions, which we may all hope will only be temporary.

"The payment of a ten per cent dividend commenced in 1899, and from that time until the end of 1907 $2,478,469 has been paid out in dividends. Since 1900 $1,161,504 has been written off. A surplus of undivided profits and premiums on stock issues is carried forward, amounting to $1,763,668, and there is a balance at the credit of profit and loss of $73,906. The total of all these items (not including payment of interest on borrowed capital) reaches the sum of $5,477,548, which we believe is a most creditable showing for a rapidly expanding industry which charges all experimental and development work to operating expenses."

ILLINOIS TRACTION SYSTEM.

The report of the Illinois Traction System for the year ended December 31, 1907, shows gross earnings, interurban, $1,610,257; local street railway, $1,226,591; gas, $259,572; electric light and power, $542,032; steam heating, $127,453; miscellaneous, $13,282; total gross earnings, $3,779,187; operating expenses, $2,065,424; taxes, $63,063; net earnings, $1,650,699; interest on bonds, $985,631; dividends on preferred stock, $201,953; surplus, $453,115.

The system extends from Danville, Ill., westerly to Urbana, Decatur and Springfield, and northerly to Peoria and Bloomington, and southerly *via* Staunton and Edwardsville to East St. Louis, with extensions building or projected to St. Louis, Mo., and Jacksonville, Ill. There were 8,132,069 passengers carried, the car mileage operated, including company freight, being 5,336,721. The average fare per passenger was 17.54 cents. The gross earnings per revenue car-mile were 31.49 cents. The passenger earnings per passenger-car-mile were 30.55 cents. The express and freight earnings per express and freight-car-mile were 33.13 cents. The total expenses per car-mile were 17.34 cents. These figures are for interurban lines only. On the city lines 26,276,649 passengers were carried, and 6,594,500 car-miles operated. The gross earnings per mile of track were $11,525. The average fare per pay passenger was 4.66 cents. The gross per car-mile was 18.2 cents. The expenses per mile were 9.76 cents.

CHICAGO RAILWAYS COMPANY.

The report of the Chicago Railways Company for the month of May and four months ended May 31 shows May gross of $902,482; expenses, $600,353; May net, $302,129. Four months' gross, $3,384,475; expenses, $2,399,831; four months' net, $984,644; an increase of $54,534 over the same period of last year.

KANSAS CITY RAILWAY AND LIGHT COMPANY.

The report of the Kansas City Railway and Light Company for June shows gross of $515,441; expenses, $298,735; net, $216,606; interest and taxes, $155,318; June surplus, $61,288.

INTERNATIONAL RAILWAY COMPANY.

The report of the International Railway Company, Buffalo, N. Y., for the quarter and six months ended June 30 shows as follows: April 1 to June 30—gross, $1,084,540; expenses, $658,797; net, $425,743; other income, $17,846; total income, $443,589; charges, $254,537; surplus, $159,052. January 1 to June 30—gross, $2,072,171; expenses, $1,319,060; net, $753,111; other income, $33,704; total income, $786,815; charges, $566,967; surplus, $219,848.

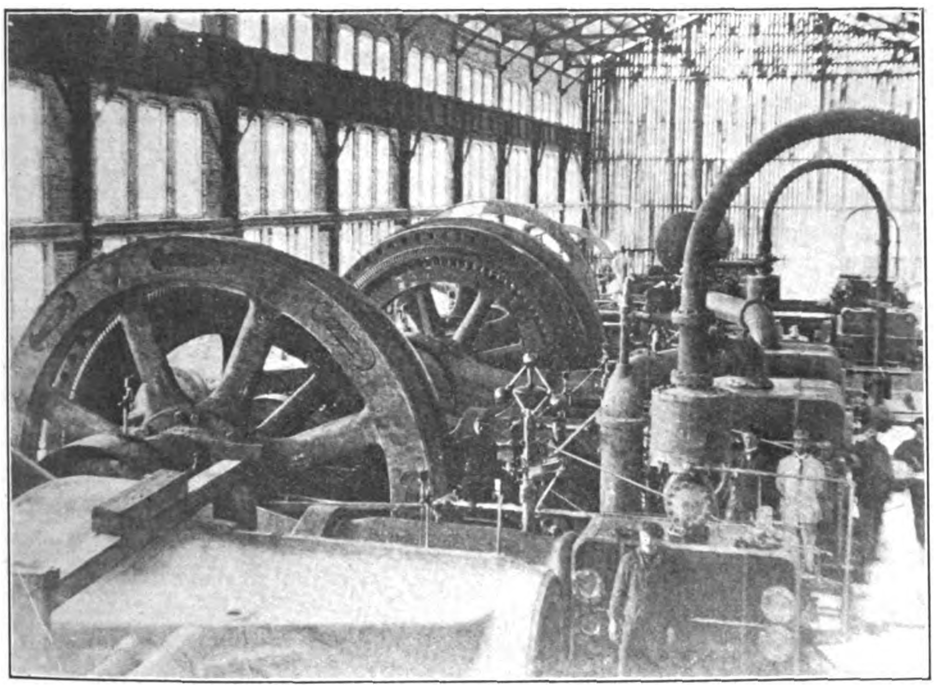
ROCHESTER RAILWAY COMPANY.

The report of the Rochester Railway Company for the quarter ended June 30 shows gross of $659,094; expenses, $435,528; net, $223,565; other income, $1,066; total income, $224,571; charges, $122,490; surplus, $102,082. This compares with a surplus of $111,012 for the same period of last year.

The Equipment of a Great Smelter — Electrically Operated.

The power-house of the Steptoe Valley Smelter, which compares favorably with the magnitude of the works of which it is a part, says Leroy A. Palmer in the *Mining World,* represents an outlay of $800,000. The boiler room is 240 feet by fifty-five feet, steel frame, iron sheathed, containing nine 400-horse-power Babcock & Wilcox water-tube boilers with Foster internal superheaters generating steam at 150 pounds pressure. One of these boilers is used to superheat the steam from three similar boilers placed in the flues of the reverberatory building and using the waste heat from the furnaces. It is expected that sufficient power will be obtained from this source to run the concentrator. The other eight boilers are arranged in two batteries of four each, fuel being fed by American stokers, which receive it by gravity from the bins. The two batteries are identical, except that one is equipped with Sturtevant and the other with Green fuel economizers. Each has a steel stack eight feet in diameter and forty feet high. Boiler draft is furnished by a National blower and stack draft by a Sturtevant blower. The ashes are discharged into a launder in the concrete floor beneath the grates and flushed out. The feed-water passes through the economizers and filter before it is injected into the boilers, a ten by eighteen by eight-inch Epping & Carpenter twin-tandem and two ten by seven by ten-inch Snow pumps being used for this purpose. By means of this preliminary heating and the use of the water from the condensers the boilers receive their feed at a temperature of about 250 degrees Fahrenheit, effecting a considerable economy in fuel, and the condenser water being distilled does not scale the boilers, materially reducing the cost of maintenance.

The power-house adjoining the boiler room is built of brick on a steel frame with reinforced concrete foundation and piers, occupying a ground space 320 feet by sixty feet. The main floor contains the switchboard, two exciters, one steam and one motor-driven, and eight condensing engines as follows: Two cross-compound Corliss, thirty-one by sixty-six by forty-eight inches; two twenty-two by forty-eight by forty-eight-inch Allis-Chalmers cross-compound Corliss, the latter direct-connected to 800-kilowatt generators and the former to 1,500-kilowatt generators, all of Allis-Chalmers Company's build; one Allis-Chalmers cross-compound Corliss duplex tandem compressor, sixteen by thirty-four by forty-eight by thirty-four, having a capacity of 6,000 cubic feet of free air per minute, supplying low-pressure air to the furnaces; one cross-compound Corliss tandem-connected duplex compressor, steam cylinders twenty-five by fifty-four by forty-eight inches and air cylinders forty-eight by forty-eight inches, having a capacity of 12,000 cubic feet of free air per minute, furnishing low-pressure air to the furnaces; one cross-compound, tandem-connected, two-stage compressor eleven by twenty-one by twenty-one by twelve by eighteen, capacity 980 cubic feet of free air per minute, supplying air at 100 pounds pressure for the forges and construction work; one tandem compound Corliss, direct-connected to a No. 10 Connersville blower with a capacity of 300 cubic feet of free air per revolution.



Steptoe Valley Smelting and Refining Company, McGill, Nev. Two 800-Kilowatt Allis-Chalmers Generators Direct-Coupled to Two Cross-Compound Engines.

These engines are equipped with steam reheaters by which the exhaust from the high-pressure cylinder is heated, thereby raising the temperature and consequently the pressure of the steam before entering the low-pressure cylinder. Steam-driven vertical pumps exhaust the air from the condensers, to which cold water is supplied by pressure from the main, doing away with the water pump usually used in this connection.

Electricity is generated at 660 volts and transmitted to a concrete transformer house where it is stepped up to 40,000 volts for transmission to the mine and 13,200 volts for transmission to the concentrator, where it is retransformed to 550 volts.

All motors are Allis-Chalmers three-phase, alternating-current, operating at 550 volts. Among these motors the following equipment may be mentioned:

First Floor—Six sets of rolls and twenty-four trommels driven by two 150-horse-power motors; twenty-four jigs and twenty-seven Wilfley tables driven by one seventy-five-horse-power motor; two elevators, each driven by a ten-horse-power motor. Jigs and trommels are on a raised platform above the floor proper.

Second Floor—Eight Huntington mills, driven by two seventy-five-horse-power motors; four elevators and eight Callow screens driven by four ten-horse-power motors (the screens on an elevated platform), and seventy-nine Wilfley tables driven by a seventy-five-horse-power motor.

Third Floor—Ninety-six Frue vanners driven by a seventy-five-horse-power motor.

Building and machinery piers and floors are of reinforced concrete, spaces being left in the floors to serve as launders. The building itself is steel frame, iron sheathed.

In general, all machinery is so installed as to be most convenient for operation and repairs, although there are some changes that would commend themselves to the practical mill man. All elevators are in pairs, set very close together with the boots some feet below the floor level, and on the roll floor so close to the rolls as to be extremely difficult of access in case they choke down.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Some Aspects of the Power Problem for the Textile Industry.

Each of the various methods employed for driving textile mills has certain peculiar advantages, so that the problem of selecting a drive for such a mill is not always easy. The electrical drive has shown excellent results, and its advantages have frequently been pointed out, though usually in some general terms. In this article C. J. Cavanagh considers them more specifically, and points out wherein this system is better than the others. The requirements of the textile industry are characteristic. The materials worked with are neither coarse nor heavy, but extremely fragile, and consequently the machines required to work them must be sensitive and as free from cyclic variation as possible. In the cotton industry, the evenness of turning is of first importance, and this necessity is much more emphasized in the jute and flax industries, where the materials worked have not the elasticity of cotton. It is the ability thus obtained to run the mill constantly at full load, thus securing an increased rate of production, that justifies the installation of an electrical equipment, because the interest on capital charges for an electrical system will increase the cost of power; and a well-installed, carefully maintained rope drive will give rise to very small frictional losses. However, in addition to the improved running conditions secured by the electrical system, this method brings advantages to a growing mill, as changes can be wrought easily and expansions effected with convenience. There is no loss in transmitting power to idle machines, and a hot bearing affects only the particular machine on which it occurs; in a mechanical drive, when a hot bearing may shut down a whole line shaft and stop production, the loss which it causes becomes severe. In selecting a type of motor for a textile mill, two complicating conditions are met. The polyphase induction motor is simple in operation and is sparkless; but its speed can not easily be regulated. The direct-current motor, on the other hand, is ideal for speed regulations, and simple in operation, but sparking at the commutator can not always be avoided. In a textile mill, where the air is full of fluff, sparking introduces some danger. In deciding between group or individual driving, the commercial factor enters largely into the question. With some machines, the power absorbed is so small that it is not advantageous to make use of an individual drive as these low-rated motors run at high speeds and generally necessitate some form of reducing gear. This increases the cost and the losses, and the liability to breakdown. In some cases the nature of the load renders group driving imperative. The ideal method of supplying power for the mills would be the erection of a central station, from which power would be distributed through a group of local mills. This would not only decrease the capital outlay by the mills, but would result in a more reliable and more efficient station. The type of prime mover most used to-day in textile mills is the steam engine, but the steam turbine has a distinct advantage in the uniformity of rotation, and hence is coming into use. The gas engine offers the mill a very efficient prime mover, but until greater reliabilty is secured, it will not make very great headway.—*Abstracted from Cassier's Magazine (New York), August.*

Diversity-Factors.

The "diversity-factor" is defined as the ratio of the sum of all the consumers' maximum demands to the maximum demand on the station. F. Fernie thinks a better definition is the following: "The diversity-factor is that number by which the sum of the consumers' maximum loads must be divided in order that this sum may equal the maximum observed load on the station." The author then discusses the use of this factor in determining the cost to the station of supplying any one consumer. According to the maximum-demand system, the cost is made up of three parts: That part of the capital charge per kilowatt which depends on the station's maximum demand, multiplied by the maximum demand of the consumer, and divided by the diversity-factor: to this must be added that part of the capital charges per consumer, which depends on the number of consumers; and a charge depending upon the number of kilowatt-hours used, multiplied by the running cost per kilowatt-hour. This method of charging assumes that every consumer affects the station's maximum load in the same way, but it is very certain that at the time of maximum load on the station some consumers will be making no demand, some perhaps half their maximum and some their full maximum; hence the method of charging is not entirely logical. If, instead of considering individual consumers, one considers groups of consumers, each group consisting of consumers of a similar class, at an approximately similar load-factor—that is to say, each group consisting of shops or residences only—consumers of similar class, having approximately similar load-factors, may then be supplied at a similar cost per unit: and for any station there is a certain consumers' load-factor above which the cost per unit alters very slowly; hence a group of high-load-factor consumers may vary a good deal among themselves and still be charged at a uniform rate, without any great error. The consumers being split up into groups, the question then arises, What is the correct rate per kilowatt-hour for each group? This must depend on the maximum demand made by the group on the station. The maximum demand of any group depends on the class diversity-factor of the group: that is to say, on the diversity-factor existing among the members composing the group. This factor will have very different values for different groups. The total cost is then made up of three items: The actual running cost for the number of kilowatt-hours used: an item to cover that part of the capital charges per consumer, which depends upon the number of consumers in the group, and a charge depending upon the diversity-factor of the individual and of the group. The latter item is found by dividing the sum of the maximum demands of the individuals in the group by the diversity-factor of the group, and dividing this again by the diversity-factor of the group as a whole. The quotient is then multiplied by that part of the capital charges which depends upon the station maximum demand. The author shows how this method of charging will affect the cost of the supply to different classes of consumers; for example, shops which close early should be charged about sixteen cents a kilowatt-hour; banks and offices, about fourteen cents; shops which close late, from six to twelve cents; private houses, from six to four cents; power consumers, two cents or less; railways, one and one-half cents or less, etc. In applying this method there would be some difficulty in determining the diversity-factors, but by careful grouping of consumers, and judicious selection of individuals whose maximum rates are determined, these factors can be found without much labor. It is a good plan to supply consumers at separate rates for light and power, but this calls for separate wiring, which is always objected to; hence a combined light and power rate might be adopted, and this would doubtless lead to a rapid development in the sale of small motor-driven appliances for household use.—*Abstracted from the Electrician (London), July 24.*

Generation and Electrical Transmission of Power for Main Marine Propulsion and Speed Regulation.

An abstract is given here of a discussion by W. B. Durtnall of the various electrical schemes proposed for adapting the steam turbine, which is inherently a high-speed machine, to driving ships' propellers, which run best at much lower speeds. These plans in general contemplate the direct driving of the generator of either the direct or alternating-current type, and furnishing power to a slow-speed motor whose speed can be changed at will. The plans also make it unnecessary to install a reverse turbine, and they bring the control of the vessel more under the hand of the navigating officer. In one of these plans synchronous generators drive induction motors wound to give three speeds ahead; in another, single-phase commutating motors are employed; in a third, the turbines are directly connected to the propeller shafts at full speed, but are disconnected at low speeds, when the propellers are driven by motors drawing their power from a separate turbine unit. The author prefers a direct-current system for low power, and a three-phase, alternating-current system for large powers, using squirrel-cage induction motors with stator windings providing three speeds, coupled to the propeller shafts. He then compares a system of this kind with direct propulsion by means of steam turbines. Assuming a vessel provided with four propellers, each requiring 1,000 brake-horse-power at 250 revolutions per minute to drive it, if polyphase induction motors with wound stators be adopted there should be two turbo-alternators with exciters capable of generating between them 3,250 kilowatts and running at a speed of 1,500 revolutions per minute. At full speed the turbines would consume about sixteen pounds of steam per kilowatt-hour, or 52,400 pounds total. This corresponds to thirteen pounds per shaft horse-power-hour, which compares favorably with what would be required if direct-coupled turbines, working under similar speeds and circumstances, were adopted; as in the latter case the consumption would be about twenty-two pounds per horse-power-hour, or 88,000 pounds per hour. The electrical transmission would, therefore, save about 36,000 pounds of steam per hour, which is forty-one per cent, and would reduce the boiler capacity in the same proportion. At half-speed one of the alternators could be shut down, and the steam consumption would then be about 17,760 pounds per hour. This is allowing the generator twenty-four pounds of steam per kilowatt-hour, at a load of 740 kilowatts. Under the same conditions, direct-connected turbines would consume about 28,200 pounds of steam per hour; so that the electrical drive shows a saving of about thirty-seven per cent under these conditions. The author estimates that the total weight of the electrical system would be 184 tons. The weight of the direct-connected turbines would be 148 tons, so that the former equipment weighs twenty-five per cent more. These figures do not include the boilers. The boiler equipment for the electrical system would weigh about 260 tons, while that for the direct-connected turbine system would weigh 440 tons, a difference in favor of the former of 180 tons.—*Abstracted from the Electrical Engineer (London), July 24.*

Teaching Mathematics to Engineering Students.

Practising engineers are to-day showing an unusual amount of interest in the education of young men for this profession. Charles F. Scott has for some time paid considerable attention to the subject, and has frequently expressed himself on various phases of the problem presented to the colleges. He here gives his views of what should be attempted in teaching mathematics to the engineering student. Recent classifications of the graduates of technical colleges show that not more than one-half are in occupations requiring advanced mathematics, and probably not more than one-third of the men classed as mechanical and electrical engineers ever use anything higher than simple arithmetic: hence a goodly proportion of engineering graduates do not need to be mathematical experts. Their mathematical studies need not aim to produce experts, but should have as a principal object mathematical training, which is a most efficient training in an engineering course. On the other hand, engineers who do have practical use for the higher mathematics find that their ability as engineers is, in a large degree, determined by their ability as mathematicians. Engineers are apt to use ordinarily the methods with which they are most familiar and which will bring the result with the least effort; hence skill in the use of mathematics is the really essential thing. A judicious use of arithmetic, with a little algebra, or a simple diagram, often leads to more satisfactory results than others can secure through more elaborate processes. The pure mathematician delights in relations, and, so far as possible, divorces his equations from actual phenomena and gives them abstract expression. The engineer, on the other hand, is concerned with the natural phenomena; he demands a physical conception, and the medium of expressing this relation is of secondary consequence. In the teaching of mathematics for its own sake stress is apt to be laid upon the process of deriving results, rather than on the real meaning of the results themselves. In teaching mathematics, the first difficulty is that the work must be laid out for the average student, as there is no possibility of differentiating between the men who will need only the simplest processes and those who should have more advanced training. The student should have enough mathematics to enable him to demonstrate the important engineering laws and formulas and to read intelligently mathematically written engineering literature. The student should understand something of the power of advanced mathematics and the field of its efficient application, although he may not be expert in using it himself. If mathematics is something for engineers to use, let its use be taught to engineering students. After the fundamentals are learned, students should attack the engineering problem at once, and bring in mathematics as a means of solving it. In mathematical training it is quality, rather than quantity, which is of first consequence. It should develop facility in systematic and logical reasoning, thus furnishing a general method, as well as a specific means of getting results. The mathematical teacher must be in sympathy with engineering work, and have a just appreciation of its problems and its methods; he must be imbued with the spirit and the ideals of the engineer.—*Abstracted from Science (New York), July 31.*

INDUSTRIAL SECTION

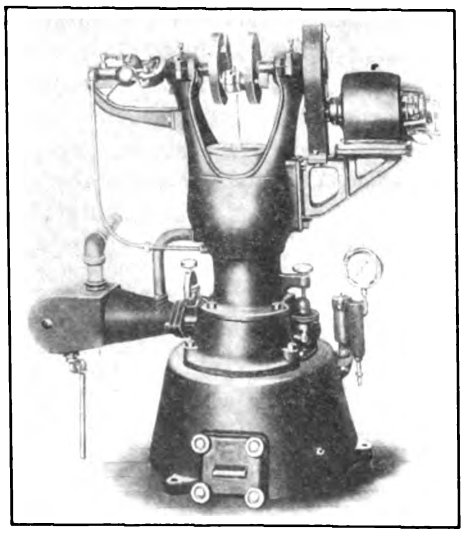
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Vacuum Cleaner.

Many types of vacuum cleaners have been developed in the past few years for all sorts of conditions. For office buildings, hotels, theatres, large residences, etc., no type is so satisfactory as that forming a permanent part of the building, as there is nothing to handle but the light hose and tools.

A pump in the basement driven by a small motor does the work. Special pipes are provided with neat outlets in convenient locations on the various floors. At these points a flexible hose may be attached and the surrounding floors, walls, ceilings, furniture and upholstery thoroughly cleaned and renovated.

One of the most satisfactory of these systems is that supplied by the Palm Engineering Company, of Detroit, Mich., which is herewith illustrated and which can be installed in any building, either old or new, at a low cost and without inconvenience.



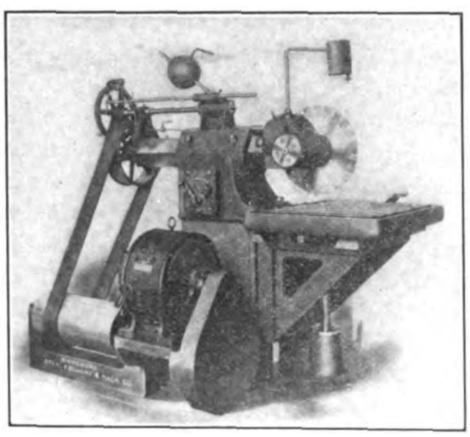
MOTOR-DRIVEN VACUUM CLEANER.

The motor and the pump are of very rugged and substantial construction, so that but little attention is required. The motor is of standard Westinghouse design of one-half-horse-power capacity, and is ample to do all the work required. The pump is of the plunger type, but has a loose-fitting piston. The feature of the system is the means adopted for obtaining the vacuum with this loose-fitting piston. Water is supplied to the cylinder and produces the effect of a tight piston without the friction and wear which would result from the dirt and dust if the piston actually made contact with the cylinder; in all other systems some sort of dust separator is required to prevent the dirt from entering the working parts.

The entire outfit is very compact and substantial and is constructed with the idea that it may be operated by persons with but little knowledge of mechanical devices. It is entirely self-contained and requires no foundation except a good floor.

The Wagner Cold Saw.

The changes which are taking place in machine tools at the present time have the object of greater production with greater ease of control. A majority of these changes are due to the adoption of electric motors for the driving power. The accompanying illustration shows a very good example of the latest development of the Wagner cold saw, manufactured by the Birdsboro Steel Foundry and Machine Company, equipped with the Westinghouse type "S" direct-current semi-enclosed constant-speed motor. The method of mounting makes a most compact unit, which can be located at any convenient point in the shop.



WAGNER COLD-SAW

The cross-feed of the work table, in connection with the vertical movement, enables the work to be brought up to the saw without blocking, except enough to level the casting. This saw is especially designed for small work, such as cutting off sink heads, and may also be used for cutting mitres or bevels, as the head may be turned through any angle desired.

Where the degree of hardness of the material to be cut varies considerably, the peripheral speed of the saw must also be varied. For this purpose variable-speed motors are supplied, permitting the speed to be reduced when cutting high-carbon steel.

A large type of cold saw is also manufactured by the same company, which is built in several sizes up to a fifty-inch saw, capable of sawing through a sixteen-inch rod. These saws are supplied with motor drive, with a chain or belt connection, or may be geared direct if desired.

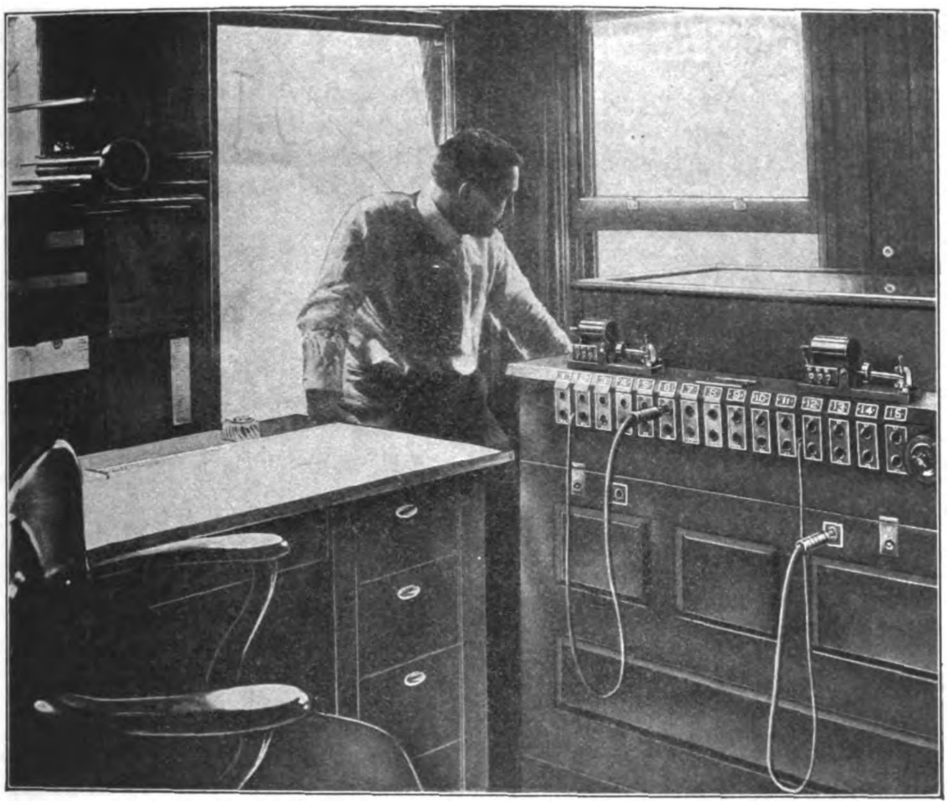
Blake Signals on the Washington, Baltimore & Annapolis Single-Phase Road.

In installing Blake despatchers' signals on a high-voltage, alternating-current, single-phase trolley road, such as the Washington, Baltimore & Annapolis, there were three points that had to be considered which do not enter into an installation on a 550-volt direct-current trolley line:

1. A small amount (about 0.7 ampere) of 550-volt direct current at the despatcher's office for operating the signals.
2. The necessary light at each line signal for night signaling.
3. Would the presence of large amounts of high-voltage, alternating current on the trolley wire and with a rail return, by induction or otherwise, prevent or seriously interfere with the proper operation of the signals?

In the case under consideration the first point was easily settled as there is available at Academy Junction, where the despatcher's office is located, an ample supply of 550-volt direct current. On any road this question could be easily solved by use of a small one-half-horse-power motor-generator set, if 550-volt direct current were not available at the despatcher's office.

For the second question the use of standard railway oil lamps seemed the proper solution for reasons of reliability, economy of maintenance and general practicability. This being settled it was merely a question of deciding upon the proper type of lamp and developing a suitable mechanical connection for it to the signal. Now, in choosing the type of lamp it is



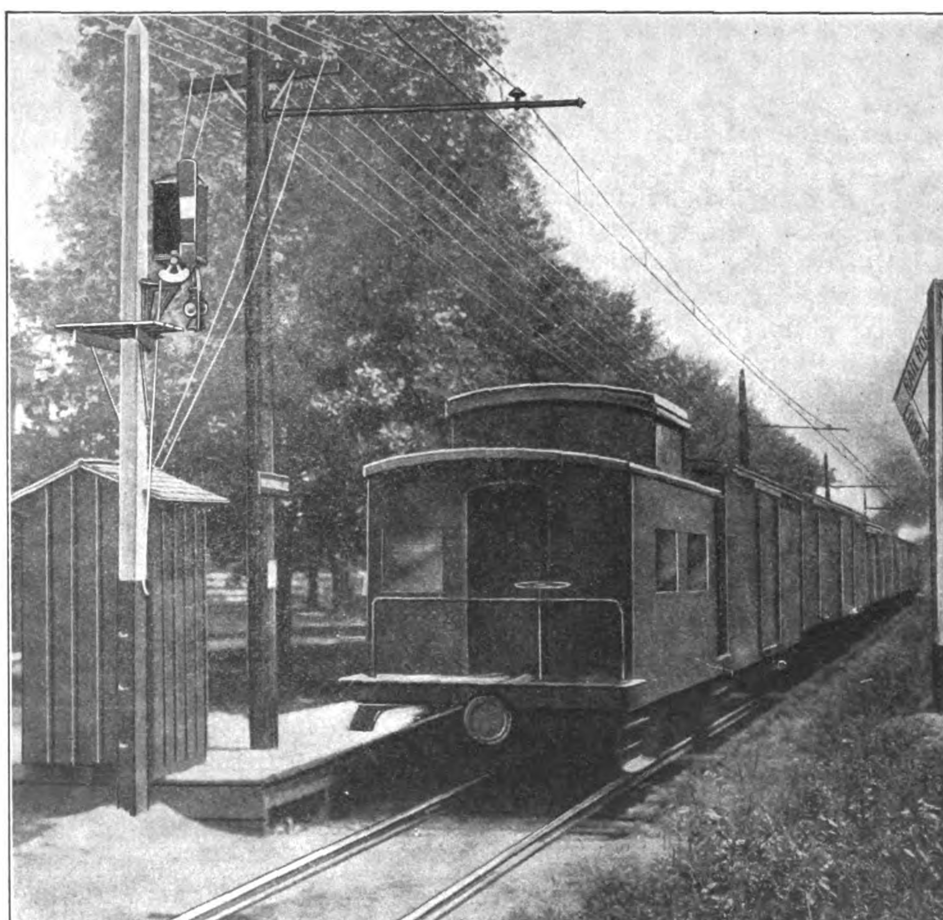
Despatcher's Office, Controlling Blake Signals on the Washington, Baltimore & Annapolis Railway.

to be remembered that the signals are a despatcher's train-order signal and therefore require and have but two positions, namely, "clear" and "stop," the semaphore blade being vertical for the former and horizontal for the latter. Also the semaphore blades on the Blake signal operate in the upper quadrant. On account of there being but two positions it seemed best to use a four-lens lamp, thus doing away with the cumbersome spectacle and additional glassware incident thereto. By reason of the semaphore operating in the upper quadrant it was possible to attach the lamp to the base of the signal suitably and substantially.

The lamp used is a standard four-lens railway switch lamp set upon a substantial and laterally rigid bail or hanger. This hanger is securely pinned to a short, heavy vertical shaft which goes up through the base of the signal and is suspended on a spiral in such a way as to permit of the shaft making a quarter turn. The top of this vertical shaft is also strongly connected with the semaphore shaft, so that the semaphore shaft and hanger shaft turn together, although one in a horizontal and the other in a vertical plane. By using a spiral support for the hanger shaft the weight of the lamp and hanger aids rather than retards the semaphore in going from the "clear" to the "stop" position, and in the event of the breakage of the rod connecting the semaphore shaft and hanger shaft the lamp will, of its own weight, make a quarter turn so as to display a red light. This is on the side of safety and prevents any possibility of the lamp showing a clear signal when the semaphore is at "danger" or "stop" position.

On the Washington, Baltimore & Annapolis a fork type, long-time-burner lamp is used having two green lenses and two red lenses. The hanger is so made that while the lamp is securely set upon it, the lamp itself may be readily removed and replaced, but the lamp can only be put up so that the green lenses show in both directions along the track when the semaphore is in the vertical or "clear" position and the red lenses show in both directions along the track when the semaphore is in the "stop" position. It is physically impossible to set the lamp so that its signal lights are at variance with the position of the semaphore arm. When the semaphore is vertical or "clear" the lamp shows a green light up and down the track. When the despatcher sets the semaphore in the horizontal or "stop" position, as the semaphore arm comes down the lamp makes a quarter turn and shows a red light up and down the track.

The lamps burn constantly and are filled and trimmed twice a week. They are of a standard railway type practically impossible to blow out, and showing a



Blake Signals on the Washington, Baltimore & Annapolis Railway.

steady, bright light visible on tangents for more than a mile.

The third and last point as to whether the signals would operate on a single-phase line could only be satisfactorily and finally settled by putting them up and trying them. It was practically impossible to artificially create for experimental purposes such conditions as would exist on the railroad itself. Several prominent engineers thought that there might be trouble and that the signals would not work. The manufacturers had nothing to go by but the knowledge that they had signals working satisfactorily on the same pole-line with high-tension, three-phase transmission lines, a thorough knowledge of and confidence in the signals themselves and their own opinion as to what probable effect the presence of a large volume of grounded single-phase current would have on the operation of the signals. It came down to the manufacturers having to guarantee at their own risk the reliable operation of the signals under the special conditions existing. This was done, the signals installed on June 24, 1908, which was within eight days from the time the signal line was ready, and the operation of them has, up to date, been absolutely successful without the least hint of trouble or disturbance due to the single-phase trolley line. On the Washington, Baltimore & Annapolis the railroad was willing to and did furnish two No. 10 bare galvanized-iron wires, on glass insulators, for the signal line. While the two wires undoubtedly make a better installation and insure a clearer indication in the despatcher's office, there is no evidence that they are necessary and that the signals would not work as reliably and satisfactorily on one wire as they do in the case of 550-volt, direct-current trolley lines.

Contract for St. Thomas-Toronto Line Awarded.

The contract for the electric transmission line to be built by the Ontario Government from Niagara Falls has been awarded to the McGuigan Construction Company, headed by F. H. McGuigan, formerly general superintendent of the Grand Trunk Railroad, and later with J. J. Hill. The total length of the line to St. Thomas on the west and Toronto on the east is 293 miles. The contract price is $1,270,000. The aluminum cable is to be constructed at Shawinigan, Quebec, and the steel towers in Ontario. The hydro-electric commission has the option of doubling the mileage at the same price.

The Roller-Smith Company.

The Roller-Smith Company was incorporated under the laws of the state of New York with a capital of $100,000 on July 15, with the following officers: President, F. W. Roller; vice-president, F. W. Iredell; secretary, A. A. Whitman; treasurer, D. R. Smith. Directors: F. W. Roller, F. W. Iredell, P. R. Van Wyck, R. S. Taylor, D. R. Smith.

The Roller-Smith Company immediately acquired by purchase all of the properties of the Whitney Electrical Instrument Company, of Penacook, N. H., and of the Switchboard Equipment Company, of Bethlehem, Pa., and assumed all liabilities of both concerns.

It is the intention of the Roller-Smith Company to continue the manufacturing and developing of the lines heretofore manufactured by both of the acquired companies. That this may be done to a greater economic advantage, the company is now erecting in Bethlehem, Pa., a modern factory especially designed for the production of this apparatus. The factory will be completed and machinery installed about November 1, when the present plants of the Whitney Electrical Instrument Company and the Switchboard Equipment Company will be abandoned.

The Roller-Smith Company will manufacture ammeters, voltmeters, ohmmeters, galvanometers, bond testers and circuit-breakers, and such other apparatus as may lie within these general lines. The principal office of the company will be in Bethlehem, Pa., with its sales office at 253 Broadway, New York city, in charge of Machado & Roller, general sales agents.

Mr. Roller, the president of the Roller-Smith Company, has been actively connected with the Whitney Electrical Instrument Company and Machado & Roller for some time. The treasurer, D. R. Smith, has been president of the Switchboard Equipment Company since its organization about three years ago.

The Grinnell Instantaneous Electric Water Heater.

The accompanying illustrations show two adaptations of the Grinnell instantaneous electric water heater, placed on the market by the Grinnell Electric Heater Company, 905 Broad street, Grinnell, Iowa. This heater is made of ordinary pipe and fittings, in which are placed two electrodes. The cold water enters the heater at the bottom, is heated by the electrodes in flowing through, and comes out of the faucet connected with the top of the heater at any temperature desired, the degree of heat being regulated by the flow of water. In Fig. 1 the heater is shown equipped with a switch attachment which turns on both the electric current and the flow of water at the same time. Fig. 2 shows the heater as attached to any bath tub, lavatory or sink. With this arrangement the current is turned on and off at will by a switch conveniently located, while the flow of water is regulated by the ordinary faucet.

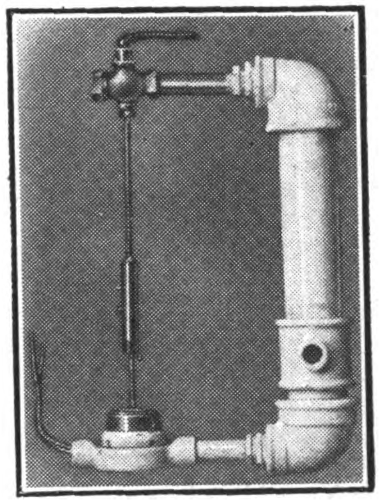


Fig. 1.—Instantaneous Water Heater in Main Pipe Line.

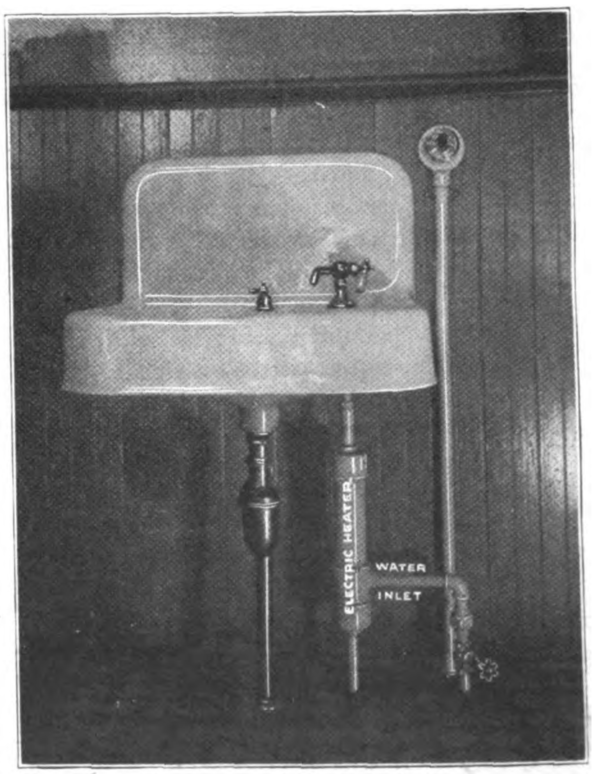


Fig. 2.—Grinnell Instantaneous Water Heater in Water Inlet to Wash Basin.

The company states that careful tests show that one kilowatt-hour will raise ten gallons of water 46.5 degrees Fahrenheit. The heaters are manufactured in sizes from one kilowatt up to any capacity desired.

Illumination of a Railroad Station.

The Union Station at Schenectady, N. Y., besides being one of the most beautiful on any of the New York Central Lines, has been pronounced by experts to be one of the best lighted depots in the country, and the same opinion is voiced by all who have seen the station illumination. When the lighting installation was under consideration careful attention was paid to the lighting units from an esthetic as well as the utilitarian standpoint, and as a result they harmonize well with the gray marble finish of the station interior.

The main waiting room is lighted by General Electric high-current arc lamps equipped with concentric diffusers and opal shades, there being three fixtures suspended from the ceiling and three eight-ampere arc lamps in each fixture. Each lamp is operated in multiple from the alternating-current, sixty-cycle supply circuit. As auxiliaries to the main lighting units, incandescent lights with frosted globes are supported in neat appearing fixtures on the side walls.

Although the arc lamp shown in Fig. 1 is not of the type used in this installation, the illustration will serve to show the relative positions of the diffuser and shade. The lower shade of light opal glass serves to direct the greater portion of the light against the under side of the porcelain covered metal reflector which, it will be noticed, is slightly cone shaped and corrugated. The corrugations serve to thoroughly diffuse the light, the rays being directed outward and downward at every conceivable angle. The resulting illumination is soft and restful, and the light penetrating to all parts of the room eliminates harsh and unnatural shadows.

Comparing this method of lighting with direct lighting, *i. e.*, with arc lamps without diffusers, the consensus of opinion among engineers and architects is that it is by far the better. Although the intensity of the illumination with this method is relatively quite low, it is easier to read or to see any object in the room, and the general effect is more restful than with direct illumination.

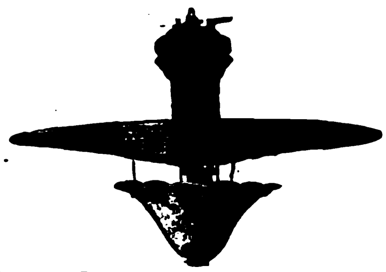
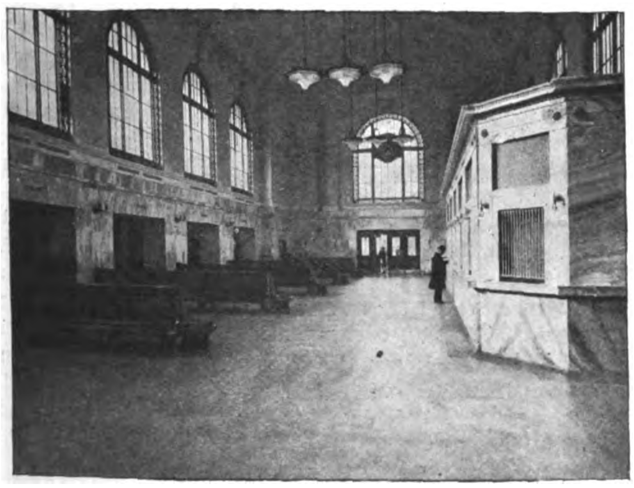


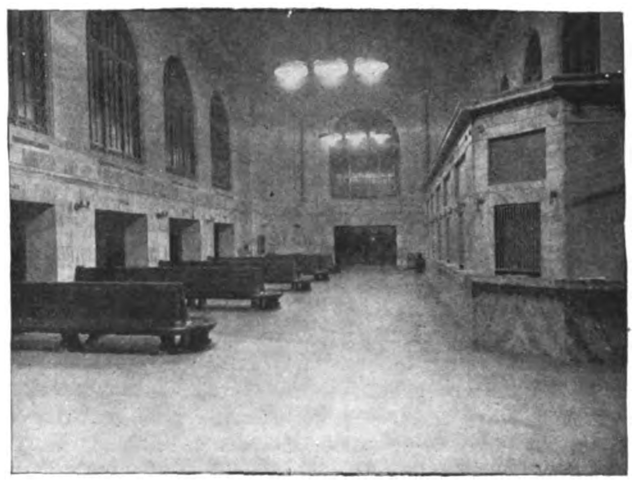
FIG. 1.—DIFFUSING CEILING REFLECTOR.

The accompanying illustrations showing the lighting of the station by day and by night, while giving a general idea of the installation, fail to show the true beauty and effectiveness of the illumination. The following tabulation of data is of interest and may serve as a basis of comparison with other installations:

Length of room..........	103 feet
Width	44 feet
Area	4,532 square feet
Number of arc lamps.....	9
Watts per lamp..........	620
Total kilowatts	5.58
Watts per square foot....	1.22
Height of lamps from floor	23.5 feet



DAYLIGHT ILLUMINATION OF UNION STATION, SCHENECTADY, N. Y.



LIGHTING WITH CEILING DIFFUSERS, UNION STATION, SCHENECTADY, N. Y.

Ceylon Rubber Cultivation.

United States Consul E. A. Creevy, of Colombo, has submitted a report upon the rubber industry of Ceylon, which shows to what extent these new sources compete with Brazil and South Africa. The cultivation of Para rubber in Ceylon dates back to experiments made at the Government Botanical Gardens in 1876. The acreage planted is being rapidly increased, and the estimate of planting for 1908 is 10,000 acres. One hundred and twenty acres will come into bearing this year.

Although the experiments in growing rubber had been attended with success from the first, the industry was not seriously considered by planters until about ten years ago. Even then plantings were small and doubtless would have continued so had not the price of tea fallen appreciably. The development of the automobile, with the consequent demand for rubber tires, so increased the price of rubber that the Ceylon planters took up its cultivation in earnest. The returns for the year 1904 showed 25,000 acres planted, with 600 acres bearing; for 1907, 150,000 acres planted, with 2,500 acres bearing. These figures are approximate only, as tea and cocoa are interplanted with rubber; but if the present prices of rubber are maintained it is probable that the tea and cocoa will be taken out.

It has been estimated by competent authorities that the total amount expended to date on rubber growing in Ceylon is about $9,000,000. It is probable that there are 250 Europeans and from 75,000 to 100,000 coolies engaged in the care of the plantations.

Records of export of Ceylon-grown rubber show that in 1904 it was thirty-five tons; in 1907, 397.2 tons, and from January 1 to May 11, 1908, it was 113.16 tons. London is the chief market for Ceylon rubber, but exports to Antwerp and New York are growing. As the native labor is cheap and furnishes the principal factor in determining the cost, there is said to be less chance of the industry in Ceylon becoming unprofitable through a fall in price than in Brazil or on the Congo.

Current Electrical News

DOMESTIC AND EXPORT.

POWER COMPANIES MERGE—The competition between the Roanoke (Va.) Railway and Electric Company and the Roanoke Water Power Company has been ended with the merger of the two companies. The Roanoke Railway and Electric Company announced that it had bought the Roanoke Water Power Company, which belonged to W. N. Camp, a Florida magnate, and his sons. The Camps recently secured a contract for furnishing the city of Roanoke street lights for a period of years, underbidding the older concern, which previously had the field to itself. The purchase price was not made public. The water power company has a large plant on the Roanoke River, three miles below the city.

NEW INDIANA LIGHT AND POWER COMPANY—Articles of association of the Indiana Lighting Company have been filed at Indianapolis, Ind. The capital stock is $4,500,000. The directors are Franklin L. Babcock, Anthony N. Brady, Charles F. Dietrich, Frank S. Hastings, James P. Lee, Samuel T. Murdock, Henry C. Paul, Albert Tag and James N. Wallace. The company is authorized to supply light, heat and power to Fort Wayne, Bluffton, Montpelier, Anderson, Lafayette, West Lafayette, Logansport, Peru, Wabash, Decatur, Geneva, Crawfordsville, Lebanon, Thorntown and Frankfort, in Indiana, and to Lima, Wapakeneta, Celina, St. Mary's, Greenville, Fort Recovery, North Mercer and Coldwater, in Ohio, and to other villages and towns in proximity to the cities and towns named.

LARGE STEEL CAR PLANT TO BE BUILT IN DELAWARE—It was announced on August 11 at the offices of the Harlan & Hollingsworth Corporation, Wilmington, Del., that the local concern and the Bethlehem Steel Company had been consolidated for the purpose of building in Wilmington a plant for the manufacture of steel passenger coaches and all kinds of steel freight cars. The name of the new company has not been determined; neither has the capitalization been announced. The announcement followed a visit of Charles M. Schwab, president of the Bethlehem Steel Company, and the directors of that concern to Wilmington. The Harlan plant at Wilmington will be rebuilt and enlarged and the largest car shops in the country erected. It is estimated that from twelve to fifteen thousand men will be employed. Work on the plant will begin at once. The Bethlehem Steel Company will make the steel and the cars will be erected in the local plant.

TOLEDO RAILWAY AND LIGHT COMPANY—Albion E. Lang has been chosen to succeed H. A. Everett as president of the Toledo (Ohio) Railway and Light Company by the directors of the company. Warren T. Bicknell, of Cleveland, was elected chairman of the board of directors, succeeding Mr. Lang, the new president. The directors present were: E. W. Moore, of Cleveland; Dr. Demers, of Quebec; W. E. Hutton, of Cincinnati; Barton Smith, A. E. Lang, Spencer D. Carr, J. K. Secor and L. E. Beilstein, of Toledo; W. E. Halsey, of Louisville, Ky., and George Hafer, of Cincinnati. The troubles of the traction company are being worked out gradually. After the appraisement of the property a new corporation will be organized, which will take in the Toledo Railway and Light Company, the Toledo and Western, the Maumee Valley and Toledo and the Ottowa Beach & Northern Traction lines. Each of these companies will go into the new company at the appraised value. The new company will be a $20,000,000 or $25,000,000 corporation. Following this organization will come the application for a franchise.

MILWAUKEE MEN PURCHASE ELECTRIC ROAD—All of the property of the Winnebago Traction Company, Oshkosh, Wis., has been sold at auction for $950,000. This includes the franchises, easements, rights, real estate, tracks, rolling stock, power plants and all other equipment. The purchasers are Oliver C. Fuller, Fred. C. Best and Russell L. Smith, all of Milwaukee. Mr. Fuller is president of the Wisconsin Trust Company, Mr. Reed is its secretary and Mr. Smith is the assistant secretary. The sale was made to the individuals named and not as representatives of the trust company. It is the purpose to reorganize the Winnebago Traction Company with Milwaukee and Oshkosh capitalists as stockholders, officials and directors and with Clement C. Smith, of Milwaukee, as president. An association of interests of the traction company and the Eastern Wisconsin Railway and Light Company will be formed within a short time. The extension of the Omro interurban line to Berlin is practically assured. The Oshkosh lines will be overhauled and repaired and changes made. J. P. Pulliam, the present superintendent of the traction company, will remain in charge as active manager. Only one bid was made, which was $50,000 more than the amount stipulated by the court as the minimum amount which would be approved by the court. The sale was made under the terms that at least $125,000 in cash be paid, bonds of the company being acceptable for the balance. A check for $25,000 was deposited by Mr. Fuller in advance, he being the actual bidder.

CONSOLIDATION OF TELEPHONE COMPANIES IN PENNSYLVANIA—The merging of the Consolidated Telephone Company of Pennsylvania and the American Union Telephone Company, of Harrisburg, has been completed. The Consolidated Company has about 20,000 instruments connected with forty-seven exchanges in the territory extending from Philadelphia to Scranton, Pa., east of the Susquehanna River. This company has a capital of $4,000,000. The American Union Company occupies the territory embracing Central Pennsylvania from Philadelphia to Pittsburg, Buffalo and Erie. It has 187 exchanges in the larger cities and towns of its region with a total of 51,000 telephones attached to its lines, and has a capital of $25,000,000. The merged company will have connections at Trenton, N. J.; Buffalo, Binghamton, Utica, Rochester and other cities in New York state. The following officers have been elected: President, Ellis L. Orvis, Bellefonte; vice-president, F. D. Holck, Harrisburg; secretary and treasurer, S. R. Caldwell, Harrisburg. These officers hold the same positions in the American Union company. Directors: M. Houck and Mr. Orvis, and the following: S. P. Light, Lebanon; James B. Krause, Williamsport; Lyman D. Gilbert, Harrisburg; B. F. Meyer, Harrisburg; James Kerr, Clearfield; J. L. Spangler, Bellefonte; Charles West, Allentown; Timothy S. Clark, Williamsport; Asbury W. Lee, Clearfield, and William Jennings, Harrisburg. With the exception of Mr. Houck and Mr. West, these directors are all on the board of the American Union company.

ELECTRIC LIGHTING.

ST. CATHARINES, ONT.—The city council has passed a by-law canceling the franchise of the Falls Power Company.

TARBORO, N. C.—The town commissioners have authorized J. A. Weddell to purchase another dynamo for the electric light plant.

OGDEN, UTAH—Work on the great Devil's Gate power plant has been started. The cost of the plant will be upward of $350,000.

LAWRENCE, KAN.—Nearly $1,000 will be spent by the University of Kansas installing a permanent system of lighting on the grounds of the campus.

BUFFALO, N. Y.—J. J. O'Leary has been engaged to draw up plans and specifications for the proposed electric lighting plant to be installed at the city and county hall.

DURHAM, N. C.—The Durham Traction Company has been awarded a five-year street lighting contract by the board of aldermen at the rate of $85 per lamp per annum.

HAZLETON, PA.—The Consumers' Light and Power Company, of Hazleton, has been awarded the contract for lighting the streets for a term of ten years at a rate of $55 per light.

FLORENCE, COL.—The Eastern Colorado Electric Power Company, which is establishing a generating plant near Glenwood

Springs, has filed on the undeveloped water of Grape Creek. The purpose of the company is to furnish power for several mills and smelters in this county.

ESCANABA, MICH.—Escanaba's new enclosed arc lights have been placed in commission. Current is furnished from the plant of the Escanaba Power Company on the Escanaba River.

SIOUX FALLS, S. D.—Scotland has decided to have electric lights, and a committee has been inspecting the systems in the surrounding towns. Bids from private concerns will be invited.

MORRISTOWN, N. J.—The Morris & Somerset Electric Company has taken formal possession of the Public Service Corporation's electric plant, the former company having leased it for ninety-nine years.

ELLWOOD CITY, PA.—The council has decided to settle the question of building a new power plant here by allowing the people of the borough to vote on the matter. Plans for a $40,000 plant have been submitted.

ELMIRA, N. Y.—The Wadhams & Westport Electric Light and Power Company, which has a plant at Wadhams, on the Boquet River, and another on the Black River, is installing an additional dynamo to care for its lighting load.

ELSINORE, CAL.—At a meeting of the trustees the committee on electric lights recommended the placing of fifty lights on various streets about town. The electric light company offered to furnish the city lamps to the amount of 1,200 candle-power for $50 a month. The proposition was accepted.

BATAVIA, N. Y.—Seth W. Warren has been appointed permanent receiver of the Batavia Light and Power Company, with a bond of $20,000. The company is solvent, having assets of about $20,000 and few liabilities. The advent of natural gas and Niagara power in Batavia is the cause of the receivership.

ALBION, N. Y.—The Public Service Commission, Second District, has approved of the petition of Sanford P. Church, receiver of the Albion Power Company, for authority to issue $20,000 in receivers' certificates, the proceeds to be used in improving the company's plant in Albion, as required in a recent order of the commission.

LORAIN, OHIO—The special committee of council on the city lighting plant presented an ordinance to the city council appropriating $250 from the board of public service contingent fund for the purpose of employing an engineer to procure data on the cost of constructing a lighting plant. The resolution was passed by a unanimous vote.

GLENS FALLS, N. Y.—The Public Service Commission, Second District, has granted the Kanes Falls Electric Company permission to construct an electrical transmission line in the towns of Fort Ann and Kingsbury, Washington County, and Queensbury, Warren County, and approval of the exercises of right and privileges under these franchises.

FRANKFORT, KY.—The Capitol Commission has signed contracts with Joseph McWilliams, of Louisville, for the erection of the new power-house and the purchase of the electrical supplies for the new capitol. The contract provides that the work must be completed within 130 days after the date of signature, and provides for an outlay of $85,521.

TIFFIN, OHIO—The Tiffin Edison Electric Illuminating Company, of Tiffin, has increased its capitalization from $50,000 to $150,000, because of extensive improvements about to be made at the plant. The buildings will be added to, and new equipment put in. The company has taken a large number of contracts to furnish local manufactories with electric power.

SCRANTON, PA.—An ordinance has been introduced in the city councils providing for the placing under ground of all electric wires in Scranton, including those of the fire alarm and police telegraph systems, and excepting only the trolley wires of the street railway company. The network of overhead wires in some of the alleys and narrow streets has been a hindrance to the work of the fire department..

PANGUITCH, UTAH—A company has been formed here to put in an electric plant about one and a half miles up the Panguitch Creek. It has a capital of $15,000. The officers are John Houston, president; Thomas Haycock, vice-president; Clem Tebbs, secretary; R. Judds, treasurer. Directors, J. J. Page, J. G. Spencer and H. P. Ipsen. The building of the plant will begin as soon as contracts are awarded.

PORT ARTHUR, TEX.—The Port Arthur Water Company is preparing to greatly enlarge its capacity for electric lighting and power. This is made necessary by the demands on the company. The water company now has three sets of generators, two driven by 150-horse-power engines and one by a 100-horse-power engine. The new addition now being added consists of a 500-horse-power engine and generator.

SOUTHOLD, N. Y.—At the annual meeting of the Southold Lighting Company the following directors were elected for the coming year: Dr. Joseph H. Marshall, Thomas Farley, Lewis W. Korn, E. D. Cahoon, Frederick C. Williams, S. Lester Albertson, Frederick K. Terry. The directors elected the following officers: President, Dr. Joseph H. Marshall; vice-president, Frederick C. Williams; secretary, Frederick K. Terry; treasurer, Lewis W. Korn.

COLORADO SPRINGS, COLO.—Alderman Carl Albin has introduced a resolution in the city council that the city at once take steps to secure the water rights granted to Irving Howber and associates to generate power for a Colorado Springs-Cripple Creek electric line, claiming that their successors had failed to keep the terms of the franchise. The resolution characterizes this as the first step toward establishing a municipal lighting plant.

DAYTON, OHIO—The county commissioners have awarded the contract for furnishing electric power for the new county infirmary building to the Dayton Lighting Company. The lighting company will furnish the power at an annual cost of $1,900, the contract to take effect as soon as the service begins. The commissioners formerly intended to install their own plant, but irregularities in the plans and specifications resulted in all bids being thrown out.

CHATEAUGAY, N. Y.—The Up-State Service Commission has acted favorably upon the petition from the Chateaugay Electric Light and Power Company, which asked for consent to transfer its franchise, works and system to the Chasm Power Company. The Chateaugay Electric Light and Power Company has been in business for about eleven years, but with the advent of the Chasm Company was unable to compete with the latter in the matter of giving a twenty-four-hour service.

DANIELSON, CT.—A force of men is at work on the construction of a dam and power plant for the Danielson Cotton Company across the Quinebaug River, a half mile above Cotton Bridge. The site is about five miles from Danielson in a northwesterly direction. The dam will be about 250 feet long and twelve feet high. The power developed will be used in the power plant to be erected nearby. Power will be transmitted over a high-tension line to Danielson for the operation of the machinery in the new addition the cotton company has under way.

MARIETTA, GA.—The Georgia Manufacturing and Public Service Company, a half-million-dollar corporation which supplies the city of Marietta with electric light and water, has been placed in the hands of a receiver, an involuntary petition for bankruptcy having been filed against it by the Atlanta Machine Works, Sciple Sons, and a local paper. The receiver appointed is James T. Anderson, a banker of Marietta. He has been ordered to take charge of the electric light and water-works plant of the company and to continue the operation of them until the further order of court.

HAMILTON, OHIO—Frederick G. Mueller, an architect of Hamilton, is engaged in drawing up plans for a new electric power plant to be constructed and operated by the Hamilton Hydraulic Company and managed by T. A. Jones, superintendent of the Harding Paper Mill, of Excello, Ohio. The new power plant will be owned by the Harding estate, of which Congressman J. Eugene Harding, of Middletown, is a member. Definite plans for the new structure have not yet been completed. The building will be about eighty feet square. Building will begin as soon as plans have been completed.

ALBANY, N. Y.—The Up-State Public Service Commission has granted permission for the operation of a second electric light company in Bath, Steuben County, and surrounding villages and towns upon the ground that the existing company has failed to keep up to the needs of the locality and consequently is entitled to little consideration when it seeks to exclude competition. The opinion, written by Chairman Stevens, states that no general rule can be formulated which will indicate with precision when a new lighting company may be permitted to do business in a field already occupied by another company, and that the circumstances and conditions prevailing must control the decision.

ELECTRIC RAILWAYS.

MONROVIA, IND.—E. M. Bowman is securing the necessary right of way for a trolley line from Mooresville to Cloverdale, passing through Monrovia.

TACOMA, WASH.—The Pacific Traction Company will complete its new line to Steilacoom, beginning work within a few weeks, and having the line in operation before winter.

ATHENS, GA.—The Athens Electric Railway Company will at once put in extra machinery for the generation of 1,000 horse-power in addition to the 3,000 horse-power now available and in service.

PLAINVIEW, TEX.—The City Railway Company has secured a franchise for the construction of an electric street railway in this city. Work will be commenced within a few months, according to C. D. Lovelace.

WATERBURY, CT.—The railroad commissioners have approved of the construction of the Connecticut Company's new trolley line between Waterbury and Thomaston, and the line has been thrown open for public travel.

DES MOINES, IOWA—The Iowa Construction Company has filed articles of incorporation with the secretary of state. The company will build an electric line from Perry to Waterloo, through Ames, Eldora and other towns. Its capital is $100,000.

NEW HAVEN, CT.—The railroad commissioners have approved the petition of the New York, New Haven and Hartford Railroad Company to allow the new trolley line between Hartford and Middletown to pass through the town of Griswoldville.

HUTCHINSON, KAN.—The People's Water, Light and Power Company, of which Emerson Carey is president and general manager, purposes building an electric line extending east and west from Hutchinson, and having a total length of about sixty miles.

BUFFALO, N. Y.—The Buffalo Southern Railway Company is completing its plans for a new line of electric railway from Seneca street to East Aurora along a private right of way for twenty miles. It is estimated that the work will cost upward of $500,000.

NORWICH, CT.—The contract for building the Willimantic and South Coventry trolley has been awarded to Lathrop & Shea, of New Haven, and work will be started within a few weeks. The line is to run from Norwich to Lake Wamgumbaug, a distance of about six miles.

INDIANA, PA.—The directors of the Indiana Street Railway Company have let the contract for the extension of their line from Homer City to Josephine, a distance of five miles. As soon as the right of way is secured the contract for an extension to Blairsville will be awarded.

OREGON, MO.—Active construction work has begun on the Oregon Interurban Railway. The contract is in the hands of M. A. Wagoner, of Leavenworth. The road will connect Oregon, Mo., with the Chicago, Burlington & Quincy Railroad at a point about four miles distant.

HELENA, ARK.—Several capitalists are negotiating with the Helena board of trade for the construction of a street car line in that city. The promoters of the enterprise propose that business men of Helena shall subscribe for one-third of the money necessary to finance the road.

WEST CHESTER, PA.—At a meeting of the directors of the proposed trolley road between West Chester and Pottstown it was decided to construct and equip the road at a probable cost of $200,000, and the contract for construction has been awarded to Charles F. Goldstrohm, of Pittsburg.

LOCKNEY, TEX.—Consideration is being given in this section to a proposed interurban from Amarillo, *via* Tulia and Plainview, through Lockney, Floydada, Emma and Lubbock. W. W. Jones, a farmer of Plainview, who is representing Ohio capital, is urging that the towns along the proposed route give a bonus of $25,000.

PATERSON, N. J.—At a meeting of the directors of the North Jersey Rapid Transit Company, formed to build an electric road from Suffern, N. Y., to Paterson, N. J., the following officers were elected: President, William A. Barbour; vice-president, Malcolm R. McAdoo; secretary and treasurer, H. H. Parmalee. The company is capitalized at $2,000,000. Construction will be started at once.

LOS ANGELES, CAL.—The Pacific Electric Railway Company is expected to begin grading soon from Santa Ana to the beet-sugar factory that is in process of construction two miles from that city on the Newport Beach route. It will be the first section of a trolleyway to run to the sea. The Santa Ana council has granted a fifty-year franchise for the part within municipal limits, and the necessary right of way has been obtained.

NAPOLEON, OHIO—The filing of a $250,000 mortgage here by the Grand Rapids Electric Railway Company to the Cleveland Trust Company to secure funds for use in the construction of the line, has revived hopes that the old Coldwater right of way will be utilized. The proposed route is from Alpena to Grand Rapids and from Grand Haven *via* Grand Rapids south through Michigan and the Ohio counties of Williams, Fulton, Henry and Wood to Fostoria.

BOONVILLE, MO.—Albert Parker, formerly mayor of Topeka, is president of a company incorporated to build an electric railroad in southern Missouri. The company is known as the Kansas City, Ozark & Southern Railroad. The present purpose is to build a line from Mansfield to Ava, fifteen miles, in Douglas County. The line has been graded, and it is expected that it will be completed within four months. There is not now a mile of railroad in Douglas County.

SEATTLE, WASH.—The Seattle Electric Company has begun an extension of its West Seattle lines, and will continue the road from its present terminus near Luna Park around Alki Point for about one and one-quarter miles. The cost of the new work will be $28,000, and about 100 men will be employed. Forty new cars have been ordered by the electric company and are now under construction in the East. They are due to arrive in Seattle within sixty days.

MAUCH CHUNK, PA.—The Carbon Transit Railway, which runs through the Mauch Chunk and over the mountain into Lehighton, familiarly known as the Carbon Street Railway, has been sold to a syndicate composed of J. M. Wolff and J. F. Geiser, of Waynesboro; L. H. Mountney, of Mauch Chunk, and C. H. Latta, of Bethlehem. Messrs. Wolff and J. F. Geiser are concerned in the Waynesboro & New Castle Railway, and Mr. Latta is interested in the Stroudsburg & Water Gap Railway.

McKINNEY, TEX.—John S. Heard, J. P. Crouch, S. D. Heard, L. A. Scott, F. B. Pope, J. L. Lovejoy, J. Y. White, R. L. Waddill, J. P. Burrus and George Wilcox, all of this city, have organized the Fort Worth, McKinney & Bonham Traction Company, with a capital stock of $25,000, for the purpose of making surveys, getting estimates and full investigation as to the merits of a road from Fort Worth to Bonham *via* McKinney. If the engineers report favorably the charter will be applied for and the capital stock will be increased to the proper amount.

TOPTON, PA.—Philadelphia capitalists are interested in the building of a proposed trolley line to connect Lyons and Macungie. The line as contemplated, while not to be an extension of the lines reaching those places, will be the closing link for continuous trolley service along the East Penn, and will pass through Bowers, Topton, Hancock, Mertztown, Shamrock and Alburtis along the south side of the railroad. Should the road be built, the different towns along the line may obtain the additional convenience of electric lights. The right of way is being obtained and progress is expected to be made rapidly.

COLORADO SPRINGS, COL.—The Kansas-Colorado Electric Railroad and Power Company has broken ground for its line connecting Canyon City with Pueblo *via* Turkey Creek at a point twenty-five miles south of Colorado Springs, and nine miles west of Pueblo. The line will be extended to Colorado Springs, where connection with Denver will be made over the Denver & South Platte electric line. The road will ultimately follow the Arkansas Valley across the Kansas border, furnishing also light and power as well as water for irrigation. W. J. Coursin, of Pittsburg, has been awarded the contract for construction of the Denver & South Platte Railroad Company's twenty-five-mile electric line from Littleton to Roxbury Park in the western part of Douglas County. Littleton, five miles out, is already connected with Denver. The road may be completed to Colorado Springs before June 1, 1909, as it is the plan to make Roxbury Park a summer resort.

PERSONAL MENTION.

MR. GASTON LACOMMI, an electrical engineer with a laboratory in Brooklyn, N. Y., is said to have devised a wireless telegraph sending apparatus capable of transmitting four messages at the same time. It is understood that Mr. Lacommi utilizes a transformer giving four different frequencies.

MR. HENRY FARMAN, the French aviator, was entertained by Thomas A. Edison at the Orange, N. J., laboratories last week, and treated to a moving-picture exhibit of his æroplane flights at the Brighton Beach race-track. Among those present were Mrs. Farman, Paul F. Mottelay, Charles M. Manly and Mrs. Manly, Albert C. Triaca and Mrs. Triaca, Robert Whitaker and William J. Hammer, who arranged the party.

MR. LOUIS WINDMÜLLER is the author of a very interesting article entitled "Reminiscences of Financial Problems" in the August *Forum*. Mr. Windmüller begins with an account of conditions in 1857, when all classes of industrial companies went to the wall and the steam railroads were particularly affected. The story takes us through the stormy days of the Civil War and the panic which followed, and reviews the runs on the savings banks in 1873. Each of the panics which have occurred since that time is taken up, and the reasons for them and the lessons taught are analyzed in a philosophic and masterly fashion which makes the article of great value at this particular time.

OBITUARY NOTE.

DR. WILLIAM M. HABIRSHAW, chairman of the board of directors of the Habirshaw Wire Company, died at his summer residence at Saratoga, N. Y., on August 16. Dr. Habirshaw had been an invalid for several years, and about three months ago suffered a relapse which totally confined him to the house. For some time he had been under the constant treatment of a physician, and was accompanied everywhere on his travels by a trained nurse. Early in the present year, attended by his nurse, he took a prolonged trip through Europe, returning in June. Shortly after this he went to Saratoga, but instead of improving, suffered a stroke of apoplexy about two weeks ago, from which he never rallied. Dr. Habirshaw was recognized as one of the most skilful analytical chemists in the country. He was a pioneer in the development of cable-making machinery and in the production of insulated wires and cables. At one time he served the Peruvian Government as official chemist, and his professional services were engaged from time to time by the New York State Agricultural Society, the New York Produce Exchange and other important commercial organizations. Dr. Habirshaw was widely known in the electrical field, and had a host of friends and acquaintances both here and abroad. Dr. Habirshaw was buried from St. Thomas's Episcopal Church, New York city, Wednesday, August 19.

DATES AHEAD.

Ohio Electric Light Association. Annual convention, Put-in-Bay, Ohio, August 25-27.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Arkansas Association of Public Utilities Operators. First annual convention, Little Rock, Ark., September 17-18.

Old Time Telegraphers' and Historical Association, and Reunion of Military Telegraphers, Niagara Falls, N. Y., September 16-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 5-6.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Electrochemical Society. Fall meeting, New York

LEGAL NOTE.

TELEPHONE—EXCESSIVE CHARGES—RECOVERY—The Supreme Court of Illinois held, in the case of The Illinois Glass Company *vs.* Chicago Telephone Company, that a customer of a telephone company cannot recover excessive charges for services voluntarily paid without fraud, mistake of fact or other ground for annulling the contract. It appeared that in January, 1889, an ordinance of the city of Chicago authorized the appellee to construct and operate telephone lines in the city for a period of twenty years. It was required to file with its acceptance of the ordinance a schedule showing the rates then charged for telephone service, and was prohibited from increasing to subscribers the rates so established. The appellee accepted the ordinance and filed a schedule showing that it charged $125 per year for a business telephone within the district where the appellant was located. The appellant contracted for a telephone at that rate and used it for some years. In time the telephone grew less efficient, and upon complaint of that fact being made by the appellant company, the appellee suggested that if the former would procure an improved telephone equipment known as a "metallic circuit" it would have a much better service, which would cost it $50 a year additional. In October, 1897, the appellant entered into a contract such as suggested and paid that rate for five years, when it brought suit to recover the excess over the rate fixed by the ordinance. The court held that although the appellee could not legally require payment of more than $125 per year, yet that the larger sum had been paid, without fraud, mistake of fact or other ground for annulling the contract, and that the court below did not err in directing a trial for the appellee.

ELECTRICAL SECURITIES.

There was a slight reaction in the stock market last week, with some of the prominent industrials falling off a few points. The copper industry appears to be improving, with general improvement, also, throughout the electrical field. Railroad freight is becoming more in evidence, and the fine weather augurs well for the harvesting of bounteous crops.

Dividends have been declared upon the following electrical securities: American Telegraph and Cable Company; regular quarterly dividend of 1¼ per cent, payable September 1. Columbus (Ohio) Railway Company; regular quarterly dividend of 1¼ per cent on the common stock, payable September 1 to stock of record August 15. Grand Rapids (Mich.) Railway Company; quarterly dividend of 1 per cent on the common stock, payable September 1. Whatcom County (Wash.) Railway and Light Company; regular semiannual dividend of 3 per cent on the preferred stock, payable September 1. Northern Texas Electric Company; regular semiannual dividend of 3 per cent on the preferred stock, payable September 1 to stock of record August 17.

ELECTRICAL SECURITIES FOR THE WEEK ENDED AUGUST 15.

New York:	Closing.
Allis-Chalmers common	11¼
Allis-Chalmers preferred	34⅞
Brooklyn Rapid Transit	52
Consolidated Gas	136½
General Electric	141
Interborough-Metropolitan common	11⅝
Interborough-Metropolitan preferred	32½
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	66½
Mackay Companies (Postal Telegraph and Cables) preferred	68
Manhattan Elevated	138
Metropolitan Street Railway	28
New York & New Jersey Telephone	110
Western Union	56
Westinghouse Manufacturing Company	68
Boston:	**Closing.**
American Telephone and Telegraph	123¼
Edison Electric Illuminating	25
Massachusetts Electric	48
New England Telephone	112½
Western Telephone and Telegraph preferred	68
Philadelphia:	**Closing.**
Electric Company of America	10
Electric Storage Battery common	37½
Electric Storage Battery preferred	37½
Philadelphia Electric	9 13-16
Philadelphia Rapid Transit	13⅝
United Gas Improvement	87
Chicago:	**Closing.**
Chicago Telephone	144½
Commonwealth Edison	104
Metropolitan Elevated preferred	43½
National Carbon common	68½
National Carbon preferred	108

INDUSTRIAL ITEMS.

THE WESTINGHOUSE AIR BRAKE COMPANY, Pittsburg, Pa., has ready for distribution its instruction pamphlet No. 5,034. This is devoted to the type L triple valve.

THE HOLOPHANE COMPANY, New York city, in the July issue of "Holophane," describes and illustrates the enameled Holophane manufactured under the Zalinski patents.

THE WEBER GAS ENGINE COMPANY, Kansas City, Mo., is distributing a bulletin describing the Weber down-draft suction gas-producer. Copies of this bulletin will be furnished to those interested upon request.

THE NORTHWESTERN EXPANDED METAL COMPANY, Old Colony Building, Chicago, Ill., is distributing a folder giving considerable information of value to architects and engineers, concerning expanded metal for concrete and steel construction.

THE AMERICAN SPIRAL PIPE WORKS, Chicago, Ill., is publishing a handsome catalogue devoted to spiral riveted pipe. A number of interesting illustrations are given, showing applications of this pipe in various hydraulic and engineering enterprises.

THE F. BISSELL COMPANY, 226-230 Huron street, Toledo, Ohio, has ready for mailing some new information concerning Bryant plug cutouts, Perkins "New Wrinkle" sockets, "Security" motor-starting panels, and "Cushing" stage-lighting specialties.

THE GOLDSCHMIDT THERMIT COMPANY, New York city, has under construction a new machine shop and foundry occupying a space thirty-four by ninety feet, just back of its present factory in Jersey City, N. J. This is to be fitted up for the purpose of handling to better advantage the extensive repair work which is now being carried on.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has published a handsome bulletin, No. 25, devoted to its machinery for handling coal and ores. This bulletin is replete with interesting illustrations showing applications of the Jeffrey company's apparatus, and will be found of value by all who are interested in machinery of this nature.

JOHN L. GLEASON, Jamaica Plain, Mass., is distributing a new bulletin describing "Fancleve" fittings for flexible armored cables, switch-boxes for old work, and the No. 750 cutout cabinet for old or new work. These fittings are especially adaptable for contractors, engineers and architects, and the literature will be sent to those interested upon request.

THE BRISTOL COMPANY, Waterbury, Ct., has ready for distribution some interesting information concerning recording voltmeters, recording ammeters, recording wattmeters for all ranges in both direct and alternating current, recording shunt ammeters for all ranges of direct current, portable recording voltmeters, pressure recording gauges and patent steel belt lacing.

THE C. W. HUNT COMPANY, West New Brighton, N. Y., is distributing pamphlet No. 081. This describes and illustrates coal-handling machinery, conveyers, industrial railways and stevedore rope. The bulletin, however, takes up only a portion of the apparatus manufactured by the C. W. Hunt Company, and is an introduction to the general line of labor-saving machinery which the company produces.

DOSSERT & COMPANY, 242 West Forty-first street, New York city, has published its annual catalogue devoted to Dossert solderless connectors, cable taps and terminals. Since issuing the last catalogue, the National Electrical Code has been amended to permit the use of an improved mechanical joint without solder. Dossert joints have been placed on the list of approved fittings, and there has been a remarkable development and expansion in their field of usefulness. The company has many new designs, and has added materially to its stock of standard sizes.

THE AJAX LINE MATERIAL COMPANY, 12 South Jefferson street, Chicago, Ill., has furnished the following additional information concerning the controversy between it and the George Cutter Company, South Bend, Ind., in regard to the trade-mark "Ajax." The full text of the decision of the examiner of interferences is as follows: "An abandonment by the George Cutter Company of the trade-mark at issue in this interference having been filed, and the same having been found to comply with the requirements of Rule 125, it is adjudged that the Ajax Line Material Company, the junior party, is the owner of the trade-mark and entitled to the registration for which it has made application."

THE SOCIETE ANONYME H. CUENOD, of Geneva, Switzerland, has published a very handsome bulletin devoted to a description and illustrations of the automatic regulators designed on the system developed by R. Thury. The descriptive matter includes a discussion of the principles, advantages and applications of the apparatus. Special descriptive matter is devoted to the use of these regulators for isolated generators, for generators coupled in parallel, for generators used in three-phase distribution, for the regulation of feeder circuits, for the automatic control of accumulators, and for the regulation of apparatus placed at a distance from the controlling point. Copies of this catalogue, which is printed in French, will be furnished to those interested, upon application to the company.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., is distributing some attractive literature concerning several important types of apparatus. Bulletin No. 4,607 is devoted to the series incandescent system with tungsten lamps. This is a timely publication in view of the present general tendency toward the illumination of streets of residential districts by means of the series incandescent system of lighting. The descriptive matter in this bulletin includes illustrations and general data on transformers, switchboards, lamp brackets and reflectors, series sockets and lightning arresters used in connection with the system. Bulletin No. 4,608 describes the company's improved type H subway transformers. These transformers are absolutely water-tight, and are proportioned for the limited space in manholes, possess high efficiency and large radiating surfaces, and their temperature rise is small. The transformers are manufactured for a frequency of sixty cycles at standard voltages, and in capacities from five to 300 kilowatts, inclusive. Bulletin No. 4,610 describes a new line of small plant continuous-current switchboards equipped with the latest and most improved controlling devices. These boards are manufactured for 125 and 250-volt circuits only, and each panel forms a separate and complete switchboard not intended for combination with other panels. They are made to control one generator and two feeder circuits, and additional feeder switches can not be furnished. The panels are made of natural black slate, and are supported by one-inch gas-pipe supports. Folder No. 3,681 is devoted to a description of mercury arc rectifiers for moving-picture machines. This apparatus will operate satisfactorily on any alternating-current voltage from 200 to 240, and any frequency between forty and 140 cycles. Copies of this literature will be furnished to those interested upon request.

NEW INCORPORATIONS.

ST. PAUL, MINN.—Royalton Power and Light Company, of Royalton. $10,000. Incorporators: A. C. Wilson, Mark Murphy and Charles R. Rhoda.

JERSEY CITY, N. J.—Southwestern Development and Construction Company, Jersey City. To operate steam or electric railroads, etc. $100,000. Incorporators: H. B. Ferber, Hackensack; W. H. Nash, Jersey City; G. E. Waesche and W. H. Wieboldt, East Orange.

DOVER, DEL.—Central Texas Traction Company. To operate rapid transit railways for carrying freight, merchandise and passengers, and to operate mines and mine tramways. Incorporators: J. J. Sears, of Chicago; Dr. J. O. Howard, of Houston, Tex.; W. W. Clopton, of Corsicana, Tex.; J. V. Watkins, of Corsicana, and Harry W. Davis, of Wilmington. $300,000.

OLYMPIA, WASH.—Nooksack Valley Traction Company, of Bellingham. $1,250,000. Incorporators: W. R. Alward, J. S. Wheeler, J. E. Morrison, Edward Brown, W. H. Jarrett and J. William Welch. To build a line of railway from a point at or near Bellingham to a point in or near the city of Blaine, and from said point at or near said Bellingham to a point at or near Sumas.

INDIANAPOLIS, IND.—Marion & Logansport Traction Company. $40,000. To build a traction line in and through the following towns: Marion, Sweetser and Nier, in Grant County; Converse, Amboy, North Grove, McGrawsville and Bunker Hill, in Miami County, and Logansport, Anoka and Onward, in Cass County. Incorporators: George D. Lindsay, Marion; John O. Spurgeon, Sweetser; Mead S. Hays, Marion; John Minnick, Grant County, R. R. No. 10; John O. Wilson, Marion; Lewis S. Marks, Marion; Alva Williamson, Sweetser, and Carl Wise and Victor Wise, Logansport.

Record of Electrical Patents.

Week of August 11.

895,421. MAIL-POUCH RECEIVING APPARATUS FOR RAILWAY CARS. Chauncey W. Broughton, Carlton, Ill. A magnetically controlled mail-pouch delivering apparatus.

895,422. MAIL-POUCH RECEIVING OR DELIVERING APPARATUS FOR RAILWAY CARS. Chauncey W. Broughton, Carlton, Ill. An electromagnet is in combination with a support for sustaining a mail pouch adjacent to a railway track.

895,431. ENCLOSED FUSE. Robert C. Cole, Hartford, Ct., assignor to the Johns-Pratt Company, Hartford, Ct. The fuse receptacle is filled with comminuted material which is retained by lint or fuzzy material without impeding the escape of gases.

895,432. ENCLOSED-FUSE TERMINAL. Robert C. Cole, Hartford Ct., assignor to the Johns-Pratt Company, Hartford, Ct. A tubular casing containing a fuse link with link terminals.

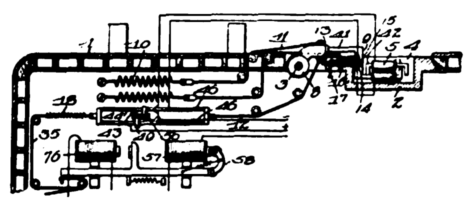
895,434. VEHICLE-SPEED SIGNAL. George L. Cooper, Troy, N. Y., assignor of thirty-five one-hundredths to Joseph F. Bush, Schenectady, N. Y. The starting movement actuates a visual signal on the car.

895,441. ELECTRIC OUTLET BOX. Conrad J. Dorff, Chicago, Ill., assignor to Frederic Greer, Chicago, Ill. The outlet box is provided with self-retaining knockouts.

895,443. COIN-BOX FOR TELEPHONES. Charles S. Ellis, Chicago, Ill., assignor to the American Coin Register Company. The coin-box is provided with sectional coin channels.

895,460. THERMOSTATIC CIRCUIT-CONTROLLER. Herman L. Hicks, Martins Ferry, Ohio, The electric circuit is closed by the alternate heating and cooling of the expansion member.

895,485. VACUUM-TUBE LIGHTING. Daniel M. Moore, Newark, N. J., assignor to Moore Electrical Company, New York, N. Y. The tubes extend to several floors from a common centre of distribution.



895,421.—MAIL-POUCH RECEIVING APPARATUS FOR RAILWAY CARS.

895,486. VACUUM-TUBE APPARATUS. Daniel M. Moore, Newark, N. J., assignor to Moore Electrical Company, New York, N. Y. The rarefied gas is admitted to the tubes through a valve automatically in response to changes of gas tension in the tube.

895,487. VACUUM-TUBE APPARATUS. Daniel M. Moore, Newark, N. J., assignor to Moore Electrical Company, New York, N. Y. The system is equipped with a device regulating the flow of gas or vapor to maintain a constant tension in the vacuum tube.

895,490. SYSTEM FOR THE GENERATION AND DISTRIBUTION OF ELECTRICITY. Thomas H. McAdory, Chicago, Ill., assignor to the Adams & Westlake Company. The resistance of the distribution system is controlled by an automatic regulator depending upon the voltage of the battery.

895,515. DYNAMOELECTRIC MACHINE. Egbert M. Tingley, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The machine has a cylindrical core member provided with longitudinal ventilating slots.

895,531. SILOXICON-COATED CARBON-CONTAINING ARTICLE. Edward G. Acheson, Niagara Falls, N. Y. The carbon-containing article has its outer portion covered with siloxicon.

895,545. CONNECTING DEVICE FOR ELECTRICAL CONDUCTORS. Ernest B. Fahnestock, New York, N. Y. A self-contained spring member forms a connecting clamp in combination with a hook and conductor.

895,549. STORAGE BATTERY. George A. Ford, Cleveland, Ohio, assignor to Harriet S. Ford, Cleveland, Ohio. The battery is formed of trays molded from paper pulp.

895,575. ELECTRIC CAR-RECORDING BLOCK-SIGNAL. William J. Murray, Leavenworth, Kan., assignor of one-half to Herbert W. Wolcott, Leavenworth, Kan. The block-signal system is equipped with a step-by-step recording device.

895,582. RAIL-BOND FOR ELECTRIC RAILWAYS. William E. Oakley, Millbury, Mass., assignor to Worcester Steel Foundry Company, Worcester, Mass. The terminal is welded to the connector and is composed of an alloy having the same temperature coefficient as that of the rail.

895,589. ELECTRIC SIGNAL FOR RAILWAYS. John S. Sims, Longbeach, Cal., assignor of one-half to Edward Richard Millar, Longbeach, Cal. The signal targets are held in inoperative position by the normally charged magnets.

895,594. ARC LAMP. Bernard A. Stowe, Cleveland, Ohio, assignor to the Jandus Electric Company, Cleveland, Ohio. The arc chamber is provided with a tube for carrying off the gases.

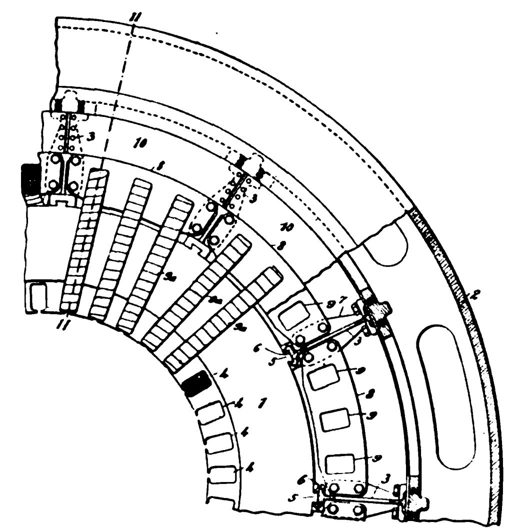
895,618. POWER-TRANSMITTING DEVICE. Leonard K. Clark, New York, N. Y. A flexible mechanical coupling.

895,660. ELECTRIC BATTERY. William Morrison, Chicago, Ill., assignor to George Rumrill Coryell, Chicago, Ill. A bromin-carbon primary cell.

895,714. BINDING-POST. Garrison Babcock and Josef Reuter, Rochester, N. Y., assignor to Merton E. Lewis, Rochester, N. Y. The terminal is formed of a base, a member with an inclined clamping face, and a locknut.

895,715. THERMOCHEMICAL GENERATION OF ELECTRICITY. Lucien P. Basset, Paris, France, assignor to Maurice Bacqua de Labarthe, Paris, France. Two electrolytes are circulated in separate compartments divided by porous walls.

895,729. ART OF SEPARATING SUSPENDED PARTICLES FROM GASEOUS BODIES. Frederick G. Cottrell, Berkeley, Cal., assignor to International Precipitation Company, San Francisco, Cal. The gaseous bodies are subjected to the action of a system of electrodes maintained at a high difference of electrical potential.



895,515.—DYNAMOELECTRIC MACHINE.

895,732. CONSTRUCTION OF BATTERIES AND ELECTROLYTIC APPARATUS. Frank A. Decker, Philadelphia, Pa., assignor, by mesne assignments, to Decker Electrical Manufacturing Company, Wilmington, Del. The battery parts are enclosed in a rubber diaphragm sealed by a plastic vulcanized material.

895,738. SOLID INSULATING COMPOUND. Jerome W. Frank, New York, N. Y., assignor to Standard Varnish Works, New York, N. Y. A solid insulating compound composed of oils and gums.

895,747. BINDING-POST. Monroe Guett, Hartford, Ct., assignor to the Hart & Hegeman Manufacturing Company, Hartford, Ct. A cylindrical binding-post with a central bore and two openings in the side wall through which operate non-rotatable studs.

895,752. LIGHTNING ARRESTER. Ernst Heddaeus and Rudolf Nothnagel, Bilbao, Spain. One of the two rotating discharge bodies has a plurality of cam surfaces, varying the distances of the surfaces of the rotating members.

895,760. SYSTEM OF ELECTRICAL DISTRIBUTION. Robert C. Hull, Philadelphia, Pa. A regulating apparatus causes the battery to charge and discharge in response to the electrical condition of the circuit.

895,772. SECONDARY ELECTRIC CLOCK. Frank F. Landis, Waynesboro, Pa. The apparatus is operated by a step-by-step electromagnetic device.

895,777. COIN-OPERATED ATTACHMENT FOR PAY-TELEPHONES. Edmond J. Lonergan, Chicago, Ill. The coin is deposited through a reciprocable coin chute.

895,785. MEANS FOR SUPPLYING AND CONTROLLING ELECTRIC CURRENT TO MOTOR VEHICLES. Alexander Palmbos, Columbus, Ohio, assignor to the Jeffrey Manufacturing Company, Columbus, Ohio. A storage battery car equipped with a trolley support.

895,801. CURRENT TRANSFORMER. Paul Schubert, Berlin, Germany, assignor to General Electric Company. The transformer is provided with means for producing two opposing alternating fluxes in the core.

895,806. TROLLEY. Frank L. Sessions, Columbus, Ohio, assignor, by mesne assignments, to the Jeffrey Manufacturing Company. The trolley pole has both a lateral and longitudinal movement.

895,822. RHEOSTAT. Charles Wirt, Philadelphia, Pa., assignor to Charles Wirt & Company, Newark, N. J. The resistance, conductor, contact blocks and hub are contained in a molded body of insulation.

895,823. SYSTEM OF ELECTRICAL DISTRIBUTION. Joseph L. Woodbridge, Philadelphia, Pa. A combination of a polyphase and a single-phase alternating-current circuit connected, respectively, to a synchronous dynamoelectric machine and an induction machine.

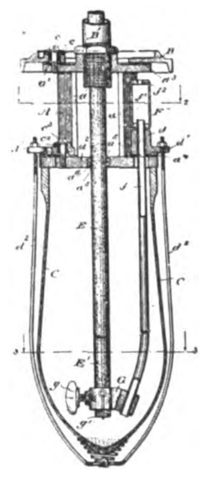
895,824. ELECTRIC GENERATOR. Joseph L. Woodbridge, Philadelphia, Pa. The pole frame is provided with polar projections in groups of three.

895,825. SYSTEM OF ELECTRICAL DISTRIBUTION. Joseph L. Woodbridge, Philadelphia, Pa. The regulating apparatus is responsive to rapid fluctuations in load.

895,830. ELECTRIC BRAKE. Edward H. Anderson, Schenectady, N. Y., assignor to General Electric Company. The hand brake is supplemented by a motor-driven device.

895,831. CONSTANT-CURRENT TRANSFORMER. Lyman Arnold, Lynn, Mass., assignor to General Electric Company. The transformer is provided with a plurality of axially aligned sets of relatively movable primary and secondary coils with a magnetic core.

895,836. CONTROLLING DEVICE FOR ELECTRIC MOTORS. Ralph E. Barker, Lynn, Mass., assignor to General Electric Company. There is a winding operating independently of the automatically changing windings.



895,594.—ARC LAMP.

895,848. ELEVATOR SAFETY AND ANNOUNCING DEVICE. George H. Foulks, San Francisco, Cal. Devices carried by the doors act automatically when brought into the range of action of the brake or stop mechanism carried upon the cage.

895,857. RESISTANCE UNIT. Joseph L. R. Hayden, Schenectady, N. Y., assignor to General Electric Company. A cast silicon rod terminates in iron terminals.

895,864. TROLLEY. Albert S. Janin, New York, N. Y., assignor of one-third to Amelia Janin, Brooklyn, N. Y. A pantograph collector with spring-actuated members.

895,869. RECTIFIER SYSTEM. Osias O. Kruh, Schenectady, N. Y., assignor to General Electric Company. The secondaries of the single-phase, alternating-current source are connected in multiple.

895,870. PROPELLED TORPEDO. Howard Lacy, Carshalton, England. The torpedo head is equipped with a magnet and magnet core.

895,878. BRUSH-HOLDER. Floyd C. Mitchell, Schenectady, N. Y., assignor to General Electric Company. The brush stud is equipped with a resilient member.

895,887. ACYCLIC MACHINE. Jakob E. Noeggerath, Schenectady, N. Y., assignor to General Electric Company. The acyclic poles extend uniformly around the armature.

895,888. UNIPOLAR DYNAMOELECTRIC MACHINE. Jakob E. Noeggerath, Schenectady, N. Y., assignor to General Electric Company. A unipolar field structure, and an armature provided with a plurality of collector rings.

895,894. MEANS FOR COOLING DYNAMOELECTRIC MACHINES. Richard H. Rice, Lynn, Mass., assignor to General Electric Company. An inner and outer ventilating case for vertical turbines.

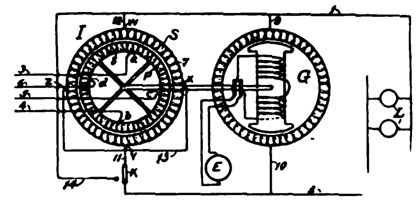
895,911. WALL BRACKET FOR ELECTRICAL CONDUCTORS. Lucius Tinsley, Crawfordsville, Ind. A wall bracket with a plurality of insulating members and a clamping member attached to the base.

895,914. VARIABLE-VOLTAGE TRANSFORMER. Matthew O. Troy, Schenectady, N. Y., assignor to General Electric Company. The core is adapted to afford two magnetic circuits, one passing through both coils, and one shunting one coil.

895,916. LIGHTNING-ROD TERMINAL. John P. Turner, New York, N. Y. A tapered, perforated body of sheet metal filled with carbon forms a self-contained ground plate.

895,925. ELECTRIC ORGAN. William R. Whitehorne, Bethlehem, Pa. The valves and stops are controlled by electromagnets.

895,928. RAIL-BOND. Montraville M. Wood, Chicago, Ill., assignor to General Electric Company. The bond head has a receptacle accommodating a piercing pin.



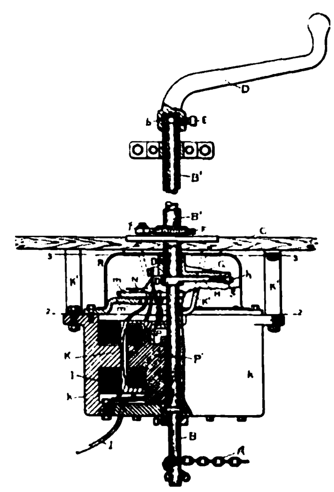
895,823.—SYSTEM OF ELECTRICAL DISTRIBUTION.

895,930. PROCESS OF ELECTROLYTICALLY PRODUCING CHROMIC ACID FROM CHROMIC SULPHATE. Gustav Adolph, Ammendorf, and Albert Pietzsch, Magdeburg, Germany, assignors to Chemische Fabrik Buckau, Magdeburg, Germany. The reducing action of the nascent hydrogen is minimized by electrolyzing the chromic solutions in the absence of a diaphragm.

895,933. SELF-EXCITING GENERATOR. Ernst F. W. Alexanderson and Emil H. Widegren, Schnectady, N. Y. The field winding is provided with a rectifying commutator and a polyphase arrangement of brushes.

895,956. LIGHTNING-ARRESTER RESISTANCE. Harold W. Buck, New York, N. Y., assignor to General Electric Company. The flexible heat-proof envelope contains granular resistance material.

895,958. ELECTROMAGNETIC SPARKING PLUG. Otto Carlborg, Providence, R. I. The sparking plug is equipped with an electromagnetic interrupting member.



895,830.—ELECTRIC BRAKE.

895,965. REGULATION OF DYNAMOELECTRIC MACHINES. Reginald C. Clinker, Rugby, England. Means are provided for varying the effect of a shunt in proportion to the rate of change of load in circuit.

895,993. TROLLEY SUPPORT. Hiram G. Farr, Melrose Highlands, Mass. The trolley wheel is chambered and provided with a core of absorbent packing.

896,060. FILAMENT FOR ELECTRIC INCANDESCENT LAMPS AND PROCESS OF MAKING THE SAME. Hans Kuzel, Baden, near Vienna, Austria-Hungary. The filaments are produced from a plastic mass containing tungsten and colloidal oxynitrid of tungsten, forming threads capable of being converted into a crystalline tungsten filament.

896,071. ELECTRIC RAILWAY. John A. Garey, Mound City, Mo., assignor of one-half to George G. Garey, Indianapolis, Ind. A third rail and means for supporting same in a conduit of spring-closed sections.

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. LIII. No. 9 NEW YORK, SATURDAY, AUGUST 29, 1908. ISSUED WEEKLY

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CONTENTS

THE SURFACE-CONTACT SYSTEM CONDEMNED IN LONDON.

Our London exchanges report the condemnation of the surface-contact system installed this year by the London County Council in place of a horse-car line on High street, Whitechapel. This at first seems to be a natural consequence. At least it has been the result of numerous other attempts to install similar systems. Indeed, so many attempts to develop a successful surface-contact system have been abandoned for one reason or another that it was a surprise when the London authorities decided to give such a system a trial. But if the accounts given of the method followed by the council in installing this system are accurate, it is evident that it was not given a fair trial, and engineering opinion should be held in abeyance until the tangle in London has been unraveled.

The system which was tried is known as the "G. B." system, and it has been in operation for nearly three years in Lincoln, England, apparently with success. We gather, from our exchanges, that the London County Council has reached a point where it must consider some other than the conduit system because of the enormous expense of installing the latter. It first considered the introduction of the overhead trolley system on this line, but met with severe opposition from the residents along the route, and it therefore decided to give the "G. B." system a trial, thinking that if this proved satisfactory all would be well; and, if it did not, the council could then proceed to install the overhead wires, since it could then say that the only other available system had been tried and had failed. It will be recalled that one reason given for the trial of the surface-contact system was the presence of an underground line along part of the route, and there was not room enough between the top of the tube and the surface of the ground for a conduit.

Be this as it may, from the accounts of the method which the council followed when installing the contact system, it seems clear that the responsibility for its failure rests entirely upon the council and not upon the system. The council's engineers refused to accept advice from the engineers who had had experience with the system, and altered the apparatus and installed parts condemned by the engineers of the company, although the latter had retained the power to condemn any part of the apparatus installed. After the council had notified the company of its intention to abandon the system the company offered to reconstruct it at its own expense and operate it for one year, at which time the council should decide whether it were successful or not, but this proposal was rejected. Evidently we have not heard the last of this matter, since the company can not afford to accept defeat so easily.

Aside from this particular dispute, the London County Council evidently has a troublesome question to answer. It can not go on forever constructing conduit lines, and the people of London apparently will not hear of the overhead trolley. Just how it will get out of this difficulty remains to be seen, but it will not help matters if, as one of our London contemporaries hints, it tries other systems with the expectation, if not the determination, that they shall fail.

THE GASOLENE-ELECTRIC DRIVE FOR VEHICLES.

A short time ago we discussed the proposed application of electrical transmission to ship propulsion and commented upon the paper read recently by Mr. W. P. Durtnall before the Institution of Marine Engineers in London. In spite of the losses necessitated by the double transformation involved in this system, Mr. Durtnall apparently made out a very good case for the electric motor. If his figures be accepted the electric system will save largely in weight of the propelling machinery due to the smaller boiler equipment required when the turbines and propellers may both be driven at their most efficient speed. When this is the case the increased economy of both turbines and propellers so reduces the demand for steam that the boiler equipment is considerably smaller than for the direct steam drive, and since by far the greater portion of the weight is in this part of the equipment, the total weight of machinery is reduced by more than 100 tons in the instance mentioned, and there is, in addition, a very appreciable saving in fuel.

Following shortly after this and, perhaps, inspired by Mr. Durtnall's paper, Mr. Frank Broadbent, in the *Electrical Review*, of London, for July 24, discusses the application of the electric drive for propelling vehicles. This system is now being tried in a number of instances, as are several other self-contained systems, so that a preliminary comparison at least may now be made, which is done here.

It is interesting to recall at this time the first attempt to utilize the electrical system of transmission for propelling a self-contained vehicle. This was the Heilmann locomotive, constructed in 1892 or thereabouts. Heilmann's idea is not entirely clear, since he installed a complete power-house on his locomotive and then attempted to use it in competition with steam locomotives for express service. He had a steam boiler and steam engine driving a generator which charged a storage battery on the locomotive and drove the motors, which were geared to the locomotive axles. At that time he did not have the prime mover which to-day seems to promise best for such service, that is to say, an internal combustion engine. Just how large this equipment was we do not now recall, but it probably was considerably too small for the use to which he put it. Moreover, one of the great advantages of such a system, if, indeed, it be not the most important advantage of all, is the rapid acceleration made possible by such an equipment. Yet this characteristic was of little value for the service to which he put his locomotive; that is to say, for high-speed runs with few stops. The locomotive, if we remember correctly, never advanced beyond an early experimental stage, and the few trials made of it showed it was inadequate for the service for which it was intended. Heilmann, however, deserves the credit for the first attempt to interpose the electric generator and motor between the prime mover of a vehicle and its axles.

Within the last year or two this system has again been taken up and tried not only for railway service, but for road vehicles as well. In the article by Mr. Broadbent, referred to above, the advantages of this system for local traffic on railways are considered and the system itself is compared with other new systems proposed and being tried for such service. He has obtained some figures showing the cost of operation of a number of these systems on the Hungarian railways, where they are being tried out with the view of determining whether any one of them will prove satisfactory for handling the traffic on these roads. As is to be expected, the electric system, involving as it does a double transformation, shows a slightly higher fuel cost than do some of the more direct systems, but the reliability and the doing away with heavy gearing, as well as protecting the prime mover from shocks, so reduce the cost of maintenance that the total cost for operation is less for the electric system than for the others. For example, it has been found that a steam equipment showed a total cost of operation of six and one-quarter cents a car-kilometre, while a gasolene-electric equipment costs only 5.75; moreover the cost for this steam car is the average of over a million and a half kilometres of running, while that of the gasolene-electric cars is for a service of less than one-tenth this. It seems likely that the average for the electric system will be reduced upon longer trial.

These figures, as well as others given by Mr. Broadbent, show the advantage of the gasolene-electric system, although it would not have been surprising if there had been less difference between the two, or even if the total cost of operation for the steam car had been found to be little less than that of the other. It is in other ways that the electric system gains most. The system of control is simple, and makes it possible for the driver to run at almost any speed necessary, and to do so efficiently; and it is hardly necessary to add that for short hauls and many stops the rapid acceleration given by the electric motor is a very great advantage, for on this depends largely the schedule which can be given on any such line.

Mr. Broadbent points out also the advantages of the mixed system for road vehicles. A self-propelled car equipped in this way has all the advantages of the electric automobile and is limited in its distance of run only by the fuel which it can carry. For city traffic the perfect control which the driver has over his car is most valuable. He can reduce the speed to a mere crawl without reducing the torque developed by his motors. He can start quickly and thus work his way along the street much more effectively than can be done with other systems; and, here again, the substitution of the electric transmission for gearing eliminates an expensive and weak part of the car equipment.

Mr. Broadbent believes that some such system will demonstrate its superiority for city service, and replace, to a large extent, the more direct but less satisfactory systems now in use.

It is perhaps proper to state here that this system was tried some years ago and was found to operate well. In fact, an automobile equipped with a gasolene-electric drive was entered in the New York-Boston endurance race, which took place in October, 1902. It is much to be regretted that for several reasons this car did not make a very good showing, although no fault whatever could be found with the electrical part of the equipment. The owner of the car had ordered a new engine and did not receive it until the day before the race, and when installing it hurriedly a nut fell into the cooling water system which smashed the impeller of the circulating pump, so that the engine got hot and refused to run after about an hour's service. This fault was not located until too late. But until the engine became overheated the car ran without a hitch.

Mr. Broadbent's stand is well taken; and, if it be borne in mind that the gasolene-electric system has been tried for a short time only, and not all of the weaker points have been perhaps sufficiently strengthened, the possibilities of the system may be imagined. Those who remember the hard and disheartening struggle to introduce the electric street car will not be discouraged by the first few failures. It is true that we know much more about the propulsion of vehicles to-day than we did twenty years ago, but we still have much to learn, particularly in the field of self-propelling road vehicles and in the use of self-contained cars for light railway service.

DIRECTIVE WIRELESS TELEGRAPHY.

From time to time we have noticed various attempts to control the direction of propagation of electric waves employed in wireless telegraphy. One or two of these are reported to have shown satisfactory results during experiments and have even been employed in actual service. On another page of this issue a new system is described due to Dr. F. Kiebitz, who has patented his system in Germany and has obtained experimental results which, although resulting from trials on a rather small scale, are encouraging. The method in brief consists in setting up an oscillating magnetic field at an angle of about sixty degrees to an oscillating electric field. The result is the production of electric waves having a maximum amplitude in the direction normal to the two directions of oscillation.

Such a system, of course, radiates in all directions, but it is stated that the intensity of radiation in the maximum direction was seventy times that in the minimum direction, and at an angle of forty-five degrees to the maximum direction the energy of radiation was only one-third of that in the maximum direction.

The value of controlling the direction of radiation of wireless signals is great, but it is well to remember that this control can be secured through fairly wide angles only. In the present instance it is probable that all apparatus which would operate satisfactorily in the direction of maximum transmission would also be affected within thirty degrees on either side of this direction, and hence not more than two such systems could be operated successfully if tuned to the same pitch in the same territory. The system, of course, radiates symmetrically about one axis, sending out equal maximum radiations in opposite directions. And another point which must not be overlooked is the variability of wireless signals during the day, so that the only way to be sure that the signal will reach the receiving instrument is to be sure that it is strong enough. Obviously such a system of operation is not conducive to directive control of transmission.

CONCRETE POLES FOR ELECTRICAL TRANSMISSION.

The increasing price of timber for all constructional purposes presents a serious problem to the engineer. Hence any method of preventing decay which will reduce the total cost of the lumber is acceptable. But the problem is being attacked in further directions, and many engineers are seeking substitutes for wood. One of the most promising materials for this purpose is concrete reinforced by steel. With this material the use of wood may be frequently avoided, and, indeed, with a proper method of construction the reinforced concrete may be made to take the place of wood in cases where it might at first seem to stand no chance. For example, reinforced concrete poles are now being used with reported success not only from the constructional standpoint, but from that of the cost as well. Elsewhere in this issue is described a method of constructing hollow poles of reinforced concrete, which has been employed in Germany. Not only is the pole thus formed a very satisfactory device for supporting an electric line, but it is estimated that such a pole would have a life of fifty years without, in that time, having cost anything for maintenance. On such a basis the cost for the pole during that time would be less than half what it would cost to maintain either an iron or a wooden pole in the same position.

DECREASE IN STEAM AND ELECTRIC RAILROAD EARNINGS COMPARED.

A comparison of the earnings of six important street railways and an equal number of steam railroads for a three months' period during the last six or eight months brings to light several interesting facts. Gross earnings of the six street railways during the period aggregated $14,012,170, against $14,025,477 in the same months of the previous year, a decrease of $13,307, or less than one-half of one per cent. Gross receipts of the six steam roads, on the other hand, for the three months' period aggregated but $79,840,909, against $95,473,826 in the same months of 1907, a loss of $15,623,827, or over nineteen per cent.

The explanation of this is to be found in the different character of traffic of electric and steam roads. Ninety-five per cent of the gross earnings of electric railways is derived from passenger receipts, while from sixty-five to seventy per cent of the steam railroad gross is realized from freight. In periods of universal curtailment, therefore, the freight earnings are one of the first to indicate such substantial depression.

Convention of the Michigan Electric Association.

The annual convention of the Michigan Electric Association was held at Grand Rapids, Mich., August 18, 19 and 20. Headquarters were established at the Hotel Pantlind. The meeting was called to order by President H. W. Hillman on the morning of August 18.

The chairman of the Board of Public Works, Mr. Prestley, on behalf of the mayor, welcomed the members to the city.

The presidential address recommended a change in the constitution to permit the election of associate members and also outlined a plan for increasing the membership.

The first topical discussion was entitled "Various Experiences with Tungsten Lamps." E. F. Phillips, of the Detroit Edison Company, related that company's experience in lighting the suburban village of Grosse Point with tungsten lamps, supplying current through an underground system 11,500 feet long. Forty-two ornamental iron poles with brackets and with two lamps on each pole were erected. The contract called for at least fifty-candle-power lamps. The company installed, last November, sixty-candle-power, seventy-five-watt series tungsten lamps, each lamp taking five and one-half amperes. These were alternating-current lamps. The renewals for burned-out lamps threatened to become a burden. The company finally dropped the current consumption to five amperes, and obtained very satisfactory results. The service is eminently pleasing to the customers, and the company is satisfied with the system as it is now operated.

F. T. Masterson, of Grand Rapids, described the series tungsten-lamp system on Canal street, in Grand Rapids. This installation consists of fifteen spans across the street, with eighteen sixty-candle-power, seventy-five-watt lamps in series on each span. The spans are spaced 100 feet apart. All of the material, except the lamps, is owned by the Canal Street Merchants' Association. The lamps and current are furnished by the Grand Rapids-Muskegon Power Company. The initial expense of installation for material and labor was about $50 a span, or $750 in all, divided among so many merchants that the individual expense was small. The power company, representing itself as one of the merchants because of a small retail store, stood its *pro rata* share of the expense. The Grand Rapids Electrical Company, a supply dealer, secured the contract for erection and furnishing the material. The installation is permanent.

The proposition appears to be very attractive from the standpoint of the merchants and is considered a forcible advertisement for their businesses. Since the installation was made the crowds of people who flock to that street offer ample evidence of its success from an advertising point of view. The expense for operation is divided among so many merchants that some of them do not pay more than $1 a month. The power company made a special feature of billing separately to the merchants, thus making the least trouble to the association. In view of dealing with a merchants' association, it appeared necessary for the company to make a contract price based on renewal and maintenance of lamps. The power company would not care to take additional business of a similar character at less than $7 per lamp per year.

William Chandler, of the Sault Ste. Marie Electric and Power Company, related the experiences of his company in a paper prepared by himself and D. B. South. The company has noted no bad effect upon the lamp from voltage fluctuations, although its regulation is quite good. The company was one of the first to make any considerable installation of tungsten lamps in a commercial way. Notwithstanding some drawbacks incident to some manufacturing defects in the early type of lamp, there seems to be no reason to doubt the wisdom of the company's decision that the thirty-volt series type of lamp is the best to use. A special fixture burning four forty or fifty-candle-power lamps in a cluster was also decided upon. The company's first order was for lamps taking from fifty-five to fifty-seven watts per lamp and giving about forty candle-power. While these gave a fine illumination, they could not be made to compete in cost with the gas arc, as the company desired, under its operating conditions. The company has had better satisfaction with the forty-candle-power lamps, and some of these have been burning 1,400 hours, with little if any diminution of light.

The company adopted the plan of either selling the lamp outright at $1.50, or renting a set of four at fifty cents per month and maintaining the lamps. This places them on the same basis as gas arcs in the city, or less, as far as the cost of service is concerned, but in quality the illumination from gas can not be compared with the tungsten lamps.

The company has made no attempt to secure residential lighting with tungsten lamps, and does not believe that the series method of installation would meet with much favor in such lighting.

The paper also described a number of installations where the tungsten lamp had satisfactorily displaced installations of gas arcs.

H. A. Chase, of the Hart Electric Light and Waterworks, Hart, Mich., read a paper entitled "Street Lighting by Tungsten Lamps." The city of Hart is thickly lined with shade trees, making it almost impossible to illuminate the streets with arcs and procure an even distribution of light. It was decided to try lighting the main street with tungsten lamps. This trial of twenty lamps gave such excellent satisfaction that the company has now sixty-two tungsten lamps installed, and expects within a year to have the village lighted throughout with the same type of lamp. Sixty-candle-power, seventy-five-watt series tungsten lamps were used, placed three to the block alternately across the street. This spaces the lamps about 150 to 200 feet apart. The lamps are placed about twelve feet from the ground, giving a fine distribution of light. On one street, where there are no trees for about half a mile, lamps have been placed on every other pole, spacing them about 300 feet apart. This gives almost as much satisfaction as the shaded streets with the lights nearer together. Through the business part of the town series alternating-current arc lamps were used on the same circuit with the tungsten lamps.

The first twenty lamps have burned 464 hours with only three burnouts. The first lamp that burned out had burned for ninety-two hours; the second, 182 hours, and the third, 184 hours. The last forty-two lamps installed have burned 180 hours with two burnouts. The first burned out after twenty-five hours and the second after 140 hours.

Mr. Chase believes that the cost of installation is a little more than with arc lamps, but when the difference in the distribution of light is compared, the extra cost is not to be considered. The cost of installing sixty-two tungsten lamps and four arc lamps, including reconstruction of the old lines and one Fort Wayne twenty-five-light arc regulator switchboard and transformer, and three-quarters of a mile of new line, was $2,252. While there was quite a little breakage in the first shipment of lamps, the supply company made up this breakage in full. The campany has one lamp which has fallen twice to the ground, a distance of twelve feet, and is still burning. This is a rather remarkable evidence of the present strength of the lamp and an indication of the future perfection that may be attained.

A. C. Marshall, general superintendent of the Port Huron Electric Light and Power Company, stated that shortly after the multiple tungsten lamps came on the market it became evident that there was a considerable demand for the new form of lamp. The company laid in a stock of sixty and 100-watt lamps and sold them at list price. The company also sold Holophane reflectors with each lamp, and recently the company's customers are making quite a demand for the tungsten lamp, as a considerable reduction is found in the cost of lighting. Mr. Marshall thinks that from the present outlook it is going to be hard after a while to get enough new business to keep offsetting the reduction in the old customers' bills. The merchants are now lighting their whole stores for what it previously cost them to light the windows only. He does not think it practicable to recommend tungsten lamps for residence lighting.

Alex Dow, vice-president and general manager of the Edison Illuminating Company, of Detroit, suggested that anything that would reduce the cost of wiring the ordinary small residence should be looked into very carefully. The small householder is afraid of the cost of electric lights. At the same time the company can not afford to stand the expense of making such an installation purely for the return which may be made by the purchase of current.

W. J. Trott, Michigan manager of the Fostoria Incandescent Lamp Company, described the recent improvements in tungsten lamps.

Darwin D. Cody, of the Grand Rapids Electric Company, related some experiences with the tungsten lamp, his opinion being entirely favorable.

F. T. Benson, manager of the tungsten lamp department of the Chicago office of the General Electric Company, said that perhaps the new 250-watt tungsten will in many cases take the place of the arc lamp for street lighting. Experiments were being conducted with a view of strengthening the filament, perhaps by alloying the tungsten with other metals. No definite statement concerning this matter could be made at this time.

George D. Westover, manager and chief engineer of the Cadillac Water and Light Company, said he believed in going after the small-residence lighting consumer. He has 300 customers on his books who do not earn wages exceeding $2 a day. These workmen are able to afford electric lights in their homes. He uses one transformer in the centre of a block of houses. A meter is installed for each customer and the company gets from $9 to $15 from each user of this class per year.

The meeting was adjourned until Wednesday morning after a brief executive session.

On Tuesday evening Dr. C. P. Steinmetz delivered an interesting lecture on "Lightning Phenomena." The lecture was illustrated with lantern slides and was enjoyed by a large number of guests in addition to the official attendants at the convention.

At the Wednesday morning session Dr. Steinmetz reviewed the development of electrical transmission systems during the past twenty-five years and made frequent references to the 100,000-volt line of the Grand Rapids-Muskegon Power Company.

C. L. Crosby read a paper entitled "Campaigning for Power."

Mr. Crosby holds that the first and most essential movement in dealing with the prospective customer is educational. The successful solicitor should understand steam engines, as in this way he is able to determine the actual effective power required, as well as the friction loss which might be excluded by the use of motors. By this means he may arrive at a very close estimate of the cost of operation by electricity. It is necessary also that he be familiar with the operation and efficiencies of gas engines under different load conditions. In competing with gas engines, the solicitor will find that his prospective customer very seldom figures any cost other than the gas bills sent him each month, and here it is necessary that the electrical solicitor demonstrate in as impressive a way as possible the cost for lubrication, cooling water, repairs, attendance, etc. The solicitor should be able to furnish to the customer figures not only on the cost of service, but also on the cost of motors, wiring, etc. He should be able to lay out the most satisfactory method of driving the shop, at the same time avoiding the installation of more power than is necessary. He should know the type of motor best suited for various types of machinery. The office should co-operate with the field force in handling customers, practising courtesy and attention with all inquirers.

A. C. Harris read a paper entitled "Electric Power Installation in a Wood-Working Plant." This paper described particularly the electrical devices used by the Grand Rapids Hand Screw Company.

Guy Lewis, manager of the Lewis Electric Company, of Grand Rapids, read a paper entitled "Ideal Relations Between the Central Stations and the Contractor."

Mr. Lewis is of the opinion that the central station should do no construction work except on very small jobs where it comes into close competition with the gas company. Central station solicitors should obtain house-wiring and other contracts and turn the work over to one of the local contractors. In return for this consideration the contractor should establish a schedule of prices for wiring houses and other small buildings that will be equitable to all concerned. This schedule should be used by the central station solicitors in going after all work. The contractor should use his influence in every way to create satisfied customers for the central station. It will be possible for him to allay much criticism that is unjustly directed at the central station. The central station should show consideration for the contractor and supply dealer in giving the latter a list of prospective motor and apparatus customers, so that all might be a solicitor for the man who wants to distribute current. The central station should place itself in a position not to do anything to reduce the contractor's profit, or in any way belittle him. The contractor therefore would have greater consideration for the central station, would exercise more care in the installation of apparatus, and reduce dissatisfaction and irritation.

In the afternoon the ladies visited the Air Dome, and the gentlemen inspected the high-voltage transmission system of the Grand Rapids-Muskegon Power Company. Visits were also made to the Grand Rapids Plaster Company's plant, and to the plant of the Fox Typewriter Company.

The closing session was held on Thursday morning. A paper was read by A. J. Mott, entitled "Electric Heating Devices."

Mr. Mott related the experience of a company in an eastern city where there was a good lighting load and a moderate day load of small motors. In its effort to increase the day load the company arranged for a kilowatt-hour rate of five cents to all persons who wired up separately for a complete kitchen outfit or luminous radiator, installing a separate meter, with a minimum rate of $1 per month. A demonstration was started in a large department store, this demonstration being advertised in the daily papers with full-page announcements. The direct results of this demonstration were not satisfactory, although it later proved to have been a very good advertisement. It was decided to start a house-to-house campaign, and a wagon and three boys were sent out, leaving a flat-iron in every other house or apartment. The wagon put out about twenty-five irons a day, and at the end of three weeks the company began to take them in again. On some days the company would collect twenty irons, and on other days none at all would come back. The average showed that over twenty irons out of each twenty-five were retained. Efforts were also made to install sewing-machine motors, percolators, water heaters and chafing dishes, and at the end of the summer campaign the company had out about 800 electric flat-irons, nine complete cooking outfits, twenty percolators, thirteen luminous radiators, thirty sewing-machine motors and thirty-five chafing dishes, besides a considerable number of water heaters and cigar lighters. The income amounted to $6 per year for each flat-iron, $48 per year for each kitchen outfit, $12 per year for each luminous radiator and $1 a year for each percolator and sewing-machine motor. The smaller articles, such as chafing dishes, hot-water heaters and cigar lighters, do not bring much income directly to the central station, but are good advertisements for the larger articles, from which an income can be derived.

Charles O. Blackford read a paper entitled "Electric Display Windows for Effectively Advertising Electricity."

Mr. Blackford thinks that many people do not realize the great number and beauty of the latest art-glass fixtures. A display of beautiful fixtures and portables in the window of the central station company's office proves to people the great opportunity offered to them for decorative purposes. If an electric company is successful in having beautiful and attractive displays, other merchants and dealers will comment on them, and they, too, will use something electrical in window trimming. The benefit received from such displays can scarcely be overestimated, because nearly everybody can use electric power in some way. The advertising man and the window trimmer should work together. In electric window trimming it is almost imperative to have motion, because electricity is energy. Something moving in the window will attract more attention and receive more thought than anything beautiful and artistic.

Errett L. Callahan read a paper entitled "Popularizing the Use of Electricity."

This paper describes the way in which a good deal of profitable central station business can be secured by fitting up a proper equipment for demonstration purposes and carrying on a campaign to bring to the notice of prospective customers the advantages of electric service. The plans which have proved of value in a number of cases are outlined, and reports are given from a dozen cities throughout the country where very successful campaigns for increasing the use of electricity have been carried out.

A paper was also read by John G. Gromberg, entitled "Electricity and the Fireless Cooker."

The following officers were elected:

President, H. W. Hillman, Grand Rapids.

Vice-president, F. B. Spencer, Sheboygan.

Secretary-treasurer, A. C. Marshall, Port Huron.

A number of manufacturers of electrical devices made attractive displays, the Nernst Lamp Company making an exhibit of a full line of the new Westinghouse-Nernst units. The many new features of these lamps, especially the screw burners and the wafer heaters, made an exhibit of unusual interest to the electrical men present.

The Westinghouse Electric and Manufacturing Company occupied a tastefully arranged booth at the end of the main corridor at the Pantlind Hotel, adjoining the convention headquarters.

Report on Ventilation for the New York Subway.

Bion J. Arnold, consulting engineer for the Public Service Commission, has submitted to that body a report on cooling and ventilating the subway.

Mr. Arnold says the most available ways of reducing the temperature are: First, refrigeration; second, cooling by water; third, blocking the automatic louvres open, and providing additional openings; fourth, frequent air changes by train movement and by the use of a centre wall, dividing the north and south bound tracks.

The report describes the four methods, and discards the first and second as being impracticable, under the circumstances, and then makes the following recommendations:

Block the present louvres open during the day, and allow them to operate at night when the fans are being run. Construct as many protected openings as practicable between the subway and the street. At the Fourteenth street and Grand Central stations install large disc fans to draw air from the street through the kiosks, and force this air in large volumes down upon and among the persons waiting for trains upon the platforms. Construct a solid, continuous division wall between the down-town and up-town express tracks, extending from the north end of Ninety-sixth street station to and including Brooklyn Bridge station. For the purpose of demonstrating the feasibility of such a wall, it is suggested that the section extending south from the centre wall now at Thirty-third street station be constructed first far enough south to include the Fourteenth street station. At stations, the upper half of the wall to have vertically sliding counterweighted windows between columns. The cost of a four-inch terra-cotta brick wall between Ninety-sixth street and the Brooklyn Bridge should not be over $76,000, or $2.25 per running foot. The cost of a concrete wall in the same section should not be over $130,000, or $3.85 per running foot.

The commission will probably hold a conference with the Interborough representatives before acting upon Mr. Arnold's recommendations, as the building of a wall of the kind described would increase the bonded debt, and, therefore, the rental of the subway.

The Electrical Equipment of the Ferndale Collieries, South Wales.

The Ferndale Collieries are situated twenty miles north of Cardiff, Wales, in one of the Rhondda valleys. They include a series of pits dotted over some three miles along the bottom of the valley. Their yearly output amounts to nearly one and three-quarters millions tons and they employ about 6,500 men. In order to secure greater efficiency in the operation of the many power-consuming appliances, the steam drive has been abandoned recently for the electric drive. A modern generating station has been installed at Tylorstown, at the lower end of the series of pits, and power is distributed from it at 6,600 volts to transformer substations at the different pits. The power-house is a handsome steel and brick structure equipped with every modern appliance. It contains four water-tube boilers with superheaters, each capable of evaporating 30,000 pounds of water an hour at 150 pounds pressure and 150 degrees Fahrenheit superheat. Each has underfeed mechanical stokers and operates under forced draft. A complete coal-handling system has been installed to take the coal from the cars and deliver it to the bins, whence it is fed by gravity to the furnaces. The water supply is pumped from one of the pits. The engine-house equipment consists of three Sulzer cross-compound engines, each rated at 2,500 horsepower and coupled to three Lahmeyer three-phase flywheel-type alternators, running at ninety-four revolutions a minute. There are three cooling towers through which the water is circulated by pumps driven by sixty-horse-power induction motors of the slip-ring type. The cooling towers are thirty-three feet in diameter and eighty-three feet high. The main generators are rated at 1,600 kilowatts at eighty-five per cent power-factor. The overload rating is twenty per cent for two hours, or thirty per cent for half an hour. Excitation is furnished by a steam-driven set of seventy kilowatts rating and a motor-generator booster set rated at 120 kilowatts, which also charges the exciting battery. The battery can also be charged by the steam-driven set if necessary. The switch gear is arranged in three galleries at one end of the engine room. The operating gallery is the middle one and consists of a benchboard of three panels and a series of seven feeder pillars. The switch handles are of the loose type, mechanically coupled to the oil switches on the gallery below. The feeder pillars control three transmission lines, the station supply and the supplies to four of the pits. The distributing stations have, in general, three floors. The transformers are on the ground floor, the switches on the second and the lightning arresters on the third. The potential is lowered here from 6,600 to 2,200. At the pits it is again lowered to 440 for motors and surface lighting. Twenty-two hoisting gears are being installed, driven by motors varying in rating from 200 to 50 horse-power. These are of the main-and-tail type, driven mostly by slow-speed, single-reduction gears, though in some cases double-reduction gearing has been necessary. The speed is about six miles an hour. A flexible coupling between the motor and gearing absorbs the shock of starting. These gears have proved to be reliable and easy to control. The underground pumping is now done by motors driving three-throw and high-lift centrifugal pumps. At one pit an Ilgner hoisting set has been installed which will raise 1,800 tons of coal a day. The ventilating fans are driven by motors, as these furnish a most desirable load. In one case there is a Sirocco fan capable of handling 300,000 cubic feet of air a minute, driven by two 300-horse-power motors, through ropes. Several similar, though smaller, fans are being installed. There is a complete telephone system connecting the generating station with the switching and transformer stations. The various mine shops have also been converted to the electric drive.—*Electrical Review (London), July* 31.

The Michigan Central's Detroit Tunnel.

One of the largest and most important projects in railroad engineering now being carried on in this country, and of which very little has been publicly said and written, is the construction of the Michigan Central's tunnel under the Detroit River at Detroit. At the present time it is about one-half completed; it is expected to be in operation by July, 1909.

Approximately one and one-half miles in length, exclusive of approaches, it will form the connecting link from Detroit to Windsor, Canada. Its cost is estimated at $15,000,000, to which must be added the cost of a new terminal at Detroit and the remodeling of the one at Windsor.

The tunnel is being constructed by the engineering firm of Butler Brothers & Hoff, under the supervision of the Detroit Tunnel Company.

The remarkable feature of the construction work is that it is being carried on according to lines entirely new. The old method of submarine tunnel construction—that of building the tube piece by piece under water by means of compressed air—has been entirely ignored. The method in use consists of building the sections at St. Clair, a point about twenty miles north of Detroit, and towing them on barges to the point at which they are to be sunk.

The sections are then permitted to fill with water and sink to a bed prepared for their reception. They are then united by divers by means of riveted flanges. This being done, the whole is enclosed in concrete, which solidifies and acts as a preservative against corrosion of the metal and protection against flooding.

The water is then drawn out by siphons, and the end tube bulkheaded, after which nothing remains but the interior work, such as the laying of a concrete roadbed, the laying of rails and conduits, etc.

The tubes, two in number, are laid side by side, one to accommodate westbound traffic, the other eastbound. The motive power will be electricity transmitted in much the same manner as that in use on the New York Central to White Plains.

Officials of the Michigan Central are confident that the project will earn its cost several times over. In the first place, the road could never be considered first-class in every particular until the present method of moving passengers and freight across the river—by ferry—is abolished. The ferriage of trains now involves a delay of from thirty minutes to almost anything, depending upon the amount of ice which, during the winter, often clogs the river.

The 1908 Electric Lighting and Illuminating Engineering Number.

The annual Electric Lighting and Illuminating Engineering Number of the ELECTRICAL REVIEW will be published September 12. This issue will be replete with interesting articles by the leading authorities in the electric lighting field, and will bring down to date authentic information concerning the development of the electric lighting industry and the present-day ideas of illuminating engineers. Some of the leading articles already scheduled are as follows: "Progress in Incandescent Lamp Development," by the engineering department of the National Electric Lamp Association and the incandescent lamp engineers of the various interests manufacturing incandescent lamps; "The New Westinghouse-Nernst Lamps," by Otto Foell, chief engineer of the Nernst Lamp Company; "Progress of Cooper Hewitt Lamps," by Dr. J. Polak; "The Kusel Colloid Lamp," by Paul McJunkin; "The Helion Lamp," by Professor H. C. Parker and W. G. Clark. Bassett Jones, Jr., contributes a masterly article treating in a philosophic vein the relations of the architect and the illuminating engineer. This article is entitled "The Illuminating Engineer as an Architectural Critic." An article entitled "The Illuminating Engineer" is contributed by Albert J. Marshall, chief illuminating engineer for the Bureau of Illuminating Engineering, New York city. Our London correspondent, A. H. Bridge, whose symposium on English conditions, published last year, attracted so much attention, will contribute a review of the conditions in electric lighting and illuminating engineering in Great Britain. In addition there will be an unusually comprehensive presentation of data concerning recent developments in flame arc lamps, tube lighting, the newer forms of incandescent units, carbon arc lamps, central station apparatus, and descriptive and illustrated matter concerning the manufacture of incandescent lamps.

So great was the interest manifested in the first Electric Lighting and Illuminating Engineering Number, published September 14, 1907, that although a greatly enlarged edition was printed, this was exhausted within a short time after the date of publication. In order to facilitate the distribution of the 1908 edition, it is requested that those desiring extra copies will send in their orders to the office of the ELECTRICAL REVIEW at once.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.

THIRTEENTH ANNUAL CONVENTION, HELD AT DETROIT, MICH., AUGUST 19-21.

The thirteenth annual convention of the International Association of Municipal Electricians was opened at the Hotel Pontchartrain, Detroit, Mich., by President R. A. Smith at noon on Wednesday, August 19. An address of welcome was delivered by Mayor William B. Thompson, and was responded to on behalf of the association by J. B. Yeakle, of Baltimore, Md.

An address by Past-President Hatch closed the morning session.

The afternoon session was opened at 1.30 and the president, R. A. Smith, then delivered the presidential address and also read a paper on "The Moving-Picture Hazard.".

There is nothing of late years that has given the insurance companies more concern than the moving-picture business. The rural districts and small towns of many states are overrun with these shows, many of which are a menace to the community owing to lack of observance of the rules of the National Code. Many of these shows use machines without magazine, booth or other approved mechanisms. In the light of what has happened, it seems criminal for those in authority to ignore these conditions. The National Code contains a rule, No. 65a, which, if followed to the letter, will eliminate the greatest danger, but there are many other precautions necessary, such as licensing the operatives of the machines, proper wiring, ample exits and red lights. Various interpretations have been put upon Rule 65a as regards the proper material for the fireproof booth. The rule plainly reads "fireproof material" and means "fireproof material" such as will not warp when heated and will stand the wear and tear that booths are subjected to. Mr. Smith called attention to the rules and precautions taken by his city of Norfolk, Va. They are as follows:

"Whenever moving-picture machines are operated in any building or tent within the city limits, they shall be so located as not to obstruct the exits, aisles or passages thereto, and shall be placed in a metal chamber of galvanized iron not less than No. 24 gauge, said chamber not to be smaller than six feet square by five and one-half feet high, inside measurement. There shall be an inner and outer wall with a two-inch air space between, for sides and top, all to be riveted to a substantial iron framework. There must be a vent pipe not less than twelve inches in diameter run from metal chamber to a point outside building. Main door must be hung by stout coiled spring hinges and swing outward; openings for lens and operator must not exceed ten inches by eight inches each, and have metal drop shutters running in metal grooves, shutters to be held open by light cotton strings passing across inner ceiling of booth, through side of booth to outside. All wiring in both to be in conduits; wiring for picture machine to be separate from lighting system; all exits to have large signs and red lanterns, burning sperm oil; not less than two five-gallon chemical extinguishers to be located near booth. All machines to be in charge of competent men who shall receive a certificate from the Board of Control, said certificate to be good for only one year and revocable for cause."

Discussing this paper O'Hearn, of Cambridge, Mass., and Jerry Murphy, of Cleveland, both remarked that a larger part of the hazard from moving-picture machines was not that caused by electrical means, but resulted from causes entirely distinct. It would seem that the proper department to place the inspection was the fire department.

C. R. George, of Houston, Tex.; W. Y. Ellett, of Elmira, N. Y.; W. M. Petty, of Rutherford, N. J., and others commented upon the paper and agreed for the most part with the author.

The first paper read and discussed at the second day's session was that by W. M. Petty, of Rutherford, N. J., on "Batteries for Signaling Systems." Mr. Petty reviewed the various types of cells used for signaling work and mentioned their advantages and disadvantages. The preparation of this paper was undertaken, primarily, to provoke discussion on the storage cell, which is, par excellence, the battery for the city electrician. It can be used for any kind of work, either open or closed circuit, and, with a minimum of care and expense, can be relied upon at all times to produce a steady flow of current.

Of late years the greatest objection urged against the storage cell, that of the means for charging, has been removed, and every place, no matter how small, now has an electric light or power circuit available. Even those places where no direct current can be secured, can, by means of simple and efficient devices, convert the alternating current to direct, and thus charge the cells at a low cost.

In investigating the storage battery when used for signaling work, Mr. Petty finds by far the larger majority are the six-ampere-hour, two-plate type. The twelve-ampere-hour cell is also much in use and is increasing in popularity.

With the latest type of switchboard made by the leading manufacturers of fire-alarm and police apparatus, the cells can be grouped so as to obtain the greatest advantages from the charging current, and they can be also controlled so as to render the operations almost automatic.

The methods of charging range from direct current at 600 volts down to 110 volts, and alternating current from 220 volts and 110 volts, converting by means of motor-generator and rectifier sets down to four volts.

The cost of maintenance varies widely. Out of the many systems examined by the writer, a large majority obtain the necessary current free of charge; others pay rates varying from five to fifteen cents per kilowatt-hour, making the average cost per cell vary from ten to fifty cents per annum. In places using alternating current the efficiency of conversion varies from twenty-five to sixty-five per cent.

Mention was made of a plant the author had installed wherein he had used the mercury arc rectifier for charging the cells. This plant has been running since June, 1907, and has shown very satisfactory results. No trouble whatever has been experienced with it, and the cells are in every respect as good as when first installed. The prediction that some trouble and expense would be experienced in the operation of the tube has been proven a fallacy. As a matter of fact, the original tube, started June 15, 1907, is still in operation and shows no signs of failing. It has given over 1,100 hours' service. This installation shows an efficiency of sixty-two per cent and is run at about one-third the capacity of the rectifier.

In the resulting discussion Jerry Murphy, A. C. Farrand, C. R. George, T. C. O'Hearn, C. P. Diehl and J. B. Bernstein participated.

The matter of overcharging was touched upon, and it was shown that in the majority of cases overcharging is a very common practice. The life of the cells, even though they may be much overcharged, seemed to be in excess of six years and an instance where a cell had been in use for nine years was mentioned.

Jerry Murphy, of Cleveland, Ohio, then read a paper on "Police Telegraph Systems." This was a general paper intended to prove the value of such systems to the community, and not taking up the question technically. This side of the problem was, however, brought out in the discussion and it was shown in many cases that a combination of the telephone and telegraph was essential to a proper system.

An elaborate paper on "Methods of Fault Location," by J. B. Bernstein, illustrated by diagrams and apparatus, was read and discussed. Mr. Bernstein reviewed the various methods of testing by means of the many forms of Wheatstone bridge and gave simple instructions regarding them.

Mr. Petty, in opening the discussion, said that the thanks of the members were due Mr. Bernstein for his very practical paper.

C. R. George's paper, on "Electrical Equipment of a Fire Station," described a system in use in the city of Houston, Tex.

The third day's session was devoted to committee reports and routine business.

The chairmen of the various departments of the organization submitted their reports, showing the progress that had been made during the year.

A resolution was passed appointing a committee of three to report on the proposed action of the United States Post-Office Department regarding the painting red of mail boxes. This committee has power to enter a protest in the name of the association against such action on the ground that it would tend to cause confusion, red being the standard color for fire-alarm signal boxes.

It was decided to hold the next convention at Atlantic City, N. J.

The secretary, F. P. Foster, was elected a life member in recognition of his excellent services to the association.

Many entertainment features were provided for the ladies and the members. The afternoon of Friday was spent on one of the river boats, with luncheon at the Casino through the courtesy of Gamewell Company.

The election of officers resulted as follows:

President—J. B. Yeakle, Baltimore, Md.

First vice-president—W. S. Devlin, New Castle, Pa.

Second vice-president—H. C. Bundy, Watertown, N. Y.

Third vice-president—F. A. Cambridge, Winnipeg, Manitoba.

Fourth vice-president—C. R. George, Houston, Tex.

Secretary—Frank P. Foster, Corning, N. Y.

Treasurer—C. P. Diehl, Harrisburg, Pa.

Executive committee—A. C. Farrand, Atlantic City, N. J.; C. A. Sundquist, Jamestown, N. Y.; L. L. Kingsbury, Baltimore, Md.; C. F. Gall, Louisville, Ky.; S. W. Manning, St. Paul, Minn.; T. C. O'Hearn, Cambridge, Mass.; R. A. Smith, Norfolk, Va.; William Crane, Erie, Pa.; John O'Brien, Fond du Lac, Wis.

Finance committee—Jerry Murphy, Cleveland, Ohio; A. L. Kittridge, New Haven, Ct.; A. L. Pierce, Wallingford, Ct.

The following committees were also appointed: Inspection—L. L. Kingsbury, R. A. Smith, T. C. O'Hearn. Police Signal—A. C. Farrand, Jerry Murphy, A. L. Kittridge. Fire Telegraph—C. F. Gall, S. W. Manning, H. C. Bundy. Electric Light—C. A. Sundquist, A. L. Pierce, F. A. Cambridge. Outside Construction—W. S. Devlin, William Crane, John O'Brien.

Among those registered were the following:

W. A. Devlin, New Castle, Pa.; C. R. George, Houston, Tex.; A. C. Farrand, Atlantic City, N. J.; A. S. Hatch, Burnside, Ky.; R. A. Smith, Norfolk, Va.; F. P. Foster, Corning, N. Y.; E. J. Hunt, New York city; L. L. Kingsbury, Baltimore, Md.; P. H. McMannus, Wilkesbarre, Pa.; C. F. Gall, Louisville, Ky.; A. C. Friend, Chicago, Ill.; R. C. Smith, New York city; R. J. Thorne, Chicago, Ill.; M. J. Donoghue, Niagara Falls, N. Y.; W. F. Wills, Niagara Falls, N. Y.; A. L. McKittridge, New Haven, Conn.; A. J. Bell, New Rochelle, N. Y.; H. C. Bundy, Walkertown, N. Y.; W. L. Kent, Lynchburg, Va.; C. P. Diehl, Harrisburg, Pa.; C. G. Sundquist, Jamestown, N. Y.; P. J. Kern, Louisville, Ky.; William Crane, Erie, Pa.; J. B. Diller, Memphis, Tenn.; Ira B. Yeakle, Baltimore, Md.; Anna Veath, Youngstown, Ohio; John Berry, Indianapolis, Ind.; Adam Bosch and Mrs. Bosch, Newark, N. J.; E. Darrow, Cincinnati, Ohio; S. W. Manning, St. Paul, Minn.; John O'Brien, Fond du Lac, Wis.; F. E. Stover, Chicago, Ill.; J. H. Warren, New Brunswick, N. J.; J. B. Bernstein, Philadelphia, Pa.; J. O. Dormer, Chicago, Ill.; J. E. Clark, Rutherford, N. J.; J. W. Whaling, Chicago, Ill.; J. B. Yeakle, Baltimore, Md.; J. C. Craig and Mrs. Craig, Toronto, Ontario; Mrs. J. L. Simpson, Washington, D. C.; C. S. Downs and wife, Altoona, Pa.; N. M. Loomis, Akron, Ohio; E. J. Loomis, Allegheny, Pa.; Ambrose Perkins, Youngstown, Ohio; W. M. Petty, Rutherford, N. J.; Mrs. P. Gykern, Louisville, Ky.; Mrs. C. Hall, Knoxville, Tenn.; Mrs. W. M. Crane, Erie, Pa.; Mrs. J. Bell, New Rochelle, N. Y.; Flora E. Hatch Detroit, Mich.; Mrs. A. Perkins, Youngstown, Ohio; Mrs. F. Quimby, Youngstown, Ohio; Fred Quimby, Youngstown, Ohio; Albert Murphy, Cleveland, Ohio; Edward Murphy, Cleveland, Ohio; Jerry Murphy, Cleveland, Ohio; F. A. Cambridge, Winnipeg, Manitoba; W. Y. Ellett, Elmira, N. Y.; T. C. O'Hearn, Cambridge, Mass.; Charles S. McCoskar, Mobile, Ala.; H. A. Bowen, Cleveland, Ohio; Mrs. A. J. Cowles, Detroit, Mich.; Lucy Peterson, Detroit, Mich.; J. W. Brooke, Cleveland, Ohio; Miss M. Buckley, Brooklyn, N. Y.; Miss K. Buckley, Brooklyn, N. Y.; Miss Stella Buckley, Brooklyn, N. Y.; F. B. Mistrosky, Detroit, Mich.; Ion Simonds, Charleston, S. C.; J. B. McCarthy, Detroit, Mich.; A. E. Braddell, Chicago, Ill.; S. C. Harvey, Chicago, Ill.

The following companies had exhibits:

Stanley & Patterson, New York city—Wireless battery holders, "Faraday" bells, etc.

Hartford Time Switch Company, Hartford, Ct.—Hartford time switches.

De Veau Telephone Manufacturing Company, New York city—Switchless telephones, etc.

Gamewell Fire Alarm Telegraph Company, New York city—Successive fire-alarm boxes, punching registers.

Duplex Metals Company, New York city—"Monnot" copper-clad steel wire.

Leeds & Northrop Company, Philadelphia, Pa.—Electrical measuring instruments.

P. R. Manufacturing Company, Detroit, Mich.—Electric bells, etc.

Frank B. Cook, Chicago, Ill.—Telephone protection apparatus.

Corwin Telephone Manufacturing Company, Chicago, Ill.—Telephone apparatus.

Gould Storage Battery Company, New York city—Storage batteries for signaling systems.

Reorganization of the Mohawk Valley Company.

The Public Service Commission, Second District, has passed upon the preliminary applications in the financial reorganization plan of the Mohawk Valley Company, the holding company of the so-called Vanderbilt or Andrews syndicate electric railroad and lighting properties.

Prior to the enactment of the Public Service Commissions law the Mohawk Valley Company could lawfully acquire and hold stock of railroad and lighting companies to an unlimited amount. Its operations have been conducted upon the assumption that this right continued in the control and management of the companies in which it owns a majority of the stock and the financing has been carried on upon this assumption.

Section 54 of the Public Service Commissions law provides that where stock shall be transferred or held for the purpose of collateral security, no stock corporation of any description, domestic or foreign, other than a railroad corporation or street railroad corporation, shall purchase or acquire, take or hold, more than ten per centum of the total capital stock issued by any railroad corporation or street railroad corporation, or any other common carrier.

Under this provision of statute the Mohawk Valley Company was required to change its method of financing, and it has been found necessary to devise other measures for the handling of its property. An extensive scheme of reorganization, which involves a series of applications to the commission, has been worked out. The plan involves a series of complicated changes in the handling of stocks and the amount thereof of the various companies concerned in the transaction.

The essential feature of the plan when it is entirely consummated is that there shall be no more securities afloat than now and that there shall have been accomplished no increased issue of stocks or bonds. The end to be attained is a change in the ownership of stocks so that the financial operations of the various companies may be placed in harmony with the existing law. The whole scheme has been informally submitted to the commission for its opinion.

The companies in which the Mohawk Valley Company is interested and its holdings are as follows:

Name of Company.	Amount Outstanding	Mohawk Valley Amount.	Co. Owns per ct.
Utica & Mohawk Valley Railway Co.	$7,500,000	$7,500,000	100.00
Oneida Railway Co.	*1,923,000	1,922,700	99.98
Syracuse R. T. Railway Co.	†3,918,071	2,317,500	59.14
Rochester & Eastern Rapid Railway Co.	1,500,000	1,500,000	100.00
Schenectady Railway Co.	4,100,000	2,050,000	50.00
Rochester Elec Railway Co	200,000	173,900	86.95
Rochester & Suburban Railway Co	420,000	400,800	95.42
Rochester & Sodus Bay Railway Co.	1,850,000	1,100,000	59.45
Ontario Light & Traction Co	100,000	100,000	100 00
Rochester Railway Co	6,000,000	900	.03
Rochester Railway & Light Co.	9,498,860	7,638,900	80.41
Canandaigua Railway & Gas Light Co.	50,000	20,550	41.00
Eastern Monroe Electric Light & Gas Co.	250,000	250,000	100 00

* $77,000 owned by Oneida Railway Co

† $81 928.26 owned by Syracuse Rapid Transit Railway Co

The net result of the changes involved is that instead of owning the surrendered capital stock of the Mohawk Valley Company the New York Central & Hudson River Railroad Company will be the owner of stocks to the amount of $10,230,480, and that instead of holding the indebtedness against the Mohawk Valley Company of $4,500,000, it would be the owner of the capital stock of the Rochester Railway Company of the par value of $2,998,700 and of the assumed value of $4,500,000. This action is approved, the commission insisting that it must, "however, be clearly understood that this action of the commission is not to be construed as an unqualified approval of the results to which it assents. The commission finds itself confronted with a situation arising out of a change of law. That change of law compels a change of corporate relations. To some change it must assent in order to preserve properties under its supervision in a condition to meet the public requirements which they were created to serve. It deems that wise policy and a just regard both for the public and private interests involved require it to authorize that course which within the law best meets the exigencies of the situation, although it might be as an original proposition disconnected from existing investments, legal at the time they were made, it would unhesitatingly stamp that course with its disapproval. The new restrictions upon corporate dealings should be applied to existing investments with sense and judgment, and that has been the endeavor in this case."

The application of the Rochester & Eastern Railway Company is for the consent of this commission to increase its capital stock from the sum of $1,500,000 to $15,290,200, thus making an increase in the amount of its common capital stock in the sum of $13,790,200.

There is nothing in the present condition of this company, if it be considered by itself, which demands for the purposes of its successful operation as a railroad that its capital stock be increased. For reasons it has been selected, however, as a company which shall become the owner and holder of certain other railroad stocks which must be placed somewhere under the proposed scheme relative to the holdings of the Mohawk Valley Company. This application is granted.

The next step is to be as follows: The consolidating company succeeding to the Rochester & Eastern Rapid Railway Company would be the owner of the total capital stock of the Oneida Railroad Company and the Utica & Mohawk Valley Railroad Company, except the amount of $300 of the Oneida Railway Company, which it is proposed to acquire. Upon the acquisition of this stock by the consolidated company, it then being the owner of the total capital stock of the two companies, it is proposed to merge the same with the consolidation, pursuant to the provisions of the statute in that behalf, and thus extinguish the two companies and reduce the number of companies to three, namely, Schenectady, Syracuse Rapid Transit and the Consolidated.

This completes the series of operations definitely projected, although it is clearly understood that these applications are granted upon the express understanding that it is contemplated by the applicants to consolidate and merge the companies, and to place a general refunding mortgage upon the property of the consolidated company, and that these applications are granted for the express purpose of bringing about the final results as indicated.

"The commission grants these applications in view of all the reasons presented to it in connection with the entire series of transactions. It might hesitate seriously to grant these applications were the proceedings to stop with them and nothing further be done. It realizes that it has no powers to compel the consolidation or the merger, and that these acts will take place depends upon the good faith of the parties, which is pledged to the same, and of which pledge these remarks are to remain as the evidence." Upon the theory that this is the proper way in which to handle the financial operations of all the consolidated companies, it is believed that a better market can be found for bonds which are secured by all of the properties than for bonds which have a security upon the property of one company alone.

The opinion written by Chairman Stevens holds:

1. That the situation of all the companies involved justified and required a change in the stock holdings.

2. That the change in the law compelled a change in the corporate relations.

3. That wise policy and a just regard for both the public and private interests affected required the commission to authorize such reorganization as within the law best meets the exigencies of the situation, although the results may be such that as an original proposition disconnected from existing investments, legal at the time they were made, it would unhesitatingly stamp them with its disapproval.

4. In any inquiry into the rates and charges of a public service corporation, that portion of its capital stock issued for the purpose of owning and holding the stocks of other corporations is not a factor to be considered. Upon such an inquiry if the capital stock of the corporation is an element to be considered, only that portion of the capital stock which may be said to represent the property operated is entitled to be regarded.

5. Capital stock will not be permitted to issue for the purchase of the stock of other corporations unless the stock to be purchased has a value substantially equal to the par value of the stock to be issued. The protection of ignorant or improvident persons against stock issues representing fictitious values requires this rule.

The Character of Corporate Stocks Discussed—They are considered to be evidence of right to an aliquot part of the corporate assets upon final dissolution and division and of the right to the same part of any dividend which may be declared. The so-called par value furnishes no indication of the true value of the property to which the stocks are mere evidences of title or the dividend-earning power of the same.

THE TEST-METER METHOD OF TESTING SERVICE METERS—III.

BY JOSEPH B. BAKER.

THE MOWBRAY TEST METER, PRESENT FORM—GENERAL FEATURES.

The Mowbray test meter is now made in improved form in both direct-current and alternating-current types.[1]

The improvements consist in a refinement of the device described in the preceding article whereby the "sight method" of reading the test meter is simplified and facilitated; in better arrangements for making connections and for starting and stopping the test meter; and in superior flexibility, portability and general handiness of the test meter as a whole.

The construction and operation of this type are based on the alternative method of testing referred to in the preceding article, in which readings of a pointer and scale attached to the test meter are compared with a determined number of revolutions of the consumer's meter under test. By the simple plan of starting and stopping the test meter electrically, however, it is made practicable for a single observer to perform the tests, instead of requiring a tester and a helper as in the use of the earlier type.

Fig. 3 is a general view of the latest type of Mowbray direct-current test meter, and Fig. 4 is a diagram of the potential circuit and of the methods of making running and heating connections.

THE DIRECT-CURRENT TEST METER.

The direct-current test meter consists of a modified, inverted commutator meter having two potential circuits and a composite field-winding, and a diamond cup-jewel step bearing and sapphire ring-stone top bearing, and is mounted in a carrying case, with soft rubber cushions to absorb vibration.

Mr. Mowbray states that the composite field-winding in the present form of test meter is designed to facilitate the accurate adjustment of the ratio between the windings by arranging the individual coils so as to make energy field (as a whole) of the same mean diameter, or in other words bring the average distance of the turns in each field of the composite winding the same distance from the armature as the average distance of the turns of every other field. In the 1902 form of composite winding, in which each pair of coils constituting a field was symmetrically arranged (one on either side of the armature) with the smaller-wire coils on the outside, it was a matter of lengthy experiment to determine the right number of additional ampere-turns to add to the outside coils in order to compensate for

Fig. 3.—Latest Type of Mowbray Direct-Current Test Meter.

the greater mean distance of this coil from the armature. In the present form the mean diameter of the two coils constituting each field is made equal to the mean diameter of the entire composite winding, by making one of the two coils

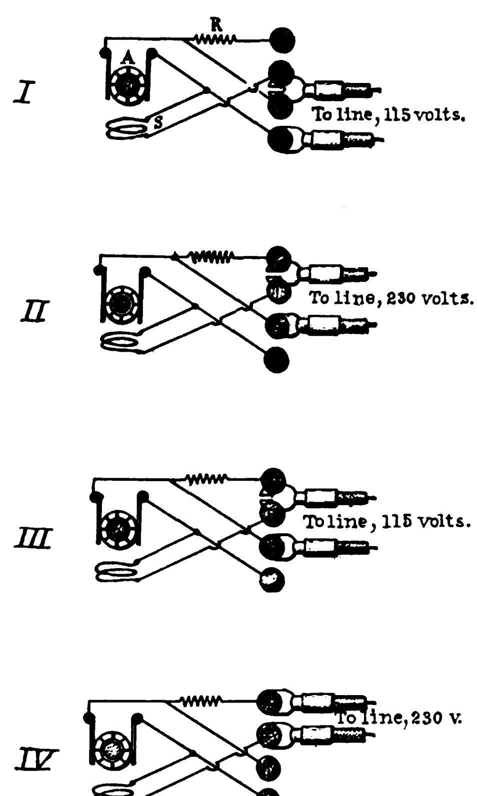


Fig. 4.—Diagram of Potential Circuit and Method of Making Running and Heating Connection.

smaller in diameter and the other an equal amount larger in diameter, than this mean. Thus, in a composite winding consisting of one-ampere, four-ampere, sixteen-ampere and eighty-ampere fields, the group of coils on one side of the armature would consist of an eighty-ampere coil (innermost) having a sixteen-ampere coil wound over it, then a four-ampere coil, and lastly (outside of these three) a one-ampere coil; whereas the group of coils on the other side of the armature, in order from innermost to outermost, would consist of one-ampere, four-ampere, sixteen-ampere and eighty-ampere coils.

Another feature of the present composite field-winding is that the available wire is used to best advantage by including the coarser coils in circuit with the finer ones in progressing from the highest-value field to the lowest. Thus, in the four-field test meter referred to the eighty-ampere field consists of the one pair of eighty-ampere coils already described, *viz.*, the innermost coil of the group on one side of the armature and the outermost coil of the group on the other side; but the sixteen-ampere field would include not only the pair of sixteen-ampere coils but also (in series therewith) the pair of eighty-ampere coils; the four-ampere field would comprise the four-ampere, sixteen-ampere and eighty-ampere coils, and the one-ampere field the one-ampere, four-ampere, sixteen-ampere and eighty-ampere coils.

The preceding arrangement, which obviously occupies the minimum amount of space for a given field strength, superseded a bulkier and more complicated form of composite field-winding comprising eighty-ampere, twenty-ampere, four-ampere and one-ampere "scales" in which a commutating switch, mounted on an insulating drum and operated by a knurled knob, was used to make the different combinations. The test meter illustrated in Fig. 5 and Fig. 6 is equipped with this arrangement and also with the telephone device described in the preceding article. The eighty-ampere scale was cut in, on this switch, by connecting four twenty-ampere coils in parallel, and the twenty-ampere scale by connecting these coils in series; and the four-ampere scale was cut in by connecting four one-ampere coils in parallel, and the one-ampere scale by connecting these one-ampere coils in series.

In some of the Mowbray test meters a brass upper bearing was used. The bearing hole was countersunk at the lower end of the bearing plug, to prevent the shoulder of the meter shaft from battering the plug—as by the up-and-down motion of the rotating element in carrying the test meter in an inverted position (see Fig. 2[1])—in such a way as to cause binding on the shaft. Modern test meters of the type exemplified in Fig. 3 and Fig. 6 are carried right side up and have a "locking device" for keeping the rotating element out of contact with the jewel in transportation.

The case is provided with a hard rubber top on which are mounted binding-post terminals of the various field and potential windings to facilitate making the various warming-up and running connections, to-

[1] The alternating-current test meter illustrated herewith is designed with 1.5, fifteen and 150-ampere current coils, for 115 and 230 volts, sixty cycles. The direct-current test meter illustrated is designed with one, four, sixteen and eighty-ampere current coils, for 115 and 230 volts. Alternating-current and direct-current test meters of just one-half the above current capacities are also made; also a direct-current meter with one, three, ten and thirty-ampere coils.

[1] Page 236, Vol. 53, No. 7.

gether with a pair of knurled heads for adjusting the friction-compensating coil without removing the meter from the case, and a small level. The usual meter register is omitted and a horizontal "dial," which is observed through a window in the hard-rubber top, is provided instead. The dial consists of a large circular scale, divided into 100 scale divisions, swept by a pointer fixed to the upper end of the meter shaft, and a smaller circular scale having ten scale divisions and with a pointer geared to the shaft in the ratio of 10 to 1, so that for every revolution of the pointer on the large scale the pointer on the small scale moves through one scale division.[1] In the lower part of the case is located a small window for observing the condition of the commutator. In the form illustrated the meter itself is not equipped with a switch for starting and stopping, this switch being inserted in the current leads.

This direct-current test meter is claimed to possess an exceedingly high torque—about double that of an ordinary small consumer's meter—secured by increasing the number of turns in both the field and armature windings, and by omitting from the 115-volt potential circuit the usual series resistance and applying the total voltage direct to the armature and friction compensating coil in series.

THE ALTERNATING-CURRENT TEST METER.

A recent type of alternating-current test meter consists of a modified induction meter mounted in a carrying case and equipped with many of the general features of the direct-current test meter. In the hard-rubber top are current and potential binding-posts, a single knurled switch for adapting the potential circuit for 115 to 230 volts, a small level, a push-button switch for starting and stopping the meter by closing and opening the potential circuit, and the window for observing the dial.

Testing with the present form of test meter, of either the direct-current or alternating-current type, requires only one man, because the test meter, which is used after the manner of a stop-watch, constitutes the only piece of test apparatus used. The starting and stopping, however, are not accomplished mechanically, as in a stop-watch, but electrically by means of the switch, which throws the test meter in or out of circuit. After making the necessary connections to the service wires at the consumer's meter the test meter is simply switched into circuit during the time required by the consumer's meter to make a determined number of revolutions, noted in the usual way by observing a mark on the disc, and out of circuit again at the end of this interval. The switching is effected in the direct-current type

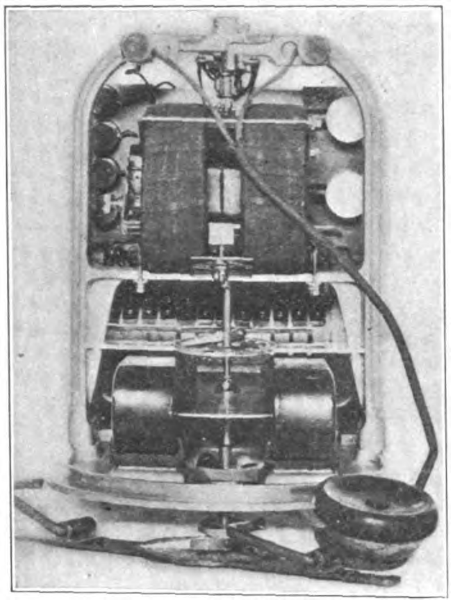


Fig. 5.—Mowbray Alternating-Current Test Meter.

by cutting in the series fields on the load, and in the alternating-current type by closing the potential circuit across the voltage. Obviously no appreciable net error is introduced by this start-and-stop method of comparing the test meter with

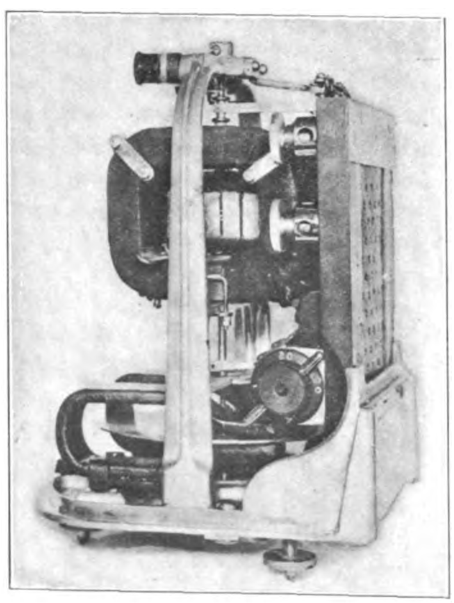


Fig. 6.—Mowbray Alternating-Current Test Meter.

the consumer's meter, as the lag of the disc in starting, due to its inertia, when the test-meter switch is thrown on is compensated for by the overrunning of the disc, restrained by the braking magnets, after the switch is thrown off.

In the direct-current test meter, normal running temperature (and consequent accuracy) is reached by the application of double voltage to the test-meter potential circuits in series, or of normal voltage to the potential circuits in parallel, for a period of two and one-half minutes. This increased time, as compared with the one and one-half minutes required for the armature of the first model to heat, is due to the fact that the new model armature is specially wound with a much greater number of turns. In the diagram of Fig. 4, I shows the connections for heating the 115-volt circuit in two and one-half minutes on 115 volts; II, the connections for heating the 115-volt circuit in two and one-half minutes on 230 volts; III, the 115-volt running connections, and IV, the 230-volt running connections. Normal voltage is then applied and the potential circuit is allowed to remain undisturbed until the completion of the test, as any interruption of this circuit would allow it to cool down and render the test meter for the time inaccurate. For this reason the operating switch of the direct-current test meter is, as already stated, located in the *current* circuit (see Fig. 3). The operating switch is constructed so as to cut the field windings in and out without at any time opening the main circuit or causing arcing.

In the alternating-current test meter the operating switch is, as already stated, in the *potential* circuit. The fact that voltage is not applied all of the time causes no inaccuracy because, as in ordinary induction meters, the temperature and resistance, and hence the accuracy, vary but slightly with respect to the length of time that the voltage is applied.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on September 1 for two sets of wireless telephones for delivery at Brooklyn, N. Y.; for miscellaneous rubber-insulated cable for delivery at Washington, D. C.; for 6,450 feet of telephone cable for delivery at Boston, Mass. On September 8, for 100,000 feet of ship lighting cable, for delivery at Brooklyn, N. Y.; for miscellaneous electrical supplies for delivery at Boston, Mass. On September 15, for 800 feet of rubber-insulated cable, 6,600 conduit clamps and six transformers for delivery at Mare Island, Cal.

[1] See also paper entitled "A New Rotative Test Meter," by W. J. Mowbray, read before the Association of Edison Illuminating Companies at the Lake Champlain convention, September 12-14, 1905.

RAIL CORRUGATION.[1]

BY PROFESSOR C. A. CARUS-WILSON.

It will not be necessary for me to spend time in giving any general account of rail corrugation; the phenomenon is, unfortunately, only too well known to all those interested in tramways. I will therefore begin by asking you to consider certain facts which may throw light on the vexed question as to how corrugations are formed.

You have no doubt observed that corrugations on grooved rails are very often accompanied by a cutting of the check of the rail immediately opposite. This is especially noticeable on curves, where the centrifugal force has made the inner flange bear against the inner check, the corrugations being on the outer rail. But the same kind of check-cutting is found on the straight, where the car has been bearing over on one side or the other, the corrugations appearing on the rail immediately opposite the one whose check is cut. Speaking generally, it may be said that, with some exceptions, to which I will allude later on, corrugation is accompanied by a cutting of the check of the opposite rail.

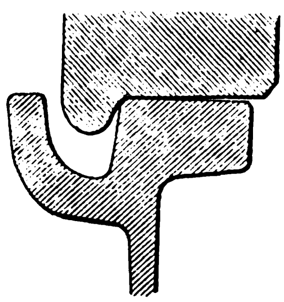


Fig. 1.—New Wheels and Rails.

When wheels and rails are new there is a clearance, generally of about one-quarter inch, between the flange and the check on both sides, as shown in Fig. 1, which represents the normal position of the flange in the groove on each side when new. Any side pressure on straight or curve is then taken by the throat of the flange bearing on the head of the rail. The flange can not come in contact with the check until considerable wear has taken place. Fig. 2, taken from a cast of an actual tire, shows how the flange bears against the check when the flange has worn sufficiently. Such instances of check-cut tires are very common.

I do not now propose to pursue the important inquiry as to how this wear is brought about, as this would involve a discussion of the whole problem of wheel wear; but, taking the fact that check-cutting generally accompanies corrugation, to consider the question as to the possible connection between the two. The answer to this question depends upon the solution of a very much wider question, *viz.*, when a wheel rolls upon a flange how is the motion affected by the grinding of the flange against the head of the rail? With a view to investigating this matter I have constructed a model which consists of a four-wheel truck with brass wheels two and one-half inches diameter, whose centres are four and one-quarter inches apart. There is an equalizer suspension by which a weight, hung from a central support, is distributed equally over the four wheels. One wheel on each axle is keyed to the shaft, the other being a loose wheel held in place by a sleeve. The left of these loose wheels has its sleeve slotted to correspond with a slot in the end of the axle; into this slot can be placed a plate or coupler which at the same time fits into a stud in the rim of the wheel. When the coupler is fixed in position the wheel is thus coupled to the axle. Different couplers may be used, some being rigid and some of the nature of a stiff spring. There is a mark on the rim of the coupled wheel which may be set opposite to any required point on the rail. The track consists of brass rails, three-sixteenths inch wide and three feet long, set to a gauge of three and nine-sixteenths inches, with a space between them to admit of the passage of the suspension for the weight.

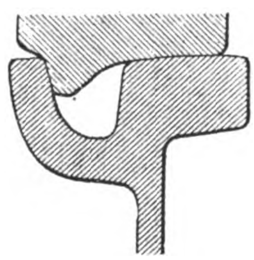


Fig. 2.—Showing Worn Flange Bearing Against Check.

The truck is first loaded with a weight of fourteen pounds, a rigid coupler inserted in the loose wheel, and the mark set opposite a point A at the right-hand end of the track. The truck is then gently pushed from behind and made to travel over the track until the wheel has made three complete revolutions and the mark has met the rail at a point B. The distance AB then represents a pure roll equal to three times the circumference of the wheel. The truck is taken back and the mark placed opposite point A as before. If the flange of the coupled wheel is now pressed hard against the rail while the truck is made to travel forward, it is found that the mark will meet the rail at a point C which lies beyond point B, the distance BC being about two per cent of AC. Owing to the side pressure the flange bites the rail on a line of contact whose diameter is greater than that of the tread of the wheel; the wheel tends to run on this line of contact, and the tread is forced to skid on the head of the rail in consequence. The result is that the motion is a combined roll and skid, the distance AB representing roll and BC representing skid. The skidding, however, is continuous, and for any part of AC covered, say the hundredth of an inch, the same proportion, *viz.*, two per cent. is skid. The two wheels, being rigid on one side, both skid an equal amount.

It thus appears that when the flange is forced against the side of the rail the wheels are made to skid a certain percentage of the distance traveled. Having ascertained this fact, the next step was to find out whether any such skidding took place on an actual tramway track. For this purpose I conducted a series of tests at Croydon on a car placed at my disposal by T. B. Goodyer, general manager of the Croydon Corporation Tramways.

The car selected for the tests was a four-wheel double-deck car with Mountain & Gibson truck equipped with two Westinghouse No. 200 motors, weighing, with five passengers, 7.8 tons. The truck had a wheel base of six feet, with British Griffin chilled-iron wheels. A bicycle gear-wheel with sixty-eight teeth was fixed on one of the axles and connected by a chain-drive to a spur-wheel with fourteen teeth secured on the floor of the car. A Harding speed counter was attached to the spur-wheel, by which the revolutions of the axle could be measured. The circumference of each wheel on this axle was measured with a steel tape, and checked by calipering, the result being exactly ninety-five and three-quarters inches in each case, the two wheels having the same diameter.

A section of straight and nearly level track was chosen on the road between Croydon and Purley. There are here two lines of rails, badly corrugated for the greater part of the distance. The track is of standard gauge with macadam sides, and the rails, weighing ninety-five pounds per yard, are laid on a six-inch bed of concrete. Two trolley poles, about half

[1] Lecture delivered before the Tramway Congress at the Franco-British Exhibition, July 10, 1908.

a mile apart, were selected, and the distance between them chained and found to be 2,597 feet. If this distance were covered by simple rolling the counter would make 1,581 revolutions. The method of test was as follows: One observer was told off to take charge of the counter, a second to take the time and a third to call the start and the stop. The car was started up some distance behind the first pole, which it passed at full speed; at the moment of passing the third observer gave a signal; the time was taken and the counter inserted in the spur-wheel. The car covered the distance at constant speed without slowing down; on passing the second pole, at a given signal the time was taken and the counter withdrawn. The car was then brought to rest beyond the second pole and was changed over to the up track, when the same process was repeated in the reverse direction. The slight difference of level resulted in the up journey being made at a rather higher speed than the down journey. Two trips were made each way with the track very dry, and two trips each way after a heavy rainstorm, the track being then very wet, but not greasy. The results are given in the following table:

	Condition of Track.	Mean Counter Revolutions.	Skid in Counter Revolutions.	Skid in per Cent of Distance Covered.	Mean Speed Miles per Hour.
Down trip	Dry.	1,516	65	4.1	11.2
Down trip	Wet.	1,535	46	2.9	11.1
Up trip...	Dry.	1,522	59	3.7	14.4
Up trip...	Wet.	1,547	34	2.1	14.0

From these experiments it appeared that when a car travels along a tramway track the wheels skid upon the head of the rails in the same way as they do in the model.

It remained to be seen in what way the skidding, which had been shown to take place, could produce corrugation. For this purpose further experiments were made on the model. In order to get a definite amount of skid that should be independent of possible variations in the side pressure exerted, a metal fillet was inserted against one of the rails in such a way as to lift the keyed wheels off the rail and force them to roll on the outside of their flanges. The diameter of the outside of the flange is about nine per cent greater than that of the tread, and a pure roll on the flange would correspond with the distance AD on the rail, where BD is about nine per cent of AB, which represents three complete revolutions on the tread.

If the loose wheel is now fitted with a rigid coupler, the motion of the coupled wheel will be a roll and a skid, and of the keyed wheel a roll and a slip, the proportion of skid to slip depending upon the relative coefficients of friction, but the sum of the two always being equal to BD, or nine per cent of AB. With a total weight of forty-two pounds—that is, 10.5 pounds on each wheel, the coupled wheel skids about eight per cent. The skidding remains quite uniform and continuous as before.

If the coupler is removed from the notch and placed on one side of the stud, the loose wheel is at liberty to roll freely on the rail, and the coupler tends to draw away from the stud under the action of a definite force. This force can be made apparent if the rigid coupler is replaced by a spring coupler fixed in the notch. Whichever way the truck is pushed the spring is bent, indicating a tendency to twist the coupled wheel relatively to the axle. The angle through which the spring is bent represents the torsion required to overcome the adhesion between the tread of the wheel and the rail.

From these experiments it is evident that when the flange of a car wheel grinds against the rail in such a way as to cause skidding, the axle will be twisted until the torsion is sufficient to make the tread of the mate wheel skid on the rail, the elastic twist of the axle representing the bending of the spring in the model.

So far, however, the skidding is quite continuous, and there is no indication of any intermittent action such as could produce corrugation. But the experiments with the model have been carried out under conditions differing in one very important respect from those of actual practice: the rails have been quite clean. It remains to be seen what is the effect of making the rail surface rough, as it is in practice. For this purpose a little sand may be sprinkled over the surface of the rail. If the truck is now pushed along the track, an entirely new effect is produced: the coupled wheel, instead of moving uniformly as before, now advances with a series of jerks at regular intervals.

The action is as follows: When the torque on the spring has increased to a certain amount, the force of adhesion is overcome, and the wheel skids, turning meanwhile about its own axis, so that the whole force of the skid is concentrated over a limited area on the rail surface. In skidding the wheel grinds through the grit on the surface of the rail and comes into contact with clean metal; there is thus a large and sudden reduction in the coefficient of friction, and the wheel flies back under the influence of the spring through a considerable angle. The result is that the subsequent motion of the wheel upon the rail will be a pure roll while the spring is being again deflected. When the limit of adhesion is reached, the wheel again skids, and the process is repeated, the motion thus consisting of alternate rolling and skidding. The addition of the grit has made the skid intermittent, whereas formerly it was continuous. When the surface of the rail is clean, there is no sudden breaking down of the adhesion which is required to make the skid intermittent. This effect is not due to the increased torsion on the spring consequent on the increase in the coefficient of friction; for the same torsion can be obtained with a clean rail by increasing the weight, when the skid remains continuous.

So long as the rail is clean, the motion is thus continuous and uniform. In order to produce intermittent action it is essential that the rail surface should have been roughened by the application of some hard and gritty material. In tramway practice such material is furnished by dust, and especially by the sand which is put on the rails. According to my observations the presence of sharp grit on the rail surface is a prime factor in the production of corrugation. Numerous instances might be quoted where corrugations are worst in places where the rails are liable to be continually covered with sharp, gritty dust. Thus, in the case of the Brussels tramways, the worst corrugated section in the whole city is on the Boulevard de Waterloo, where the tram lines are flanked from end to end by a sand-covered avenue. This may also explain why the tram lines in one town—say, for example, Norwich—are badly corrugated, while at another — say, Coventry—where the track, the rails and the rolling stock are identical in character, there is little or no corrugation, the difference being due to the quantity of dry flint-dust that is blown over the Norwich tracks by the prevailing east winds.

The experiments on the model afford an explanation of the connection between check-cutting and corrugation. The flange of one of the two wheels on an axle grinds against the rail on a line of contact having a diameter greater than that of the tread, causing both wheels to skid. The skidding on the one side, where the flange is grinding, will be uniform, but on the other side, owing to the twist of the axle, the skidding will be intermittent, provided the rail surface be sufficiently rough, and the motion will be an alternate rolling and skidding. This explains why, as a rule, corrugations appear on one rail only: both wheels are skidding, but, owing to the twist of the axle, one skids uniformly and the other intermittently, the intermittent skidding taking place on the rail opposite to that where the flange is grinding. Observation shows that the rail opposite the corrugated rail is generally scored uniformly, though often with a slight wavy appearance which is caused by the sudden release of the twist on the axle affecting the motion of the non-corrugating wheel.

The distance apart of the marks on the rail, or the pitch of the corrugations, necessarily depends on the action above described. When the coefficient of adhesion, the weight on the wheel and the dimensions of the axle are fixed, the limiting amount of twist measured, say, in fractions of an inch at the rim of the wheel, is also fixed. Now the skid is a definite per cent of the distance traveled, say, x per cent, and when corrugation takes place the skid between any two marks is accumulated in the twist of the axle, hence x per cent of the pitch must equal the limiting twist on the axle. Thus if the skid is two per cent and the limiting twist 0.02 inch, the pitch would have to be one inch. It is necessary, therefore, to ascertain whether this relation holds good in practice.

With the car used in the Croydon tests the weight on each wheel was 4,370 pounds, the diameter of the axle three and three-quarters inches, and the distance between wheel hubs forty-eight inches. Taking the modulus of transverse elasticity for the axle at 14×10^6, and the coefficient of friction at 0.4*, the twist measured at the rim of a wheel thirty-one inches in diameter will be 0.073 inch. For a skid of three per cent the pitch of the corrugations would therefore have to be 2.4 inches. On the Croydon tramways the pitch of the corrugations on the straight varies from two and one-quarter inches to two and three-quarters inches.

During the process of corrugation the axle is subject to torsional vibration, and in order that the skidding may continue to take place intermittently the twisting force must be applied rhythmically with a time interval equal to the period of vibration of the axle. Hence the time occupied in covering the distance between two successive skids will be a constant quantity for any given wheels and axle. It follows, therefore, that the pitch of the corrugations will depend not only upon the skid, but also upon the speed of the car. Thus, if the mean speed is twelve miles an hour for corrugations having a pitch of two and one-half inches, when the speed is twenty-four miles an hour, the pitch would be five inches. This increase of pitch with speed has been noticed by many observers.

It would seem, then, that the pitch is determined, in the first place, by its relation to the per cent skid and the limiting twist on the axle, and in the second place by the speed, and that corrugation can not take place unless the two sets of conditions are to some extent in agreement. Thus in the case just quoted the skid at twenty-four miles an hour must be half that at twelve miles an hour; that is, if the skid is halved the speed must be doubled.

This may explain why on tramways in this country corrugations rarely appear unless accompanied by check-cutting on the opposite rail. Until such check-cutting takes place the side pressure is taken by the throat of the flange bearing against the head of the rail, the line of contact being only slightly below the tread of the wheel. Under these conditions the skid is small—not exceeding one or one and one-half per cent. Taking the relation of pitch to skid as calculated for the Croydon car, this amount of skid would correspond with corrugations having a pitch of from five inches to seven inches, involving a speed of from twenty-four to thirty-six miles an hour, or two to three times our normal speed. Hence the speeds on tramways in this country are too low to give corrugations except where the skid is large, as happens when there is check-cutting. Similar conditions obtain more or less on the Continent.

Where the speeds are higher, as on American tramways and on steam railways, corrugations may, and do, appear with the small per cent of skidding that is caused by the ordinary side pressure of the flange on the rail.

The side pressure of the flange on the rail that is necessary for the production of corrugations is caused, on the straight, by irregularities of gauge and level, which make the car lunge from side to side and bear over against one rail or the other. This accounts for the irregular distribution of corrugations along the track, first on one side, then on the other, in long or short stretches, with smooth parts in between. The tendency of a car to lunge from side to side in the manner described neutralizes the tendency of the car to ride down on the lower side on a double track, in spite of the usual camber, and corrugations are found quite as frequently on the inside as on the outside rail on a double track on the straight. The irregularities of gauge and level, due in the first instance to faulty construction, are augmented by the wear and vibration to which the track is subjected. This is one reason why corrugations generally take time to develop.

On a curve there is always a definite force, due to centrifugal action, tending to press the flanges outward. If the curve is of large radius the speed will be practically the same as on the straight, and the conditions under which corrugations may be produced will be similar, except that the pressure is constant and always in one direction. When flanges and rails are new the pressure is between the outer flange and the outer rail, but the skidding thus caused is small, and not enough to produce corrugations at ordinary speeds. After sufficient wear has taken place to bring the inside flange against the check of the inner rail, corrugation will begin on the outer rail. For this reason, on any tramway system, corrugation will generally first begin on large radius curves, corrugations appearing on the outer rail accompanied by cutting of the check of the inner rail.

The difference of length between the inner and the outer rail on a curve gives rise to a skidding or slipping quite apart from that due to the grinding of the flange on the rail. With curves of large radius this difference is small, and does not greatly affect the conditions of corrugation. With curves of small radius the difference produces a skidding or slipping which is large compared with that produced by flange grinding, and the conditions of corrugation become very complex. Speaking generally, however, it may be said that the speeds on small-radius curves are, as a rule, too low to admit of corrugations being formed.

The pitch of the corrugations on a curve is generally less than on the straight. Thus in the case of a car which produces corrugations on the straight having a pitch of 2.4 inches with three per cent skid, on a curve of 500-foot radius

*The most complete tests made to determine the coefficient of adhesion for a wheel on a rail under varying conditions are those made by Captain Galton, and published in the Proceedings of the Institution of Mechanical Engineers, 1878-9. The results there recorded indicate that the limiting or static coefficient of adhesion, immediately previous to skidding, exceeded 0.38 for a clean dry rail, and rose still higher on the application of sand. The value 0.4 is here taken as the limiting coefficient of adhesion.

the skid on the outer rail due to the difference in the length of the inner and outer rails will be about 0.9 per cent, making a total of 3.9 per cent. Now the pitch is inversely proportional to the per cent skid, so that the pitch of the corrugations on the curve should be about 1.9 inches. Observation shows that the pitch on curves is reduced about in this proportion.

The appearance of corrugations on the grooveless girder-rail used in Philadelphia and other American cities presents some interesting features in connection with what has been said as to side-flange pressure. A full report on this subject was presented by H. B. Nichols, engineer to the Philadelphia Rapid Transit Company, at the 1907 convention of the American Street Railway Engineering Association. (See Tramways and Light Railways Association circular for April, 1907.) A section of the rail and tire used in Philadelphia is reproduced in Fig. 3. The rail shown is a ninety-three-pound girder-rail, eight and three-quarters inches deep with a three-eighths-inch web. Careful observation showed that when the normal traffic was passing over this rail at a point on the straight where corrugations had appeared, the head of the rail was forced outward, due to a bending of the web, by as much as three-thirty-seconds inch. The web was then stiffened by the addition of fishplates, after which the corrugations disappeared. Subsequently this rail was replaced by another rail weighing 137 pounds, with a one-half-inch web, after which corrugations appeared only in a few places. Finally this rail was replaced by a rail weighing 141 pounds, with a nine-sixteenths-inch web, after which there was no trouble from corrugations.

It has been suggested that the corrugations in this case were due to vibrations in the rail, which were stopped by the stiffening of the web; but I would submit the following as a more probable explanation. A side deflection of three-thirty-seconds inch corresponds to vertical depression of 0.03 inch at the outside of the tread of the wheel—that is to say, the side pressure caused by the lunging of the car lifted the wheel off its tread, and threw almost the whole weight on the throat of the flange, causing the wheel to ride on a line of contact about one-quarter inch below the head of the rail —that is, on a diameter about one and one-half per cent greater than that of the tread—thus producing corrugations in accordance with the principles already stated. A simple calculation will show that when the web has been thickened to nine-sixteenths inch the lift off the tread for an equal side pressure has been reduced to 0.009 inch, and the tendency of the wheel to ride on a larger diameter than the tread has been practically eliminated.

Although corrugations are, in my opinion, generally caused by the grinding of the flange on the rail, this is not the only way in which they may be produced. A similar action may be set up if for any reason the wheel should be forced to run on its flange. This often happens at points and crossings, the tread of the rail being lifted clear off the rail-head, when corrugations may frequently be observed on the opposite rail. The same thing happens when the rail has been badly worn and the flange actually touches the bottom of the groove.

The most common example of flange riding, however, is found where the groove is allowed to get full of dirt. I have seen places where the groove has been packed with a mixture of dirt, wood-pavement scrapings, paper, etc., so hard as to resist any attempts to move it with a metal-tipped stick. The flange runs on this packing, and if the other groove does not happen to be packed so full, corrugations will appear on the opposite rail. In the course of a few days the first groove may get cleaned out and the other groove may get packed, when the conditions will be reversed, and corrugations will then appear on the previously uncorrugated rail.

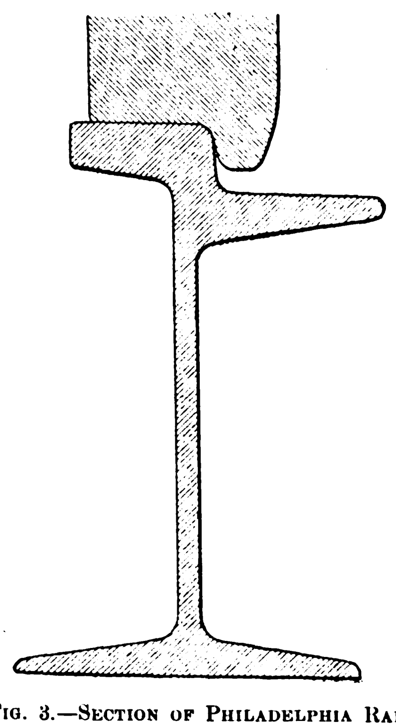


FIG. 3.—SECTION OF PHILADELPHIA RAIL.

In this way both rails become corrugated. Flange riding on a packed groove is responsible for some of the most perplexing vagaries of corrugation. The hardness of the packing depends very largely on the condition of the weather. Corrugations may be very pronounced in a certain place owing to a packed groove. A few days' rain will soften the packing and remove the cause of the corrugations, which will then get worn down and disappear, only to reappear again, perhaps on the other filled.

The corrugations which have appeared on certain steam railways in India illustrate the conclusions arrived at above as to the conditions under which oorrugations are produced. For more than ten years past corrugations have been noticed on some Indian railways, especially on the Eastern Bengal State Railway, a full account of which may be found in a paper written by G. Moyle, published in the official circular of the Tramways and Light Railways Association for June, 1906. Investigations of an exhaustive character were carried out with a view to ascertaining the cause of these corrugations. The following definite conclusions were arrived at: (1) The track on which the corrugations appeared was invariably found to be boxed with burnt clay or brick. (2) Corrugations were hardly ever found with stone boxing and never with earth boxing. (3) When the brick boxing was replaced by earth or stone boxing the corrugations disappeared. (4) To get this result it was necessary to change the boxing only, and not to remove the brick ballast packing under the sleepers. (5) Corrugated rails removed and replaced on an earth-boxed section would wear smooth, while smooth rails taken up and set down on a brick-boxed section would become corrugated.

A careful study of Mr. Moyle's paper, and the conclusions there stated, convinced me that the corrugations were in some way caused by the gritty dust that would work up from the brick boxing and be scattered over the surface of the rail by the air suction of passing trains. A possible objection to this view might be found in the fact that corrugations had appeared on open-girder bridges, where, of course, there was no brick boxing. But the objection might turn out to be a confirmation if it could be shown that the approaches to these bridges were brick-boxed, for in that case the brick dust could be carried on to the bridge by the suction of the train. Upon inquiry I was informed that investigation showed that corrugation only developed on open-girder bridges the approaches to which were brick-boxed, thus confirming the suspicion that the corrugations were in some way caused by the dust from the brick boxing.

It remained to be ascertained in what way this dust could be essential to the production of corrugations. The subsequent experiments on the model, already described, showing how intermittent skidding is brought about by covering the rail with a gritty powder, seemed to afford the required solution. Through the kindness of Sir Alexander Rendel and F. E. Robertson I was supplied with a sample of the brick boxing taken from a section of the Eastern Bengal State Railway, where corrugations are very pronounced. Some of the brick was crushed, making an exceedingly sharp and gritty powder. The model was arranged as before with a spring coupler in the loose wheel. So long as the rail remained clean the skidding was quite uniform as the truck was pushed along the track. When a little of the brick powder was scattered over the rail the skidding immediately became intermittent, indicating clearly the part played by the brick boxing in the formation of corrugations.

The investigations outlined above appear to show that the following conditions are necessary for the formation of corrugations on grooved rails:

(1) As regards the track:

(*a*) Irregularities in gauge or level,

or

(*b*) Curvature,

or

(*c*) A packed groove.

(2) As regards the rails:

(*d*) Surface rough with sand or gritty dust.

(3) As regards the rolling stock:

(*e*) Wheels with check-cutting flanges.

(4) As regards traffic:

(*f*) A critical speed.

Corrugations can not be formed unless conditions (1), (2), (3) and (4) are all present at the same time—that is, peculiar conditions must exist simultaneously in the track, the rails, the rolling stock and the speed, and the absence of any one of these conditions will prevent corrugations being formed. These considerations suggest the lines on which it may be possible to avoid the formation of corrugations. My object this morning, however, is simply to put before you the conditions under which corrugations are produced, in the belief that a correct diagnosis of the disease is the first step to be taken toward providing a remedy.

Legality of Public Service Commission Questioned.

An order has been issued on Mayor McClellan, Comptroller Metz and the Public Service Commission directing them all to appear in court. This order, which has been promulgated by Adolph Gutner through an attorney, is a notice that a motion will be made before Justice Bischoff in Part II of the Supreme Court on August 31 why an injunction should not be granted pending the determination of the suit. The injunction is sought to prevent the further payment from the city treasury of the expenses of the Public Service Commission of the first district.

The plaintiff and his attorney, Mr. Leary, propose to put Governor Hughes's Public Service Commissions to the test of a judicial scrutiny, and Mr. Leary thinks he has an unanswerable argument against the constitutionality of one of the chief sections of Chapter 429, Laws of 1907, which act establishes the Public Service Commissions and prescribes their powers and duties and provides, through them, for the regulation and control of the public service corporations. He attacks the provision in the act that makes an appropriation for the expenses and salaries.

Lawyer Leary's principal claim against the constitutionality of the act providing for the two commissions is that it makes obligatory upon the city the payment of the expenses of a purely state and not a local official body. Granting that the two commissions are composed of state officers he asserts that the imposition upon the city of New York of several hundred thousand dollars each year of expenses for one of them is clearly unconstitutional; that the city can incur no indebtedness except for city purposes. Lawyer Leary proposes to get the courts to stop Comptroller Metz from paying any more of the expense bills of the commissioners who have to do entirely with the first district. His attack upon the second district commission is based upon other grounds.

In Section 14 of Chapter 429, Laws of 1907, relating to the payment of the commissions' salaries and expenses, Lawyer Leary points out that the salaries of the commissioners, the counsel and secretary shall be audited and allowed by the state comptroller and paid monthly by the state treasurer. The commissioners were appointed by Governor Hughes and they have control over state corporations; the city officials have no power over them or their expenses and the Appellate Division of the Supreme Court, another state institution, orders the bills paid. All this, Lawyer Leary insists, makes the commission a state board.

In his complaint the plaintiff asserts that the board of estimate has appropriated large sums of money belonging to the city on the requisition of the commission, and that the payment of this money is an illegal act on the part of the city officials. He asks that the city chamberlain and comptroller be stopped from making the payments, as the plaintiff "is advised and he is informed, and believes that the said act, Chapter 429, Laws of 1907, is wholly unconstitutional and void; and in particular the aforesaid Section 14 of said act, in so far as it attempts to impose upon the city of New York the payment of the expenses of said Public Service Commissions."

Fatal Shock from Portable Electric Lamp.

At Pinxton, England, an inquest was held on the body of William E. Phillips, a young man who was killed in the locomotive shed adjoining No. 1 pit of the Pinxton Collieries, Limited, several weeks ago, it is alleged by shock from a portable electric lamp. The evidence of Joseph Surgey, a locomotive driver, was to the effect that Surgey and the deceased were working together. Surgey left the shed, and in his absence the deceased picked up a portable lamp which was attached to an electric cable. He cried out, and when the witness went to his assistance he was found to be dead. Fred Smith, of the Langton Colliery, the electrician for the owners, said he found the porcelain inside the lamp broken, and the lamp partly unscrewed.

Cleveland Municipal Traction Makes Better Showing.

According to figures given out by the Municipal Traction Company, Cleveland, three-cent fares made a profit of $19,686 for the company during the month of July. This is the first statement which has not shown a deficit. For May, the first month the street railways were operated at three-cent fares, a loss of $54,916 was reported. During that month the motormen and conductors were on a strike. For June the loss was given at $23,829. The gross earnings for July were $437,174.

A New Type of Switchboard for the United States Reclamation Service—Salt River Project.

The Salt River project of the United States Reclamation Service is more or less familiar to a great many individuals on account of the wide advertising it has received, due to the immense size of the dam and storage basin, the latter being the largest artificial reservoir in the world; and also because the large town of Roosevelt will be wiped out of existence when the reservoir is filled. About 200,000 acres of arid land near Phœnix, Ariz., is to be irrigated by a canal system fed from the main reservoir, and it is intended to irrigate an additional 40,000 acres by underground waters, made available by the installation of pumping stations at suitable points. Two important features of the Salt River project are a 6,000-kilowatt hydroelectric power station and a 45,000-volt transmission system.

The primary object of the generating station referred to above is to provide power for the operation of these pumping plants, and it is expected that several other generating stations will be constructed at various points to provide still more power. A market for surplus power can easily be found in the towns in the Salt River Valley. A temporary plant has been in operation for some years at the Roosevelt dam to supply power for the operation of the cement mill, construction machinery, lighting of the town, etc., and some of the machines in this station are to be transferred to the new power plant. The purpose of this article is to describe the controlling board which has recently been completed for installation in the new power station.

The alternating-current switchboard selected by the Government engineers for controlling the apparatus in the main station is an excellent illustration of recent "bench" control-board construction. It is of the open type, that is, there is a space left between the instrument sections and the control bench, so that the switchboard operator can have an unobstructed view of any part of the generator room without going to the end of the board, which is located at the edge of the gallery about eighteen feet above the main floor. This benchboard is equipped for the control of the following circuits, the exciter switchboard being entirely independent and of the ordinary vertical construction.

Six 2,300-volt, 1,060-kilovolt-ampere, twenty-five-cycle, three-phase, three-wire generators.

Six 2,300-volt delta, 45,000-volt Y,

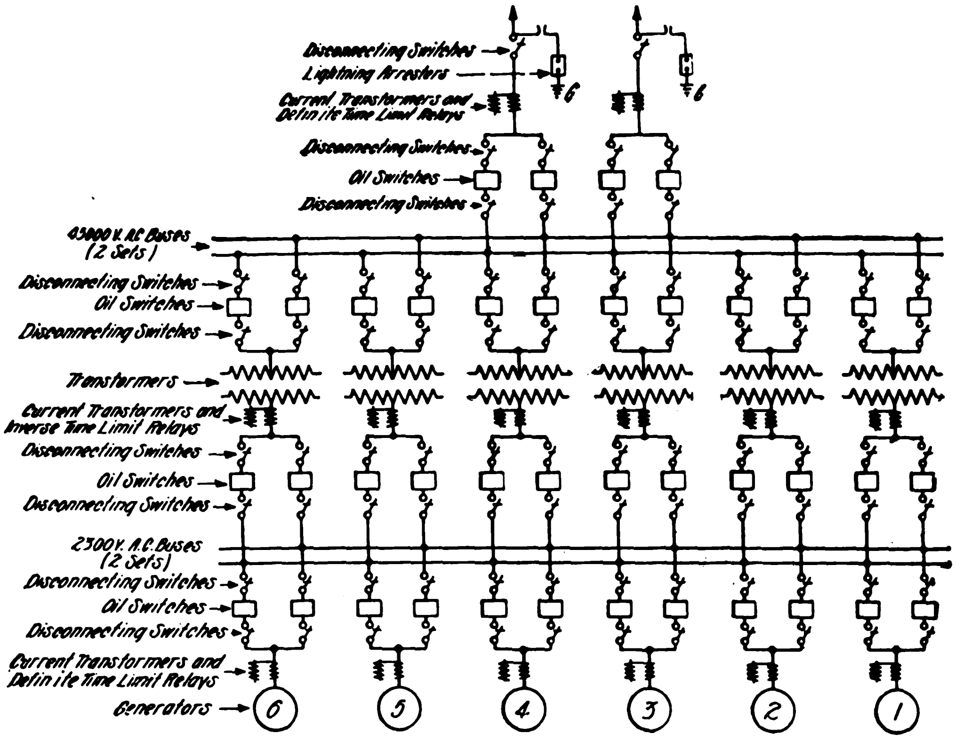


Fig. 1.—System of Connections, Switchboard for the Salt River Project of the United States Reclamation Service.

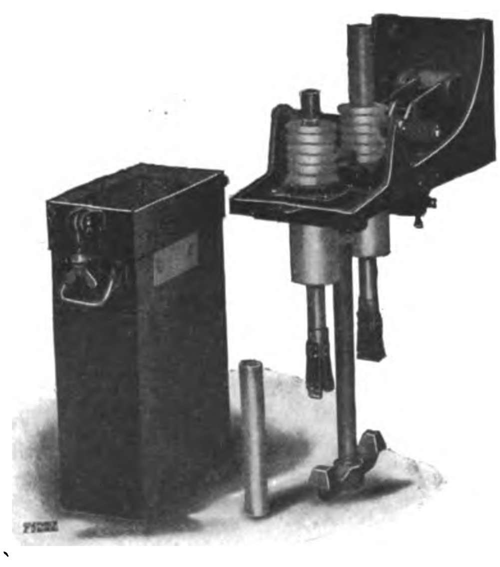


Fig. 2.—300-Ampere, 15,000-Volt Oil Switch.

Fig. 3.—100-Ampere, 45,000-Volt Oil Switch.

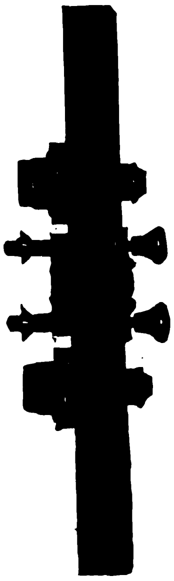


Fig. 4. — Twin Pull-Button Controlling Switch for Oil-Switch or Solenoid Control Circuit.

1,060-kilovolt-ampere, twenty-five-cycle, three-phase banks of transformers, grounded neutral.

Two 45,000-volt, 6,000-kilowatt, three-phase outgoing lines.

Fig. 1 shows the system of connections specified by the Government, one line in this diagram representing the three phases. It will be seen that both high and low-tension buses are in duplicate, allowing ample flexibility for operation, testing, inspection and repairs. Two electrically operated oil switches are used in every circuit, and complete control of the system is therefore obtained at the benchboard. This arrangement is advantageous where it is important that there be no shut-downs of an appreciable length of time. With more than two transmission lines it would probably have been advisable to modify the connections to allow of isolating any line for testing purposes after the automatic switch had been tripped by a short-circuit or other line trouble.

All protective relays used on this board are of the time-limit type in order to prevent shut-downs due to momentary overloads. The definite time-limit overload relays on the lines will, of course, be set for such a current and time that they will take care of overloads or short-circuits external to the station. Generator relays are also definite time-limit overload and will be set so that the generator switches will be tripped only on account of large exchange currents at the time of synchronizing. Inverse time-limit overload relays are used on the transformer circuits, and are so connected that trouble in any transformer will automatically disconnect all the transformers but will leave the generators operating in parallel on the low-tension bus. That the Government engineers anticipate but little trouble with the transformers is evidenced by the fact that no provision is made in the transformer-protective devices for selective operation. By using series inverse time-limit overload relays on the high-tension side of the transformers, in addition to the low-tension relays, only the defective bank of transformers would be disconnected in case of trouble.

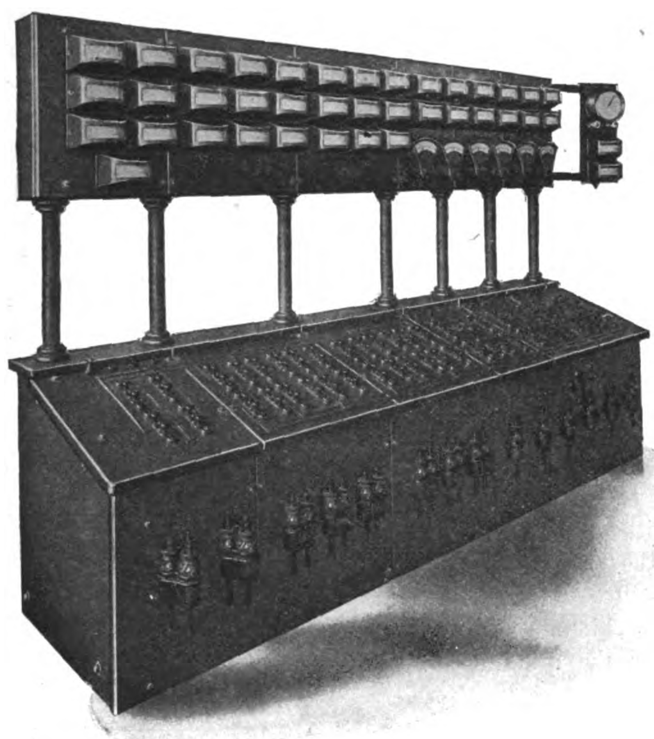


Fig. 5.—Alternating-Current and Direct-Current Switchboard, United States Reclamation Service, Salt River, Ariz.

The low-tension oil switches are the General Electric Company's standard type F form K-4, as shown in Fig. 2, each complete switch consisting of three single-pole, single-throw elements operated by a single solenoid. The switches are mounted in fireproof cells, each pole in a separate compartment, with the solenoids in small subcells. The cell doors are made of asbestos lumber with a fireproof wooden framing and are pivoted at the top, but have no fastenings at the bottom. This light, free-swinging construction of cell doors has proven preferable to heavy doors which are fastened tightly to the cells, as the effect of explosions in the cells is temporary only, so far as the door is concerned. The disconnecting switches, bus-bars and instrument transformers are mounted on pipe framework above the oil-switch cells. As will be seen from the diagram of connections, disconnecting switches are provided on both sides of every oil switch, so that any switch can be inspected, tested and repaired without shutting down any of the circuits.

The high-tension oil switches are similar in construction to the low-tension switches, and are shown in Fig. 3. These type F form K-6 switches are operated in groups of three single-pole elements by solenoids mounted on top of the switch cells. The form K-6 switch is a top-connected device, but in this case the buses and disconnecting switches are necessarily located below the oil-switch cells. The adaptability of the switch to different arrangements will be appreciated when it is stated that the only change made in the ordinary layout with the buses above the switches was an increase in the size of the cells, this being necessary in order to obtain suitable striking distance from the leads to the ground. Masonry compartments are provided for the high-tension bus-bars.

Protection against lightning is obtained by the use of a three-phase aluminum-cell lightning arrester for each transmission line, these arresters being mounted outside of the station.

The benchboard proper consists of six panels of oiled black slate, the total height, including the instrument section, being eight feet two inches, and the length, exclusive of the swinging bracket, twelve feet seven inches. Facing the switchboard, the first panel at the left controls the two outgoing lines, the next two panels each controls three banks of step-up transformers, and the three panels at the right-hand end control two generators each. The alternating-current voltmeters and the synchronism indicator are mounted on a swinging bracket at the right-hand end of the board. The back of the instrument sections and control bench is entirely enclosed by removable grille-work doors.

One alternating-current ammeter, one field ammeter and one polyphase indicating wattmeter are provided for each generator circuit. The two voltmeters on the swinging bracket are connected to the synchronizing bus in such a way that, when synchronizing, one indicates the voltage of the starting machine and the other the voltage of the bus-bars to which the incoming machine is to be connected. At other times the synchronism indicator is disconnected from the synchronizing bus by means of a small snap switch mounted on the swinging bracket, and the voltmeters can then be connected to any machine by means of the synchronizing plugs, entirely independent of the synchronism indicator.

The synchronizing and control switches and the relays are mounted on the control bench. Two synchronizing receptacles are provided for each generator, one being used when synchronizing with bus No. 1 and the other when synchronizing with bus No. 2. Two sets of contacts in these switches are used for synchronizing purposes, but the third set of contacts is connected in series with the closing side of the corresponding oil-switch control switch, so that no damage can be caused by the operator becoming excited when synchronizing and trying to close the wrong oil switch. To assist the operator in synchronizing, a governor control switch is provided for each generator circuit, this being a double-pole, double-throw reversing switch connected to the governor motor.

The controlling switches for the oil switches and field switches are the well-known twin pull-button type as shown in Fig. 4, which also shows the indicating lamps or bull's-eyes. One button actuates the closing contacts and the other the opening contacts, and they are so interlocked that it is impossible to operate both buttons together. An indicator is provided on each switch, which shows green after the control switch has been operated to open the coil switch and red after it has been operated to close it. Being a pull-button switch, it is impossible to cause trouble by accidental pressure, and, as the contacts are behind the panel, there is no danger to the operator and no chance of accidental short-circuits. Severe arcs can not occur in the control switch on account of a solenoid control relay being used to open and close the closing coil circuit of the solenoid. The use of this relay, which is mounted close to the solenoid, makes it unnecessary to run large control leads to the benchboard. The indicating lamps are connected so that they show the actual position of the main switch—red when the oil switch is closed and green when it is open. If the indicating lamps and the switch indicator do not agree the operator knows that the oil switch has tripped automatically. When this has occurred the control-switch indicator shows red and the indicating lamps green. To make the indicating lamps plainly visible from a considerable distance or at an angle, a V-shaped projection is cast on the front of the lens.

Generator field rheostats are mounted below the switchboard gallery and are controlled by combination bevel-gear and chain mechanisms, the operating hand-wheels being mounted on pedestals in front of the switchboard. The field switches are solenoid-operated and controlled from the benchboard, the same type of control switch and indicating lamps being used as for the oil switches. As stated above, the exciter and field-switch panels are of the ordinary vertical type, two sets of bus-bars being used. As the field switches are single-pole, single-throw, it is necessary to connect double-pole, double-throw lever switches in series with them so that the fields can be connected to either bus.

Mimic bus-bars are mounted on the control- switch bench, and consist of small polished copper bars which have no electrical connection with any part of the circuit. They show the system of alternating-current connections exactly as indicated in Fig. 1, the controlling switches representing the oil switches and name-plates representing the generators, transformers and lines.

The overload relays provided for the generator circuits are single-pole, the secondaries of the current transformers being cross-connected. As the generators are three-wire machines, the third line necessarily carries the resultant current of the other two current transformers. This connection can not be used on the transformer panels as three ammeters are provided for the transformer circuits, and it was, consequently, necessary to use double-pole relays. On the middle generator panel is mounted the signal relay which is used to ring an alarm bell when any of the oil switches is tripped automatically. This relay is arranged so that the bell continues ringing until the operator releases the relay, and is connected in such a way that it does not operate when the oil switches are opened or closed by the switchboard operator.

Each transformer circuit and each line is equipped with three ammeters. In addition to these instruments there is one ammeter connected in the neutral bus so as to read ground currents. Controlling circuit equipments are similar to those for the generator panels. Synchronizing receptacles are provided for the line circuits, but not for the transformer circuits, the receptacles for the line circuits being intended for use when additional generator stations are placed in operation.

In conclusion, attention is directed to the general arrangement and equipment of the board. No panel is at all crowded, the control and measuring apparatus is simple, and no superfluous or infrequently used devices are included. The equipment for each circuit is segregated so that there is no confusion in emergencies. Many recent switchboards have been unnecessarily complicated and crowded on account of including elaborate testing equipments or other devices used only at long intervals of time, the designers apparently overlooking the fact that switchboards are primarily intended for constant use in controlling the machines and circuits. Simplicity in operation involves a corresponding simplicity in design and equipment, and insures reliability, which, in the large majority of central stations, is of the greatest importance.

The switchboard described above was designed and built by the General Electric Company, of Schenectady, N. Y., to meet the requirements set forth in the Government specifications, and has just been shipped to Arizona. The photograph was taken at the factory and shows the board exactly as it will be installed.

Allis-Chalmers Business.

An officer of the Allis-Chalmers Company, of Milwaukee, Wis., is quoted as saying:

"Business booked by Allis-Chalmers in July and August showed substantial gains compared with previous months. At one time we were operating only fifty per cent of our capacity, but it has since been increased to about seventy-five per cent. All plants are now being operated.

"While all departments have recorded gains in new business, the greatest increase proportionately is shown in the demand and orders booked for mining machinery.

"We are prepared to do an electrical business on a larger scale than heretofore, and a great deal will be devoted to street-railway equipment, the bulk of which work will be performed at our West Allis plant, recently enlarged at a cost of some $5,000,000. The smaller electrical contracts will be cared for by the Bullock Electric Manufacturing Company, one of the principal subsidiary concerns.

"The foreign department is booking a good business, particularly in South Africa, Japan, China and South America."

Report of Receivers of the Metropolitan Street Railway Company.

The receivers of the Metropolitan Street Railway Company, who were, until recently, also receivers of the New York City Railway, have issued a statement showing the income account of their property from the time of their appointment on September 25, 1907, up to the end of the fiscal year on June 30, 1908.

Not taking into consideration that the company, in the nine months' period, has defaulted about $4,700,000 in rentals to lines leased or under agreements, which amount does not appear as charged against income, the deficit for the above period was $1,047,682, as follows:

Period from September 25, 1907, to June 30, 1908:

Gross earnings:		
Cash fares		$11,497,007
Ticket fares		28,438
Mail		819
Express		20,883
Total		$11,547,147
Operating expenses:		
Maintenance of way and structures	$929,012	
Maintenance of equipment	1,912,254	
Operation of power plant	899,431	
Operation of cars	3,639,086	
Injuries and damages—expended	48[illegible],813	
Injuries and damages—deferred	686,264	
General	708,076	
Total		$9,263,838
Net earnings		$2,283,308
Other income:		
Advertising	$178,108	
Rental of land and buildings	109,921	
Rental of tracks	11,109	
Rental of equipment	8,712	
Miscellaneous interest	222,016	
Other income	4,744	
Total		$533,783
Gross income		$2,817,091
Deductions from income:		
Taxes, other than special franchise	$607,424	
Taxes, special franchise, estimated on basis of assessment for year ended December 31, 1907	599,812	
Rent of leased lines on which permanent default has not been made	2,156,727	
Interest on funded debts of companies whose roads are operated under agreements on which permanent default has not been made	79,083	
Interest on real estate mortgage	36,416	
Interest on floating debt	2,112	
Claims against companies in hands of receivers	383,197	
Total		$3,864,773
Net income—deficit, not including charges defaulted		$1,047,682

In addition to the above deficit of $1,047,682, there is a further expenditure charge of $344,883, resulting from operation, about which there is a disagreement as to whether it should be charged to the Metropolitan Street Railway Company or the New York City Railway Company. Allowing for this charge and for the $4,720,114 charges on account of interest on bonds and rentals of subsidiary companies defaulted, the total deficit would approximate $6,000,000.

A statement of the default on mortgage bonds and rentals follows:

Metropolitan Street Railway Co.:			
General collateral trust mortgage	$12,500,000	@ 5%	$625,000
4% refunded mortgage	16,604,000	@ 4%	664,160
Dividend rental on capital stock	52,100,000	@ 7%	3,640,000
Third Avenue Railroad Co.:			
First mortgage	$5,000,000	@ 5%	$250,000
First consolidated mortgage	37,560,000	@ 4%	1,502,400
Dividend rental on capital stock	15,995,800	@ 6%	959,748
Central Crosstown Railroad Co.:			
Dividend rental on capital stock	$600,000	@ 15%	$90,000
Fulton Street Railroad Co.:			
First mortgage	$500,000	@ 4%	$20,000
Totals	$140,759,800		$7,751,308
Central Park, North and East Rivers Railroad Co.:			
Dividend rental on capital stock	$1,800,000	@ 9%	$162,000
Twenty-eighth and Twenty-ninth Streets Crosstown Railroad Co.:			
First mortgage	$1,500,000	@ 5%	$75,000
Totals	$3,300,000		$237,000
Grand totals	$144,059,800		$7,988,308

The statement of default covers the entire twelve months. Representatives of the company said in reference to the defaults that consideration should be taken of the fact that the company no longer received the seven per cent on $52,000,000 stock guaranteed by the Metropolitan Securities Company, which amounts annually to about $3,500,000.

Provision is made for the special franchise tax on the basis of last year's assessment, but no provision is made for depreciation.

Assuming that the Metropolitan deficit, including the charge of $344,883 in dispute, was $1,392,565 for the period from September 25, 1907, to June 30, 1908, the receivers state that if the remaining charges on account of leased lines, aggregating $2,235,810 in interest and rentals were defaulted, the road would have a surplus from operation of $800,000 after paying taxes other than special franchise of $607,424, and making provision for special franchise taxes of $599,812.

The special franchise taxes have never been paid by the surface roads, and prior to this year no provision has been made for paying them. And up to the present time no fund has been created for the purpose, but their amount has been taken into consideration in calculating the deficit on the Metropolitan system.

Receivers for Long-Distance Telephone Company of Decatur, Ala.

On petition of Frank Caughring, of Toledo, Ohio, Judge Shelby, of the United States Court of Appeals, has placed the Long-Distance Telephone Company, of Decatur, Ala., in the hands of receivers. L. G. Barker, of Louisville, Ky., and Douglass Taylor, of Huntsville, Ala., are named as receivers. The bonded debt of the company is estimated at $586,000.

New Haven's Control of the Portchester Lines.

At the hearing of the Public Service Commission for the First District, New York, in the matter of the New York & Portchester Railroad, the following statement was submitted concerning the disbursement by the New York, New Haven & Hartford Railroad Company of $11,000,000, paid for the control of the Westchester and Portchester companies:

"The New York, New Haven & Hartford Railroad Company owns 990 shares of the capital stock of the Millbrook Company out of the authorized issue of 1,000 shares, par value $100.

"The Millbrook Company owns (1) 91,581 shares of capital stock of the New York & Portchester Railroad Company, par value $100. Total issued, 91,590 (nine shares held by directors), and (2) one temporary five per cent first mortgage gold bond of New York & Portchester Railroad Company for $100,000.

"The New York & Portchester Railroad Company owns (1) 7,260 shares capital stock of the New York, Westchester & Boston Railway Company, par $100; (2) 23,614½ shares of capital stock of New York, Westchester & Boston Railway Company (voting trust certificates); (3) five shares of capital stock of the City & County Contract Company; 6,895 shares of capital stock of the City & County Contract Company (voting trust certificates); total number of shares issued City & County Contract Company capital stock is 6,890; and (4) an underwriting agreement to the amount of $13,490,000 cash to bonds and stock of New York, Westchester & Boston Railway Company. On this underwriting has been paid $4,819,120. Upon payment of balance, New York & Portchester Railway Company will be entitled to receive 13,490-13,500 of $15,000,000 par five per cent Westchester bonds and 45,000 shares of Westchester capital stock. These securities now being held under the syndicate agreement by Knickerbocker Trust Company, depositary for the syndicate managers.

"The total amount of cash advanced by the New York, New Haven & Hartford Railroad Company is $11,265,000. Of this amount $10,873,169.04 was expended in acquiring the securities of the several companies as detailed above, and the remainder, $391,830.96, is represented by demand notes or open account of the several companies. What securities will be issued against this amount can not as yet be determined."

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Kiebitz's Directive Arrangement for Electric Waves.

A brief description is given here of a directive system for electric waves which has recently been patented in Germany by Dr. F. Kiebitz. In the arrangements hitherto proposed for this purpose use has sometimes been made of some form of compound oscillator—that is, one in which an electric or open oscillator is combined with a closed oscillator. Dr. Kiebitz's device consists of a new arrangement of the compound oscillator. Although it has been tried over short distances only, sufficient data are given for an energy diagram to be plotted. In it the directed electromagnetic waves are excited by giving the radiating system such a shape that although the electric and magnetic systems generated in space have each an axis of symmetry, the two axes are in this case perpendicular or make an acute angle, while at the same time the direction of the magnetic force is inclined to that of the electric force. In this case the plane of the greatest magnetic force is inclined to the plane of the greatest electric force, the line bisecting the enclosed angle being in the direction of the greatest energy emission. The same device can be used at the receiving station, when it then absorbs chiefly those waves having the direction in which it is set. The arrangement consists of a solenoid with its ends connected to two metal surfaces. When such a system is excited inductively the electromagnetic field which it sets up consists of a magnetic doublet oscillating in the direction of the axis of the solenoid and an electric doublet oscillating in the direction connecting the two metal surfaces. The electromagnetic field thus has a minimum in the plane containing these two directions and a maximum at right angles to it. Nothing is changed when the earth is substituted for one of the metal surfaces, the direction of the maximum force then being along the earth. Experiments with this apparatus have been conducted both in the laboratory and in the open. The wavelength employed was twenty-two metres and the received energy was measured thermally. On revolving the transmitter in the laboratory a diagram of received energy was obtained having the form of a narrow lemniscate. In the open the ratio of maximum to minimum energy received was 70 to 1. A directive receiver gave the same results. With an electrolytic receiver at thirty metres, receiving distinct signals at zero degrees, rotation of the arrangement through thirty degrees caused the signals to cease. Before the practical value of the apparatus can be determined, experiments on a larger scale must be conducted.—*Abstracted from the Electrician (London), July* 31.

Weaving Concrete Poles.

A type of reinforced concrete pole, developed and used to some extent in Germany and just introduced into England, is described here. These poles are made in a machine invented by Hans Siegwart. They are hollow and tapering, in lengths up to about forty feet. The machine is capable of making columns of any size and lengths within the limits of forty feet long and two feet in diameter. Pipes can also be made in lengths three or four times as great as those customary for iron pipes. In the process of manufacture a long sheet-iron core is mounted on two trestles, running on rails, so as to be capable of rotational and longitudinal movements. Upon this core small longitudinal steel rods are fixed. The core is drawn through the machine, which is stationary. Concrete made of clean screened grit and Portland cement is mixed dry in a mechanical mixer and discharged through a chute into a hopper or drum, in which rotating paddle-wheels regularly discharge the concrete upon a bandage of coarse webbing laid on a conveyer belt, that takes one lap around the core. This continuous traveling conveyer belt is stretched so that the concrete is wrapped about the core under great pressure. As the core issues beyond the conveyer belt, wire is fed spirally around it so as to press into the concrete wrapping, and small rollers then apply great pressure by working on the webbing, the slack of which, caused by the reduction in diameter, resulting from this pressure, is taken up by another device. The core as it issues from the machine is wrapped about spirally with a bandage of cloth. The machine pulls the trestles forward with the suspended core as the concrete is wrapped on, and when the core has passed completely through the machine it is lifted by an overhead crane and laid to one side to harden. It is kept constantly damp so as to secure the maximum hardness. In about twelve hours the interior sheet metal core is reduced in diameter by means of a screw attachment inside and withdrawn. After hardening six days the bandage of webbing is removed and the pole is then complete for setting. Poles are made up to thirty-nine feet long and pipes up to twenty feet, two feet in diameter. The poles are estimated to have a life of fifty years, and during that time will cost nothing for maintenance. On this basis the total cost of an electric railway pole at the end of fifty years is estimated to be $20 for the concrete pole, $50 for an iron pole and $53 for a wooden pole, all including maintenance, repairs and renewals. This is for a twenty-nine-foot pole. For a thirty-six-foot pole for transmission service, and for the same period, the corresponding figures are: for the concrete pole, $26; for the iron pole, $68, and for the wooden pole, $68.50. Any desired amount of ornamentation may be given to the poles. Some tests on a pole of this type, thirty-two feet nine inches long, showed a deflection of two and three-quarters inches with a tensile strain of 15,000 pounds. The process is also applicable to the manufacture of concrete piles.—*Abstracted from the Electrician (London), July* 31.

The Nature of the Gamma and X-Rays.

A reply to certain criticisms of the neutral-pair theory of gamma rays, proposed by W. H. Bragg, is made here by him. Several objections have been raised by Dr. Barkla, all relating to this theory as applied to explain the behavior of secondary X-rays, as the latter thinks these rays are convincing proof of the ether-pulse theory of gamma rays. One of these refers to the equal penetrating powers of primary and secondary rays in certain cases. Mr. Bragg thinks that this is a natural consequence of any corpuscular theory. Another objection is the supposed equality in the proportion of rays of different penetrating power which are scattered. Mr. Bragg says this fact has not been conclusively proved, and if it be a fact, it is not inconsistent with the corpuscular theory. The same may be said of the proposed law of the distribution of the secondary scattered rays. The law is of limited application only, and not irreconcilable with the neutral-pair theory. Again, Dr. Barkla points out his discovery of the fact that the ratio of the quantity of secondary radiation to the quantity of primary radiation depends only on the density of the gas producing it. Others have not been able to verify this law except when used within such narrow limits that any other theory would hold equally well. Moreover, J. J. Thomson made use of this ratio in determining the number of electrons in an atom. Two other objections, related to the polarization effects, have already been answered by Mr. Bragg, and the remaining ones are based upon remarkable effects observed by Dr. Barkla and a few others, but not yet satisfactorily established. In Mr. Bragg's opinion none of the proposed theories can be considered as offering a satisfactory explanation of these phenomena, hence the neutral-pair theory is no worse off than any other. On the other hand, the ether-pulse theory will need radical alteration before it will explain satisfactorily the asymmetrical effects of the gamma rays noticed by Dr. Madsen and the author.—*Abstracted from Nature (London), July 30.*

The Teaching of Mathematics to Students of Engineering from the Standpoint of the Practising Engineer.

Mathematics is to the engineer what anatomy is to the surgeon, what chemistry is to the apothecary, what the drill is to the army officer — it is indispensable. This is the opinion of Ralph Modjeski, the well-known bridge engineer. There is much agitation at this time in France and Germany, especially in the former, favoring the limitation of the mathematical programme at present in force in the engineering schools, on the ground that it is unnecessarily extensive. From personal observation Mr. Modjeski says that the programme in the two countries mentioned covers a considerably wider range than in the average American college. In the first place, a student entering an engineering college in Europe must already know analytical geometry, the rudiments of differential and integral calculus and descriptive geometry, none of which is taught here until after the student enters college. The average length of the engineering course in Europe is four years; hence the student in the European college has more time for practical studies than the student in the American college. Mr. Modjeski believes that the time will come when only applied mathematics will be taught in the engineering college, and all necessary abstract mathematics will be required for entrance. As one result of the specialization now going on in engineering there is not the same need for advanced mathematics among all branches. The bridge engineer and the electrical engineer require more advanced mathematical training than the railroad official; while the latter needs greater knowledge in other lines, such as geology. The question then arises, Will it be desirable and possible to specialize in mathematical courses in college and adapt them to each branch of engineering? This is done at present to a limited extent only in applied mathematics. Although bridge engineers require probably as advanced training in mathematics as any other engineers, Mr. Modjeski has not found the higher mathematics which he learned at college in France of any use to him. One reason for this is that it was not taught so thoroughly as to become second nature; and unless this is the case advanced mathematical instruction is of not much value to the engineer. One can not be said to know a foreign language until he thinks in it; nor can he be said to know his mathematics until he thinks mathematically. It is not necessary for him to go to the higher mathematics, but it is necessary to be thoroughly drilled in the elementary principles of each subject. When these have become second nature, problems which arise every day in the practice of the engineer are easily solved without going into calculation. With a proper foundation the engineer's mind becomes so trained that he applies unconsciously these fundamental principles; they direct his line of thought automatically. How to secure such a foundation is the problem of the engineering college.—*Abstracted from Science (New York), August 7.*

The Petrol-Electric Drive and Other Mixed Systems.

The flexibility and serviceability of the electric transmission system for self-propelled vehicles is held by Frank Broadbent to be more than an offset to a somewhat greater fuel consumption, should this be found to result from the adoption of the system. After recalling the pioneer vehicle of this type, the Heilmann locomotive, which, he says, was not given the proper sort of trial, as it was tested in connection with steam locomotives for fairly long hauls with few stops, some of the recent systems are described. The North-Eastern Railway Company, of Great Britain, has two gasolene-electric cars in service on its Hartlepool branch. These are equipped with an eighty-five-horse-power four-cylinder engine, direct-connected to a fifty-five-kilowatt compound-wound generator which drives two fifty-horse-power motors. Several somewhat similar cars are in use in Hungary and have given good results. The fuel costs are reported to be 1.5 cents per car-kilometre. The maintenance costs are about 0.8 cent for a gasolene-electric car, which may be compared with 0.97 cent for a similar straight gasolene car; with 1.1 cents for a steam car, and 2.4 cents for a steam locomotive, all for the train-kilometre. The fuel costs for a steam car are given by the same authority as 0.9 cent, which is favorable to this system. But when all costs are considered the mixed system makes a better showing. The total costs for the steam car are given as 6.24 cents a car-kilometre, while the corresponding cost for the gasolene-electric car is only 5.73 cents. Moreover, the former figure is the average of 1,591,411 kilometres, while the latter is the average of only 135,048 kilometres, and would probably be lower for a longer use. In addition, for frequent service, where the stops are many, the better starting characteristics of the mixed system give it a decided superiority. One of the most recent systems is that proposed by Smith and Stevens. A dynamo with a falling characteristic is coupled to a gasolene engine and supplies current to two series motors. By this arrangement a constant torque is developed, irrespective of the speed. The speed is controlled by varying the speed of the engine. When the engine speed is reduced to a certain point the dynamo drops its excitation and the motors stop. Thus it is not necessary to stop the engine in order to bring the car to a standstill. For the highest speeds the resistance of the shunt field winding of the dynamo is lowered, while for the lower speeds the motors are connected in series, enabling them to develop full torque at the lowest speeds. While this system has been put forward for road vehicles, it is as suitable for local traffic on railways or any similar service. When all costs are considered it is thought that a gasolene-electric bus would show an economy of four cents a mile in running costs, and a corresponding saving should result from a proper use of this system for railway traffic.—*Abstracted from the Electrical Review (London), July 24.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Central Station Transformers.

The manufacture of transformers of fifty kilowatts and smaller—known among central station men as "lighting" or "central station" transformers, in contradistinction to the so-called "power" or "transmission" transformers, of sizes above fifty kilowatts—presents certain special problems which are only to be solved by manufacturers having years of experience in the design and construction of apparatus of this character. These problems are entirely apart from the question of type (whether "core type" or "shell type"), which may be a matter of individual preference or precedent on the part of the transformer builder, and which is in any event a manufacturer's question and not one in which the customer is materially interested.

The experienced builder of central station transformers must, first and foremost, understand the conditions that confront the operating companies. One of the most important of these conditions is the compulsion that the companies are under to meet their service requirements with minimum investment in transformers. This condition does not mean the selection of transformers on a criterion of low first cost; on the contrary, it means that the careful buyer, in making his yearly contracts, or in individual purchases, will give greater weight to efficiency, reliability and life than to saving in first cost of installation. The unwisdom of being blinded by the latter consideration, to the exclusion of other and more vital ones, has often been exemplified in the disappointment and loss occasioned by buying transformers of incorrect design or poor materials, or both. Such apparatus is bound to fall short in the important features of core and copper losses, insulation, cooling and general ruggedness in service—in all of which features the user is vitally interested.

Another condition is the necessity of good regulation which is recognized as essential to satisfactory lighting service, and which is essential no less to the satisfactory load performance of motors. The importance of good regulation in the latter service may be clearly shown. The prevailing types of alternating-current meters all operate on a power-factor varying from fifty to ninety per cent, depending on the percentage of load carried. On the other hand, it is well known that the load capacity of any alternating-current meter drops with the square of the fall of pressure supplied to the meter terminals. For example, a ten-horse-power motor at a pressure of 110 volts will have a capacity of only eight and one-quarter horse-power if operated on 100 volts. Since a drop of ten volts may easily occur in the transformer if the latter be of poor design with respect to regulation, the importance of the wise selection of transformers to meet such conditions is obvious.

Intimately connected with the preceding is a third condition, *viz.*, the way in which transformers of poor regulation menace the service of the central station company by shirking their load. Thus, if transformers of poor regulation are connected in parallel with transformers of good regulation, as the load increases the former will, by falling off in voltage, shift a good part of their share of the load on to the latter, which will thereby be overloaded and may even be burned out.

The Wagner Electric Manufacturing Company, of St. Louis, Mo., has specialized in the manufacture of transformers since 1891. Its experience and its recognition of the needs of the central station companies, as above outlined, have resulted in a line of central station transformers having the following operating characteristics and features of design and construction:

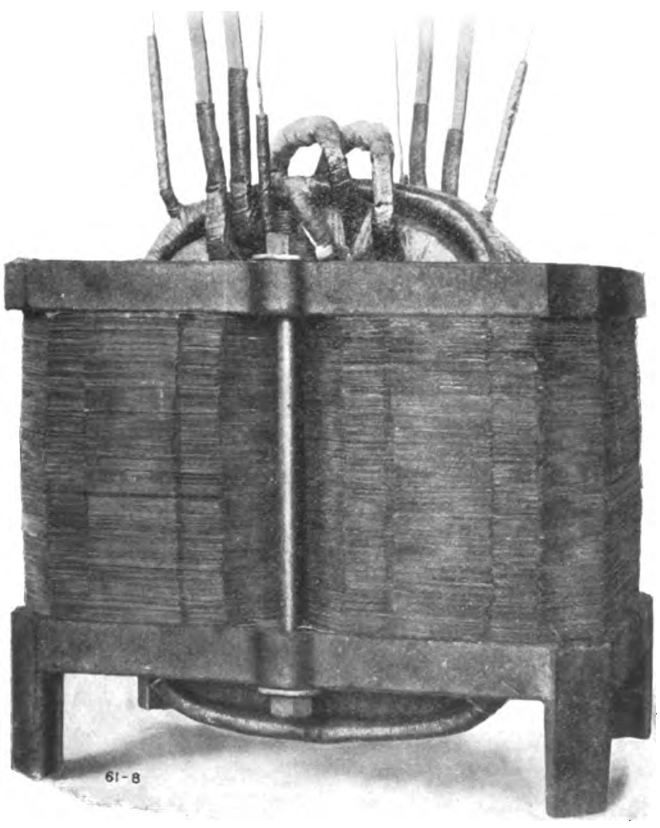


Fig. 1.—Wagner Single Central Station Transformer, with Case Removed.

In the first place the practice of this company is to employ in its central station transformers substantially the same features of electrical and mechanical design as are employed in power transformers, with the object of attaining thorough reliability in service and long life, and the maximum efficiency consistent therewith. Fig. 1 and Fig. 2 are views of the transformer element with case removed and of the complete transformer, respectively. It will be seen that the transformer is of the shell type, which is employed by all manufacturers of high-tension and large apparatus. In this form of construction the magnetic circuit of laminated sheet steel is built up around the copper coils of

Fig. 2.—Fifty-Kilowatt Wagner Central Station Transformer, Complete.

the primary and secondary windings; whereas in the core type the relative positions of magnetic circuit and copper coils are reversed—the coils enclosing the limbs of the magnetic circuit.

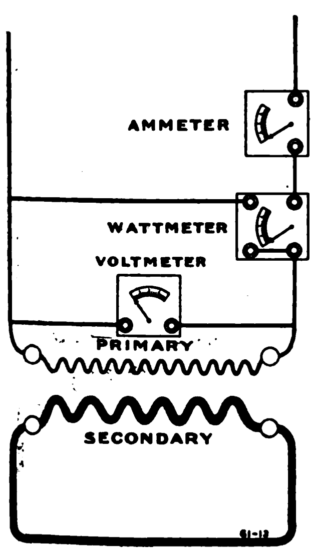


Fig. 3.—Connection for Impedance Test of Transformer.

The use of the new, so-called "alloy-steel," which the Wagner company employs, has resulted in marked advantages. Transformer cores built of this steel show not only marked reduction of initial core losses, with corresponding reduction in all-day efficiency, but also freedom from "aging" and consequent lowering of efficiency from heating of the transformer in operation.

The new steel gives a transformer having lower internal losses than has hitherto been produced, and also one in which aging is eliminated. Previous to its introduction, the operation of apparatus of this character was wisely restricted to the temperature limits prescribed by the American Institute of Electrical Engineers, for the reason that the sheet steel then employed in transformer construction aged rapidly if heated much above these limits. In the present transformers the criterion of heating is not under this restriction, but is the safe operating temperature of the insulating materials employed, although it has not been deemed wise by the company to modify the standard temperature limits that have hitherto obtained.

Unusually effective oil cooling and insulation is another salient feature of these transformers. The secret of success in properly cooling a small transformer consists in affording the oil ample opportunity to reach all the active materials. That this result is not only possible but is actually accomplished in Wagner transformers is due to the peculiarly efficient method of spacing all the parts. There are no wide individual coils in these transformers, but the coils are so subdivided as to make the interlacing layers comparatively narrow. This spacing not only permits free circulation of the oil and the maintenance of all parts at a uniform temperature, but it also reduces to the smallest working limits the pressure between layers, thereby practically eliminating the liability of puncture between them.

Wagner central station transformers do not depend upon the oil for internal insulation. All of the customary guarantee insulation tests are made upon the transformers, and sustained successfully by them, before adding the oil. The insulation of these transformers is, therefore, extraordinarily good since the effective dielectric strength of the oil is added to the already high insulation of the transformer structure due to the design. Moreover, in the construction of the transformer no insulating compounds are used that can dissolve in, or be affected by, the oil.

The attaining of excellent regulation has been made a matter of the first consideration in the design and construction of the Wagner central station transformers, which are designed with a view to their employment on either lighting or small-motor service. An approximate rule for determining whether two transformers of the same size but different makes will operate satisfactorily in parallel is to compare them on what has been termed the "impedance test" applied to each of the transformers in turn. As shown in the accompanying diagram, Fig. 3, this test consists in short-circuiting the secondary and applying an alternating current of low voltage—not exceeding two to five per cent of the normal operating voltage—to the primary, adjusting the value of the current until full-load current flows through the latter. A wattmeter inserted in the circuit will then indicate roughly the actual full-load copper loss of the transformer under service conditions. If the wattmeter and voltmeter readings are about the same for the two transformers, the latter will operate fairly well in parallel.

New Mining Property Adopting Electricity—Westinghouse Motors to Be Used.

The Virginia & Mexico Mining and Smelter Corporation, of Hostotipaquillo, Jalisco, has in transit from the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., whose agents for the republic are Messrs. G. & O. Braniff & Company, a number of electric motors to be used in connection with its new mill. There will be some fifteen motors, totaling over 300 horse-power, the majority of which will be used for belt drive. There is to be a thirty-stamp mill, each fifteen stamps driven by a separate thirty-horse-power motor. A twenty-horse-power motor will drive ten Wilfley concentrating tables. One thirty-horse-power motor will be used to drive three crushers, and a second thirty-horse-power motor to operate air-compressor, mechanical agitator and vacuum pump. These last are for use in connection with the slime agitation and the Butters filter press which is to be installed. Another thirty-horse-power motor will be installed to drive three solution pumps and three Frenier pumps. A ten-horse-power motor will operate a Robins belt-conveyor for handling the sands, etc.

The above mill is to be one of the most modern in the republic, and the extraction obtainable will be correspondingly high, partly due to the modern machinery, and partly on account of the better efficiency obtained by the use of individual motor drives on the separate machines. Jesse Scobey is manager of the property.

Moving-Picture Machines on Alternating-Current Mains.

In the earlier days of the adaptation of the focusing arc light throwing a ray of light through a moving film, objections came from the users of alternating-current arcs, which caused the engineering department of the United Electric Light and Power Company, supplying alternating current throughout New York city, some concern. This subject is interestingly discussed by T. I. Jones in the current *Bulletin* published by the National Electric Light Association. These earlier objections included hissing at the arc, flickering and occasional black spots in the picture.

The study of this trouble showed that the black spots were most noticeable when the films had reached a given speed. This speed was found when the number of single pictures passing in front of the arc equaled the alternations per second of the current supplied. In other words, at certain times the arc was absolutely out when the picture passed in front of it; or if the arc was not actually out the difference in illumination due to the red carbon when current was absent and the incandescent carbon when current was present was sufficient to cause the black spots complained of on the screen. These black spots, therefore, had a direct bearing on the frequency of the current, as it followed that where the frequency was higher the number of spots was less and with lower frequency the spots increased.

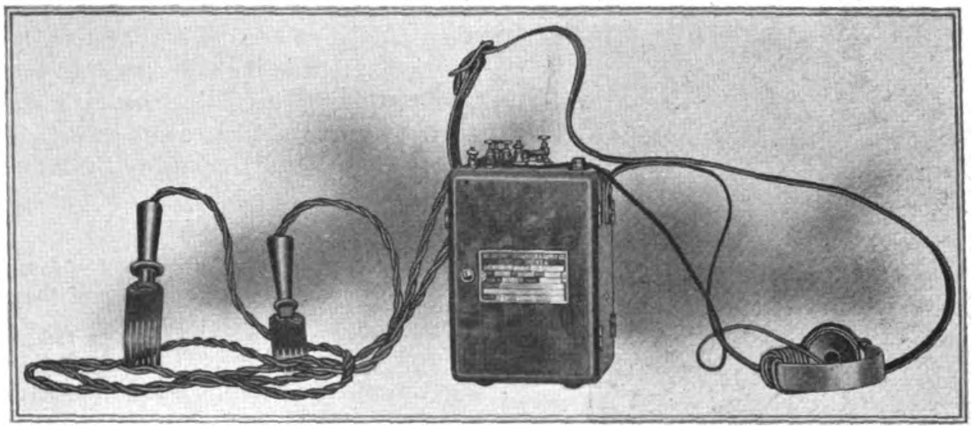
Combinations of two or more arcs were suggested, also changes of frequency of the current supplied. These suggestions, however, simply bettered without removing the condition. Accordingly, the matter of mercury rectifiers was taken up with the engineers of the United company, and in conjunction with both the Westinghouse and General Electric companies a rectifier was designed adaptable to moving-picture machines.

One of the important features in the design of the rectifier was the starting apparatus, by means of which the act of closing one switch, placed at any location, and closing the carbon switch started the entire outfit.

The direct current obtained from the rectifier removed the frequency trouble of black spots, and the use of the transformer of the rectifier outfit has a material advantage over the direct-current 110-volt street supply in that it is not necessary to use a rheostat in series with the arc to cut the voltage from 110 down to the voltage of the arc—about fifty-five. These rectifiers are now used in a number of moving-picture places in New York city.

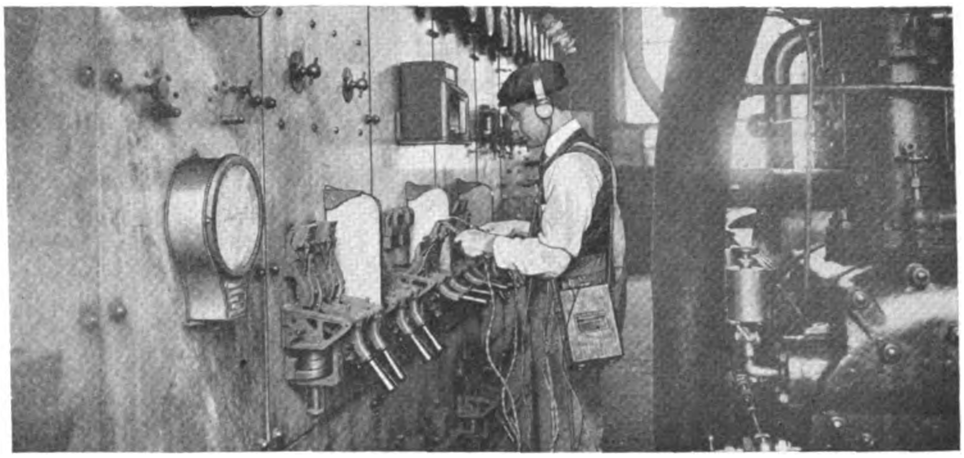
The Electric Fault Finder.

A new and useful instrument has just been brought out by the Electric Controller and Manufacturing Company, of Cleveland, Ohio, for detecting and locating grounds, short circuits, open circuits, leaks and other faults in armature coils, field coils, control circuits, switchboard wiring or any other electrical circuit. Its name, the "electric fault finder," truly describes its use since it not only indicates trouble, which is all that a magneto will do, but finds or locates the trouble. With the electric fault finder, for instance, in a motor armature a faulty coil can be absolutely located and the nature of the trouble definitely told. If a field coil is damaged the layer in which the fault lies can be absolutely determined. If there is trouble in a bunch of control wires in a multiple-unit train control, or other magnetic switch control, the faulty wire or pair of wires can be promptly located and the nature of the fault quickly found.



A New Electric Fault Finder.

As will be seen from the accompanying views, the instrument consists of a small box provided with a strap so that it can be slung over the shoulder when testing motors in place, such as under a car or on an electric overhead traveling crane. From this small box leads go to a telephone receiver fitted with a headpiece so as to leave both hands free for testing. For working in very noisy places, such as bridge and boiler shops or some parts of steel mills, the headpiece may be fitted with two receivers, one for each ear, which will shut out all sound save that received from the instrument. This arrangement not only allows perfect testing to be done in noisy places but enables partially deaf persons to use the instrument. In one case, by adjusting the rheostat to give a very loud sound (more than the normal ear could stand) and using two receivers, a very deaf man did very accurate work with this instrument. From the box leads of convenient length go also to two test terminals.

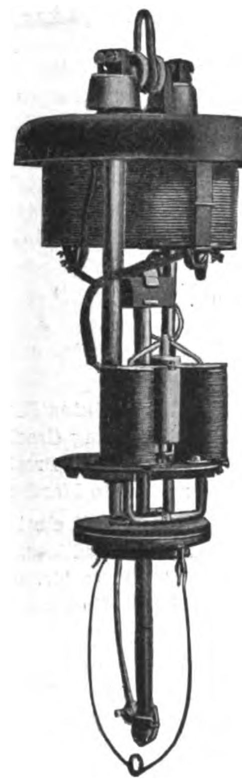


Using the Electric Fault Finder.

The electric fault finder is cheap, small, portable, and requires no outside current to operate. It requires only one man to operate under any conditions, so there is no excuse for the tester desiring a helper.

The Westinghouse 110 and 250-Volt, Multiple, Direct-Current Arc Lamps.

The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has



INTERIOR VIEW, MILL TYPE DIRECT-CURRENT ARC LAMP.

developed a 110 and 250-volt, direct-current arc lamp for installation where the lamp may be operated under very severe conditions. The design has been adapted

EXTERIOR VIEW OF MILL TYPE DIRECT-CURRENT ARC LAMP.

especially for mills, factories and other places where a unit of delicate mechanism would not be suitable. The construction of the lamp has been simplified to the last degree, and its parts are few in number. The mechanism is of ample strength and is easy of access and thoroughly protected. The lamps are designed primarily for 110 and 250 volts, direct current, but can be adjusted to operate between the limits of 100 and 125 volts, and 200 and 260 volts, respectively. The normal current taken by these lamps when adjusted for normal voltage is four and one-half and two and three-quarters amperes, respectively. The normal life of one set of carbons is from 125 to 150 hours.

The lamp case consists of a single piece of sheet copper of cylindrical shape, finished in black japan. The mechanism of the lamp may be entirely exposed by removing the outer globe, turning the case through a small angle and lowering it. Numerous openings are made in the case through which air passes into the lamp. The air passes out through a space between the upper part of the case and the upper casting. This current of air circulates around the resistance coils in the upper part of the lamp and provides ventilation.

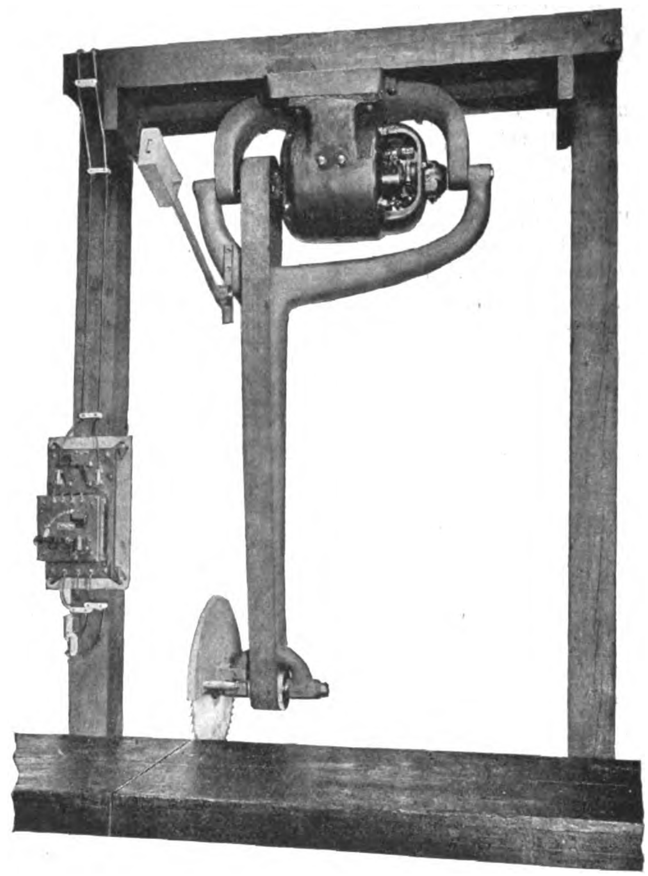
The magnet coils are wound with asbestos-covered wire and all the windings in the lamp are fireproof. The windings are so proportioned that even on a short-circuit test of several hours' duration no deterioration of the insulation nor burnouts will develop. This insures immunity from burnt-out coils whatever the exigencies of the service.

The outer globe or shade is held in place by an adjustable ring with two latches which are used for fastening the globe to the lamp housing. These latches are large and convenient to manipulate and permit the globe to be quickly released for trimming. During the operation of trimming the globe hangs suspended by a chain provided for the purpose.

Exports of copper for the first seven months of 1907 were 97,160 tons. Imports of copper for the first seven months of 1907 were 79,000 tons. Exports of copper for the first seven months of 1908 were 181,711 tons. Imports of copper for the first seven months of 1908 were 46,000 tons.—*Copper Gossip.*

The "Reliance" Electrically Driven Swing Saw.

The accompanying illustration shows the "Reliance" electrically driven swing saw placed on the market by Carse Brothers Company, 165 Broadway, New York city. In this saw compactness, simplicity and strength have been combined with great rigidity. The weight has been kept as low as is consistent with the best engineering practice. The bearings of the arbor are long, self-aligning and of the best grade of babbitt metal. The base of the saw is made in one piece, and there is no twisting, sagging or lost motion of the swinging arm. The apparatus may be mounted either on the ceiling or on a side



"RELIANCE" ELECTRICALLY DRIVEN SWING SAW.

wall. It can be supported on standards attached to a bench, and when mounted on a bench may be used as a portable tool and moved with the bench from place to place to suit the demands of the work being done.

The starting box and switch are placed in a convenient position, and the operator can start and stop the saw at will. The base supporting the motor is of cast iron, heavily ribbed, and the saw frame is a hollow cast-iron cylinder, strong and rigid. The saw is counterbalanced so that it automatically returns when the handle is released.

Current Electrical News

DOMESTIC AND EXPORT.

NORTHERN COLORADO POWER COMPANY—Harry Bronner, George C. Smith and James N. Wallace, voting trustees of the Northern Colorado Power Company announce that a meeting of the holders of voting trust certificates for preferred and common stock will be held on September 5 to vote on the authorization of a $6,000,000 issue of five per cent bonds to be secured on the property and franchises of the company.

NEW MEXICAN POWER COMPANY—The Atotonilco Light and Power Company has been organized in Guadalajara with a capital of $50,000 to install a hydroelectric plant and furnish light and power to the town of Atotonilco and to haciendas and industrial plants in the tributary territory. Atotonilco is the centre of the orange district of Jalisco. The officers of the new company are: Enrique Alvarez del Castillo, president; Francisco Muñoz, vice-president; Alfredo Gonzalez, secretary; José M. Corvera, treasurer, and Alfredo Gallardo, general manager. The other stockholders are Manuel Cuesta Gallardo, Dr. Felipe Valencia, Carlos Hering, Vicente Orendain, Frederick M. Newton, José C. Dieguez and Dr. Carlos Barriere. In the generation of electric current the new company will use the Faretan waterfall near the town of Atotonilco. The water drops a distance of seventy-five feet, and power sufficient for all needs in that section can be developed. Alfredo Gallardo, general manager of the new company, is responsible for the proposed enterprise. He planned the utilization of the waterfall and promoted the company.

NEW IOWA ELECTRIC ROAD—With a view to the construction, equipping and operating of a combination steam and electric railroad between Council Bluffs and Des Moines, Iowa, *via* Treynor, Carson, Oakland, Walnut, Elkhorn, Exira, North Branch, Guthrie Center, Panora and Dallas Center, a company with an authorized capital of $1,000,000 has been organized at Treynor, Iowa, a preliminary survey made and bonds, it is said, guaranteed. The Metropolitan Trust and Savings Bank, of Chicago, is quoted as financing the movement to a large extent, and that part of the work is practically completed. The road will be fourteen miles shorter than any now in operation. Gasolene or electricity will serve for passenger service, while steam is to be used for heavy traffic. The right of way will be secured at once and construction work begun in early spring. The officers chosen were as follows: President, G. W. Adams, Walnut; vice-president, C. L. Kirkwood, North Branch; treasurer, A. L. Ingram, Treynor; secretary, Peter Kaghmann, Treynor; general attorney, Orran Mosher, Jr., Walnut. Directors—S. B. Shultz and Arthur Saar, Treynor; V. B. Spangler, North Branch; G. L. Artist, North Branch; Charles Peterson, Walnut.

ELECTRIC RAILWAYS.

SCRANTON, PA.—Work has been begun on a new power-house for the Scranton Street Railway Company.

BROOKINGS, S. D.—The city council has granted a twenty-year franchise to the Brookings & Sioux Falls Railway Company.

APPLETON, WIS.—Plans for building an interurban line with local capital to New London by way of Hortonville are under discussion.

ALTOONA, PA.—An electric line from Altoona to Wopsononock, and over the mountain to Dougherty and Patton, is being considered by local business men.

LEWISTON, IDA.—Contracts for the grade work on the Johnson electric road between Nezperce and a connection with the Culdesac-Grangeville line have been awarded.

ARGENTA, ARK.—The town council has granted a new franchise to the Argenta Street Railway Company. The city light plant will furnish the necessary current to the railway company.

MIDDLETOWN, N. Y.—Capitalists are planning the construction within a short time of an electric railroad from Goshen to Central Valley and over the mountain to Haverstraw, to be called the Hudson River Traction Company.

KANSAS CITY, MO.—The Kansas City-Olathe Electric Railway, building south from Rosedale to Olathe, is now completed as far as Shawnee, Kan. Work is being pushed on the remaining part of the road from Shawnee to Olathe.

LOUISVILLE, KY.—The needed finances having been secured from a Boston bank, the Louisville & Eastern will complete its electric line from Louisville to Shelbyville, a distance of thirty miles. The line to Lagrange is now complete.

ELKINS, W. VA.—The power-house of the Elkins Electric Railway Company will be built by October 1 at Roaring Creek Junction, by which time it is stated cars will be running. President J. C. McSpadden states that the line will be complete to Harding this fall.

AURORA, ILL.—The Aurora, DeKalb & Rockford electric line has been sold to Edwin Bailey, of Boston, to satisfy creditors. Securities worth $835,000 par value were sold for $185,000 to Mr. Bailey, who, President Fred Dolph, of the Aurora Railway Company, says, has interests in common with him.

NEW HAVEN, CT.—The Connecticut Company, a holding corporation for the New York, New Haven & Hartford electric traction service, has awarded to C. W. Blakeslee & Sons, of this city, the contract for a trolley line from Middletown to Wethersfield, eleven miles, at an estimated cost of $400,000.

ROCK ISLAND, ILL.—At a meeting of promoters of the Rock Island Southern Interurban, from Monmouth to the tri-cities, held at Davenport, it was decided to build the connecting line in order that Aledo may be included. The line will be constructed from Preemption to Monmouth by way of Viola.

MEXICO CITY, MEXICO—The Mexico Electric Tramways Company has applied to the superior council of the federal district government for permission to build a new line to reach the new Covadonga Park of the Spanish colony in time to establish the service before the next Covadonga festivities in September.

CLARKSBURG, W. VA.—At a meeting of the Morgantown & Dunkirk Valley Traction Company, at Blacksville, it was ordered that the first section of the road, extending five miles out of Morgantown toward Wadestown, be commenced at once. Amri Martin, of Morgantown, was named as superintendent of construction.

WHITE PLAINS, N. Y.—Arrangements have been completed between the Tarrytown, White Plains & Mamaroneck Trolley Company and the Westchester Lighting Company, by which the latter is to furnish the power with which the line will be operated. Three additional lines will be strung between New Rochelle and White Plains.

PITTSBURG, PA.—A syndicate of Pittsburg and Butler men has plans for the building of an interurban traction line from Butler to Slippery Rock by way of West Sunbury. It is planned to run through cars from Pittsburg to Slippery Rock over the proposed stretch and the Pittsburg & Butler line, which would compete most of the way with the Bessemer railroad.

BILLINGS, MONT.—The sale of a franchise for an electric street railway, which was granted to Yegen Brothers by the city council some months ago, has been effected, N. S. Poole, an electrical engineer of Townsend, being the purchaser. It is stated that Yegen Brothers retain some of the stock and that a company will be organized for the purpose of constructing a line in the city and through the valley.

MASON CITY, IOWA—Charles City, Greene, Parkersburg, Allison, Grundy Center, Marshalltown and other smaller intervening points are interested in a proposed electric line from Marshalltown north to Charles City and probably beyond. Several meetings have been held and interest in the scheme has been awakened. It will take $600,000 to carry through the enterprise, and this must be raised by the cities and towns interested.

ALBANY, N. Y.—The Public Service Commission has granted permission to the Champlain & Sandford Railroad Company to construct an electric line fifty-eight miles in length in Essex County. The proposed line will tap the ore mines in the vicinity of Lake Sandford and connect with the Delaware & Hudson at Riverside. A magnetic survey shows that there are 300,000,000 tons of ore in the territory which will assay fifty per cent iron.

ALTON, ILL.—A new trolley line from Alton to Jacksonville, sixty-four miles, is in prospect through the announcement of the Alton Construction Company that work on the new Alton, Jacksonville & Peoria road will begin September 15. The line is now built from Alton to Godfrey, a little more than four miles. The money to build through to Jacksonville is said to have been pledged by a European syndicate. An extension to Peoria is planned later.

RICHMOND, VA.—Colonel C. P. E. Burgwyn and a corps of engineers have begun a survey for a railway line from West Point, on the York, to Urbanna, in Middlesex County, on the Rappahannock, a distance of about twenty-five miles. It is stated that the road is to be run with modern gasolene electric motor-cars, and will be a high-speed road traversing a section of the state now free of modern transportation facilities. Northern capitalists are said to be back of the enterprise.

OGDENSBURG, N. Y.—Representatives of New York capitalists are securing the consent of property owners to building an electric railway from this city through to Edwardsville, a distance of fourteen miles, thence across to Morristown and along the St. Lawrence River bank to Ogdensburg. The plan also contemplates a line from Edwardsville through Rossie to Gouverneur. Options will be secured later for a line from Ogdensburg to Canton, Potsdam, Massena, Louisville, Waddington and back to this city.

OKLAHOMA CITY, OKLA.—Officials of the Oklahoma City Street Railway Company are planning a number of extensions to be made within the next sixty days, to cost in the neighborhood of $50,000. John W. Shartel, vice-president and general manager of the company, has been in the East for some time looking after matters connected with improvements. It is stated that a line will be built to the state fair grounds in time for the fair in October. This line will be double track and will cost $40,000. The company is in a position to construct this line and have it in good running order by the latter part of September.

CINCINNATI, OHIO—Representative men of Erlanger, Ky., it is stated, have been at work for some time planning an extension of the Cincinnati, Newport & Covington Light and Traction Company from the St. Mary's Cemetery, on the Lexington pike, to Erlanger. Dr. James P. Riffe, who has been pushing the extension, says: "We had several interviews with Mr. Archibald White, the president of the company, and told him we would raise a subscription of $60,000 in four per cents, sufficient to pay for the extension. He assured us the extension under those conditions and it looks like a certainty now."

WELLSVILLE, OHIO—That the construction of interurban roads that will close all gaps between here and Columbus, Cleveland, Pittsburg and Cincinnati will be undertaken during the coming eight months is the belief of traction interests here. Now that a complete interurban system is open from Rochester, Pa., to Bellaire, a distance down the Ohio Valley of nearly 100 miles, attention is to be given immediately to the building of a line from Bellaire to Zanesville, on the Ohio side, and from Moundsville to Steelton, W. Va., a distance of twenty miles, and from Friendly to Williamstown, W. Va., a distance of thirty-seven miles.

GUTHRIE, OKLA.—Philadelphia capital is reported back of the proposed construction of the Oklahoma City-El Reno Electric Interurban Railway, and the work of grading is expected to commence November 15, according to statements by local promoters. The surveys have been completed between the two towns, and the work of acquiring right of way is going on gradually. A special election will be called in El Reno on the proposition for granting the street railway company a four-year extension on its franchise. The life of the franchise is twenty-one years, the company claiming that its bonds can be better disposed of if the company has a twenty-five-year franchise. The first mile of line has been completed and will be extended as soon as material arrives.

TUSCALOOSA, ALA.—The Birmingham & Gulf Construction Company has given up its contract to build the electric line from Tuscaloosa to Gadsden. By mutual agreement the contract was terminated. All of the equipment owned by the construction company has been turned over to the railroad. There have also been some changes in the officers of the Birmingham & Gulf Railway and Navigation Company. Mr. Vandergrift, who had been general manager, has been succeeded by J. T. Pultz, of New York, whose title will be general superintendent. E. F. Enslen, Jr., of Birmingham, has been appointed superintendent of the Birmingham & Gulf Railroad to succeed George H. Rois. Owing to the cancellation of the contract with the construction company the work on the line will be delayed for a short time. It is understood that a new contract will be arranged for an early conclusion.

BROOKLYN, N. Y.—The Long Island Railroad has applied to the Public Service Commission for its approval of the grant of a franchise to lay surface tracks on Atlantic avenue, Brooklyn, between Flatbush and Shepard avenues. The company claims a right of way through Atlantic avenue, but explains in the application that it is asking for a franchise for the reason that it does not wish to enter into litigation with the city. The company's claim to the right of way is based on its purchase of the rights of the old Brooklyn & Jamaica Railroad Company, which operated a surface line through Atlantic avenue. According to the application filed at this time the original grant to the Brooklyn & Jamaica Railroad Company was for a railroad from Greenpoint through Jamaica to the river's edge in Brooklyn for the term of 250 years. It is claimed that this grant gave the company "the perpetual use for railroad purposes of the thirty-foot strip in the centre of this portion of said avenue," the portion referred to being the greater length of the proposed route, and that, for the rest, a similar provision was made in the "tripartite agreement of 1855."

HOUGHTON, MICH.—At the annual meeting of the Houghton County Street Railway Company, held at the company's offices in Houghton, directors and officers for the ensuing fiscal year were elected. The election resulted as follows: President, F. J. Bawden; vice-president, F. S. Pratt; treasurer, Henry D. Sawyer; secretary, Alvah K. Todd; assistant treasurers, J. Harry Dufresne and Willard W. Dow; directors, C. A. Stone, T. E. Tripp, T. N. Perkins, Edwin S. Webster, Henry G. Bradlee, F. J. Bawden, Russell Robb, N. H. Stone and F. S. Pratt; executive committee, Henry G. Bradlee and Russell Robb. The only change made was that of F. S. Pratt in place of Henry G. Bradlee for vice-president. General Manager McGrath announced that articles of incorporation for the Houghton County Traction Company have been filed at Lansing. This company has been organized for the purpose of operating the Mohawk extension, and it is the intention of the company ultimately to take over the Houghton County Street Railway Company. The right of way for the Mohawk extension has all been secured, and nothing now stands in the way of completing the road, work on which is progressing rapidly.

BARRE, VT.—The Barre & Montpelier Power and Traction Company has closed a contract with Dornsife & Miglierini for the erection of a dam and power-house on the Winooski River, near Kinney's Mills, toward East Montpelier, that property and water rights having been purchased some time ago. When the work is completed the company will have sufficient power to run its cars between Barre and Montpelier and also for lighting purposes. It is planned to have the construction finished by November 1. The dam will be eighteen feet high and 178 feet long. Power will be transmitted from the East Montpelier side of the stream by a 600-foot penstock to the power-house, to be located near Gallup's bridge. This building will be of cement blocks and will contain two turbines, one of 350 horse-power capacity and the other of 600. There will be, in addition, an auxiliary plant, so that the company will be prepared for emergencies. At the annual meeting of the company F. M. Corry, E. H. Deavitt, I. M. Frost and T. J. Deavitt, of Montpelier, and H. K. Bush and D. M. Miles, of this city, were re-elected directors. Subsequently Frank M. Corry was re-elected president; E. H. Deavitt, clerk and treasurer; I. M. Frost, general manager, and H. K. Bush, vice-president. The reports showed that the business of the road increased during the past year. The capital stock is now $120,000.

ELECTRIC LIGHTING.

BOYERSTOWN, PA.—A site has been purchased for the proposed electric light plant, and a building forty by 100 feet will be erected.

MANCHESTER, MASS.—The proposition for the purchase of the Manchester Electric Light Company by the municipality has been defeated.

LOS ANGELES, CAL.—The directors of the Escondido Mutual Water Company have voted for the installation of an electric light and power plant to cost about $30,000.

POTTSVILLE, PA.—Contracts have been signed for the erection of a ten-mile electric transmission line in western Schuylkill. This will extend from Tower City to Lykens.

ARGENTA, ARK.—The city council has decided to expend $12,000 for additional machinery for the electric light plant to enable it to light for commercial purposes.

PASCO, WASH.—Fire destroyed the Northern Pacific Light and Power Company's plant on August 7. The plant was valued at $51,000, and was partly covered by insurance. The origin of the fire is unknown.

WASHBURN, WIS.—The city council has voted to annul the purchase of the electric lighting system from the Washburn Electric Light and Power Company. The city paid $22,580.40 for the plant but has been unable to make it pay.

ST. LOUIS, MO.—A municipal lighting plant, to supply the needs of the new city hall, municipal courts buildings and all city buildings in the downtown district, has been approved by Mayor Wells. The new plant is to cost $100,000.

SHERMAN, TEX.—At a meeting of the Sherman city council it was decided to draw up an ordinance in blank ordering an election for the issuance of bonds in the amount of $30,000, the proceeds to be used for improving the electric light and water systems.

BERLIN, MASS.—Berlin voted in special town meeting to authorize a special committee to make a contract for five years with the Marlboro Electric Light Company for electric lights in its streets. The same committee was empowered to act in regard to lighting the town hall.

PORTAGE, WIS.—Surveyors are running a line through Columbia County from Kilbourn for the Southern Wisconsin Power Company. By running through Portage, Wyocena, Rio and Columbus these towns will have the advantage of the power produced by the Kilbourn dam.

WEST CHESTER, PA.—The borough council of West Chester has made a new contract with the Edison Electric Illuminating Company to light the streets with 2,000-candle-power arc lamps at $75 each per year instead of $80 each, the price under the contract for the past five years.

CANTON, OHIO—Manager W. C. Anderson, of the Canton Electric Company, states that the contract for furnishing the city 185 arc lights or more on moonlight schedule at $41.50 per arc per year, has been returned to him from Philadelphia with the signatures of officers of the company.

MORRISTOWN, N. J.—The Morris & Somerset Electric Company has plans out for the addition to its power-house on Whippany street, made necessary for additional machinery for lighting the town, and it has taken over the Public Service Corporation's plant. Two additional 250-kilowatt generators will be put in.

MILFORD, MASS.—The Massachusetts Lighting Companies, of Boston, which operates the Milford Electric Light and Power Company, has petitioned the state gas and electric light commissioners for the right to issue $40,000 worth of first mortgage bonds to meet floating indebtedness and to further extend the local system.

MACON, GA.—By granting an amendment to the original charter, Judge Felton has allowed the Central Georgia Power Company to increase its capital stock from $100,000 to $400,000. At the same time the amendment was granted the name of the company was changed from Bibb Power Company to the Central Georgia Power Company.

ST. LOUIS, MO.—At a meeting of the United Light, Heat and Power Committee at the Planters' Hotel a subcommittee was named to make an inquiry into a proposition to build a municipal lighting plant. A resolution recommending that the city purchase the underground conduit system of the Union Electric Light and Power Company was adopted.

POTTSTOWN, PA.—Pottstown has closed a five-year contract with the Pottstown Light, Heat and Power Company for electric street lighting at the rate of $70 yearly for arc lights and $25 for incandescent, a reduction of $12.50 and $6.90, respectively, a saving to the borough of about $1,600 annually. The lighting company will make improvements costing between $15,000 and $25,000.

HOLYOKE, MASS.—The July figures for the lighting department show a gain in the output over the same month of 1,415,332 feet, or twelve and one-tenth per cent over last year. In the electric department the gain is also satisfactory, the output for last month being 360,880 kilowatts, as against 343,190 kilowatts for the same month a year ago. The greatest gain occurred in the commercial output, where a gain of twenty-four and four-tenths per cent was made.

OREGON CITY, ORE.—F. M. Swift, who is backing the project to construct an electric railway from Oregon City into the Beaver Creek, Molalla and Wilhoit Springs sections of Clackamas County, has filed notice of the appropriation of water from the main channel of the Molalla River. Swift proposes to build a canal or ditch, twenty-five feet wide at the bottom, thirty-three feet wide at the water surface, to carry an eight-foot depth of water, with a grade of two-tenths foot.

NOBLESVILLE, IND.—Ralph Wing, of Peru, and C. B. Shaber, of Arcadia, receivers for the Arcadia Electric Light Company, have reported to the court that they have sold the plant to the Noblesville Heat, Light and Power Company for $2,500, of which A. R. Holliday, of Indianapolis, is one of the largest stockholders. The court has approved the sale and discharged the receiver. The Noblesville company intends to supply Arcadia with current from Noblesville. It is already supplying Cicero and expects to extend the line to Atlanta.

WAHPETON, N. D.—Negotiations are about completed looking to the passage of a franchise which will bring water-generated electric light and power from a few miles this side of Fergus Falls, and will permit manufacturing at this railroad centre with cheap power. The total available power will be 2,000 horse. The Commercial Club has on foot a plan to connect by electric railway Sisseton with Wahpeton *via* Hankinson. The line would pass through some of the best farming land and most thickly settled country in the Dakotas, much of which is relatively far from any railroad.

ALBANY, N. Y.—The Public Service Commission has granted the application of the Williamsville Electric Light and Power Company for permission to construct and operate and exercise rights and privileges under franchises in the village of Williamsville. The order is granted upon the condition that the company will have its plant and lighting system completed and ready for supplying and distributing electricity on or before May 18, 1910. The commission has also granted the company authority to issue $25,000 of common capital stock to be used to acquire power-house and equipment. The company applied for permission to issue $35,000 stock.

CLINTON, MASS.—At a town meeting a resolution to the effect that the town acquire a plant for the manufacture and distribution of gas and electricity for municipal use and the use of its inhabitants was passed by a vote of 223 to twenty-seven. The committee that was appointed last May to investigate the subject submitted a report and was retained to make further investigation. The board of selectmen was instructed to communicate with the Clinton Gas Light Company and request them, according to law, to file with the town clerk a schedule of the property it desires to sell and the price it intends to charge. The committee's report gave some figures regarding the approximate value of the gas company's property and the result of a conference with the Metropolitan Water and Sewerage Board. From the latter the information was secured that power could be taken from the Wachusett dam at a charge of $15 per horse-power per year, and 2,500 horse-power would be available.

PERSONAL MENTION.

MR. EDWIN FERRIN has succeeded O. E. Bostick as superintendent of the Palestine Telephone Company, Palestine, Tex.

MR. CHARLES R. HUNTLEY, president of the Buffalo General Electric Company, was a visitor to New York last week in attendance at the funeral of the late Dr. William M. Habirshaw.

MR. F. H. KNOX has been made vice-president and general manager of the Electric Power and Manufacturing Company which owns and operates a street railway system, electric light and gas plants at Gaston Shoals, S. C.

DR. S. N. TAYLOR has been appointed head of the department of electrical engineering at the University of Cincinnati. Dr. Taylor has been professor of electrical engineering at the Western University of Pennsylvania for six years. Previous to that he was assistant professor of physics at Syracuse University.

MR. C. E. DUCK, formerly connected with the Waynesboro Electric Light and Power Company and Chambersburg, Greencastle & Waynesboro Street Railway Company, and who resigned from the service of the latter corporation some time ago, has accepted a position with the Carbon Transit Company, Mauch Chunk, Pa.

MR. FRANK J. QUINN, who for the past fifteen years has been associated with the Pacific Telephone and Telegraph Company as purchasing agent, and subsequently with the Western Electric Company as buyer, has become identified with the Sterling Electric Company, San Francisco, Cal., and will act as a director and treasurer of the company.

MR. ALBA H. WARREN, formerly manager of the Brockton & Plymouth Street Railway Company, of Plymouth, Mass., has assumed the management of the Pensacola (Fla.) Electric Company and the Escambia County Electric Light and Power Company, *vice* John W. Leadley, who is now on an extended vacation prior to taking up other work with the Stone & Webster interests.

MR. BEN S. REED, New Orleans manager of the Cumberland Telephone Company, has been appointed superintendent of the New Orleans district to succeed E. L. Powell, whose resignation has been announced. Mr. Reed has been in charge of the New Orleans exchanges since the beginning of this year, reorganizing the force and making many improvements. He has been manager at Owensboro, Ky.; at Chattanooga and at Louisville.

DATES AHEAD.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Arkansas Association of Public Utilities Operators. First annual convention, Little Rock, Ark., September 17-18.

Old Time Telegraphers' and Historical Association, and Reunion of Military Telegraphers, Niagara Falls, N. Y., September 16-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 5-6.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Pittsburg, Kan., October 8-10.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Railway Signal Association. Next meeting, Washington, D. C., October 13-15.

Order of the Rejuvenated Sons of Jove. Annual meeting, Buffalo, N. Y., October 15-16.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

ENGINEERING SOCIETY NOTE.

THE ELECTRIC CLUB OF CHICAGO—Mr. Clarence E. Freeman, of the Arnold Company, Chicago, Ill., addressed the Electric Club of Chicago on August 26 on the subject of "Irrigation and Power Development in the West."

ELECTRICAL SECURITIES.

The stock market developed considerable irregularity last week, with a distinct tendency to travel downward. Murmurings have been heard indicating that this was the result of manipulations carried on by the financial powers which have been instrumental in the upbuilding of the stock market for the past two or three months. The impression is gaining ground that a good deal of the trouble has been caused by the throwing over of investment stock which has been held for some time. The steel stocks contributed the real element of strength to the stock situation, while other metals were comparatively weak. This is essentially a period of marking time, and while the present outlook is favorable for a healthy market and increasing values, very little is being predicted one way or the other as to what turn will be made in the next two or three months.

Dividends have been declared upon the following electrical securities: Twin City Rapid Transit Company; regular quarterly dividend of 1¾ per cent on the preferred stock, payable October 1 to stock of record September 16. American Railways Company; regular dividend of 1½ per cent, payable September 15.

ELECTRICAL SECURITIES FOR THE WEEK ENDED AUGUST 22.

New York:	*Closing.*
Allis-Chalmers common	11¾
Allis-Chalmers preferred	34¼
Brooklyn Rapid Transit	51⅝
Consolidated Gas	135
General Electric	143
Interborough-Metropolitan common	11¼
Interborough-Metropolitan preferred	31⅝
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	66
Mackay Companies (Postal Telegraph and Cables) preferred	66½
Manhattan Elevated	135
Metropolitan Street Railway	28
New York & New Jersey Telephone	110
Western Union	55¼
Westinghouse Manufacturing Company	71
Boston:	*Closing.*
American Telephone and Telegraph	124⅞
Edison Electric Illuminating	216
Massachusetts Electric	47
New England Telephone	114
Western Telephone and Telegraph preferred	70
Philadelphia:	*Closing.*
Electric Company of America	10
Electric Storage Battery common	38
Electric Storage Battery preferred	38
Philadelphia Electric	9¾
Philadelphia Rapid Transit	14
United Gas Improvement	87½
Chicago:	*Closing.*
Chicago Telephone	145⅛
Commonwealth Edison	108
Metropolitan Elevated preferred	43½
National Carbon common	72½
National Carbon preferred	108

NEW PUBLICATION.

A NEW BOOK ON ELECTRICAL ENGINEERING—Robson & Adee, of Schenectady, N. Y., are preparing for publication a new book on electrical engineering by Dr. Charles P. Steinmetz. This book contains a series of lectures delivered by Professor Steinmetz under the auspices of Union University, in the winter of 1907-1908, to a class of younger engineers consisting mainly of college graduates. The lectures give a broad review of the entire field of electrical power generation, transmission, distribution, control and use, showing the close relation and dependence upon each other of all of the factors of the problem.

EDUCATIONAL NOTE.

THE ROSE POLYTECHNIC INSTITUTE—The Rose Polytechnic Institute is one of the few special technical institutes in the West. It is located at Terre Haute, Ind., and under the presidency of C. L. Mees is maintaining a high standard of excellence. The institute occupies a large and completely equipped building within the city limits, and its work is both theoretical and practical, its equipment enabling it to give its students in civil, mechanical and electrical engineering an abundance of practical work.

TELEPHONE AND TELEGRAPH.

ONEIDA N. Y.—Ground will be broken shortly for a new building for the Central New York Telephone and Telegraph Company.

NASHVILLE, TENN.—The Western Union Telegraph Company has taken over the wires on the Tennessee Central Railway between Nashville and Hopkinsville, Ky., formerly operated by the Postal Telegraph Company, and will operate them hereafter.

SPENCERPORT, N. Y.—The Ogden Telephone Company, which was organized last winter, has now practically completed the construction of its system and is furnishing service to over 300 subscribers. The Milliner Building has been leased for the Spencerport exchange and two switchboards have been placed in the building.

WICHITA, KAN.—Surveys are being made for a trunk telephone line from this city to Abilene to connect the Oklahoma service with the up-state systems. The intention is to build a later one to Omaha. One already extends from Abilene to Kansas City. The capacity of this will be doubled. The expansion of the independent service among the farming communities makes trunk lines between the cities necessary for toll service.

CENTERVILLE, N. Y.—An association, to be known as the Centerville Telephone Company, has been organized, with J. C. Vosburg, president; Victor O. Crowell, secretary, and Nelson Hauber, treasurer. Its purpose is, first, to put up a line from the post-office to the Buffalo & Susquehanna Railroad station; second, to extend a line to Fairview, four miles from here, and to create a system to cover the town of Centerville and connect with the Inter-Ocean at Rushford.

LITTLE ROCK, ARK.—The Valley Telephone Company, of Warren, contemplates an extension of its system from Warren to Dermott, *via* Monticello, a distance of forty miles. The company has 600 miles of pole line, 100 stations, thirteen exchanges and operates in seven counties. It has connection with the Cumberland at Greenville, Miss., and Lake Providence, La., and with the Southwestern Telegraph and Telephone Company at Fordyce and Pine Bluff, and has a cable across the Mississippi at Greenville. It sub-leases its instruments from the Southwestern.

REDLANDS, CAL.—A long-distance telephone line from Redlands Junction to El Paso, a distance of about 750 miles, is to be built this fall by the Consolidated Telegraph and Telephone Company, of Tucson, Ariz. The line will be the longest of the kind in the West, and a branch line which will tap the mining district of Arizona and the Imperial Valley will make the entire length 1,009 miles. The cost will be approximately $250,000. Charles A. Rolfe, of Redlands, who is identified with the Southwestern Company, of this city, has been given the contract and expects to begin work in about three months. Although the contract reads "To Redlands Junction only," the terminal point, of course, will be Los Angeles. Mr. Rolfe says it has not been decided with which company connections will be made in that city. In the construction of the line over 880,000 pounds of copper wire will be used and more than 50,000 poles.

NEW MANUFACTURING COMPANIES.

DOVER, DEL.—A charter has been filed for the Steven D. Large Company, Incorporated, Philadelphia, Pa., to engage in a general electrical engineering business. The capital is $10,000.

COLUMBUS, OHIO—The Browne-Cross Company, of Columbus, has been incorporated with a capital stock of $10,000, by Morton S. Browne, S. E. Browne, Charles W. Cross, H. H. Wilson and F. H Heywood. The company will manufacture and deal in electrical devices.

SEABRIGHT, N. J.—The Atlantic Coast Electric and Protective Company has been incorporated to manufacture burglar-alarm apparatus, with a capital of $10,000. The incorporators are: P. Hall Packer, Seabright, N. J.; Joseph Swanson, James Otterberg, New York city.

ALBANY, N. Y.—Camden & De Young, Incorporated, have filed incorporation papers with the secretary of state to carry on business as electricians, electrical engineers and general contractors. The capital is $20,000 and the directors are William Kelly, Leonard De Young and Fred Raff, of New York.

INDUSTRIAL ITEMS.

THE H. KRANTZ MANUFACTURING COMPANY, 160 Seventh street, Brooklyn, N. Y., is mailing a card calling attention to the features of the type P. C. knife switch.

THE WESTINGHOUSE TRACTION BRAKE COMPANY, Pittsburg, Pa., has ready for distribution instruction pamphlet No. T-5035, devoted to the A M S brake equipment.

THE CHICAGO PNEUMATIC TOOL COMPANY, Fisher Building, Chicago, Ill., has ready for distribution advance sheets from its catalogue No. 26, devoted to Franklin air-compressors.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has issued several supplements to its instruction book 5,007. These are devoted respectively to supply parts for potential starters, type A1, type A2, type B1 and type B2.

THE PACIFIC ELECTRIC HEATING COMPANY, Ontario, Cal., has begun the publication of a little monthly entitled "Hot Points." This contains some very interesting matter concerning the electrical heating apparatus manufactured by this company.

THE NILES-BEMENT-POND COMPANY, 111 Broadway, New York city, has published a handsome catalogue devoted to Niles boring mills. Some of the illustrations show exceptional applications of electric motors to the direct driving of these important machine tools.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has issued bulletin No. 81, devoted to central-station transformers. This takes up, in a very careful way, an analysis of the use of the new "alloy steel," with which all Wagner "Standard" and "High-Efficiency" transformers are now built. The use of this steel has resulted in marked advantages.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has ready for distribution bulletins No. 3,134 and No. 3,306, devoted, respectively, to single-phase induction motors, frame 24 DA, one-fortieth and one-twentieth horse-power, light-load start type, for intermittent service, and electric blowers for furnaces for alternating or direct currents.

THE ELECTRIC CONTROLLER AND MANUFACTURING COMPANY, Cleveland, Ohio, in the August issue of its attractive little bulletin, "Common Sense," devotes some descriptive matter and illustrations to the electric fault finder which the company is now calling attention to. Of course, there is the usual matter which has attracted so much attention to this excellent publication.

THE PITTSBURG TRANSFORMER COMPANY, Pittsburg, Pa., is announcing its new silico-vanadium steel transformers. The company has also completed its final designs based on the remarkable characteristics of this new alloy. The company states that core losses in Pittsburg transformers have been reduced thirty to fifty per cent, and improved copper losses and regulation have also been secured.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., has recently completed delivery on a large number of New Lexington high-tension porcelain insulators for use on the lines of the Sanitary District of Chicago. These insulators are of a new type, being fired by natural gas, and they are fully described in the insulator book which the company is now distributing. Copies of this book will be sent upon request.

THE RAILWAY SPECIALTY AND SUPPLY COMPANY, Chicago, Ill., has published bulletin T-228, describing and illustrating the Smith improved nut. This nut is made of spring steel, oil tempered. The bore of the spring end is larger than the root of the nut thread. When the nut is set tight home the spring is compressed until it rests against the main body of the nut. In this position it exerts a constant heavy pressure between the nut and the parts being held, which forces one side of the nut threads against the corresponding side of the bolt threads.

THE WYCKOFF PIPE AND CREOSOTING COMPANY, INCORPORATED, 50 Church street, New York city, states that the Degnon Contracting Company has recently removed one block of its conduit, twenty-four-duct run, the property of the Empire City Subway Company, from Sixth avenue, between Eighteenth and Nineteenth streets, New York city, owing to excavation for the Hudson River tunnels. This conduit was laid in the year 1887 and was removed in June, 1908. After twenty-one years it was sound and without the least sign of decay in any instance. The company has documentary proof of the above facts, and has samples on exhibition at its New York office which it will be pleased to show to any interested party. This conduit is being stored, as it was taken up without breakage, except a portion where it was inexpedient to pull the cables and interrupt the service.

TUNGSTEN LAMP PRICE REDUCTION—The General Electric Company announces that after September 1 there will be an extra discount of ten per cent allowed on all purchases of tungsten lamps in standard package quantities. This additional discount is made to cover all losses incident to breakage in shipment, careless handling, early burnouts, etc., and does away with the necessity of adjusting such claims with the consumer. A careful record has been kept to determine the value of the special resilient packing cases used by the General Electric Company, and the average transportation breakage in six months has been less than two per cent. Another advantage to the consumer of a different character also goes into effect the first of the month. This is a general rearrangement of the delivery schedule. Thereafter all standard package shipments to points east of the Mississippi River will be made with transportation charges allowed, and for other points, excepting a few specially designated free delivery places, a small addition to the net price will be made. The company has four factories manufacturing tungsten lamps exclusively and has a combined capacity of 35,000 lamps a day, while ample stocks are carried at eleven different district sales offices to insure prompt deliveries to any part of the country.

Record of Electrical Patents.

Week of August 18.

896,081. TELEPHONE CALL REGISTER. Byron B. Brockway, Cleveland, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. The register is made a part of, and attached to, the diaphragm containing receptacle.

896,092. ELASTIC SUSPENSION FOR THE FILAMENTS OF ELECTRIC INCANDESCENT LAMPS. Paul Druseidt, Remscheid, Germany. The stem is spring-supported in three different places.

896,103. TELEPHONE SYSTEM. Charles L. Goodrum, Philadelphia, Pa., assignor, by mesne assignments, to the Dean Electric Company, Elyria, Ohio. A metallic-circuit central exchange and substations.

896,120. ELECTRICALLY OPERATED VALVE. Christian Krämer, Frankfort-on-the-Main, Germany, assignor to Felten & Guilleaume-Lahmeyerwerke Actien-Gesellschaft, Frankfort-on-the-Main, Germany. The closure is effected by means of a stem working in an electromagnet.

896,122. PLURAL LAMP SOCKET. Edward A. Lefèbre, Jr., Brooklyn, N. Y. The threaded base is equipped with a plurality of contact shells and socket-held plates.

896,130. RECEIVER FOR WIRELESS TELEGRAPHY. Guglielmo Marconi, London, England, assignor to Marconi Wireless Telegraph Company of America, New York, N. Y. The oscillation valve and primary winding of the induction coil are connected in series with each other, but in shunt with the condenser.

896,144. ELECTRODE. Harry Pauling, Gelsenkirchen, Germany, assignor to the firm of Salpetersäure-Industrie-Gesellschaft, G. M. B. H., Gelsenkirchen, Germany. Melted oxides are formed and maintained in their liquid state by the treatment of gases by arc discharges.

896,165. FAN. Otto Selg, New York, N. Y. The fan is fitted with an annular slitted deflector having a series of V-shaped blades.

896 173. TELEPHONE APPARATUS. James H. Thompson, Trenton, N. J. The bell box is provided with a drum for winding up the slack telephone cord.

896,184. APPARATUS FOR THE ELECTROLYSIS OF FLUIDS. Emil Weichert, Augsburg, Germany. The electrodes are fitted in conjunction with the convolution of each coil.

896,188. SYSTEM OF STORAGE-BATTERY CONTROL. Edward Wray, Janesville, Wis. An electromagnetic latch holds the switch arm locked when a battery is being charged.

896,189. ELECTRIC TROLLEY. John Young, Toledo, Ohio. The trolley wheel is carried in an eccentrically mounted case suspended from the trolley harp.

896,192. TERMINAL PIECE FOR ELECTRIC CIRCUIT-BREAKERS. Christian Aalborg, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The terminal piece is composed of a plurality of cylindrical radially slotted lamina having an inwardly tapered open end.

896,198. TROLLEY POLE. Lawrence C. Collins and Arthur R. Eltom, Cranford, N. J. The self-seating trolley pole is provided with inner and outer telescoping members.

896,200. BRANCH CONNECTION FOR ELECTRIC CABLES. John J. Dossert, New York, N. Y., assignor, by direct and mesne assignments, to Dossert & Company. The conducting yokes are adapted to be brought into contact with the cable on diametrically opposite sides.

896,210. CONTACT MEMBER. Henry D. James, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. An end recess engages with a projecting plug of materially smaller section, located in the recess of a co-operating contact member.

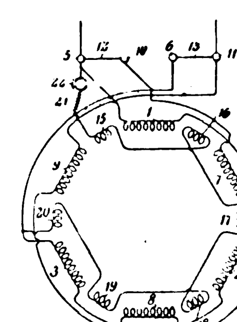
896,216. ELECTRICALLY PROPELLED VEHICLE. Louis Krieger, Paris, France. The battery, through a resistance, floats in the generator circuit.

896,217. WINDING FOR SINGLE-PHASE INDUCTION MOTORS. Fred R. Kunkel, Edgewood Park, Pa., assignor to Westinghouse Electric and Manufacturing Company. The main winding of the motor is adapted to be connected in either series or parallel relation with an auxiliary winding.

896,218. ELECTRIC WELDING MACHINE. Laurence S. Lachman, New York, N. Y. A spot-welding pole connected to a source of current, and a cross-sectional area large enough to give it rigidity.

896,220. ELECTRIC LOCOMOTIVE. Benjamin G. Lamme and Norman W. Storer, Pittsburg, Pa., assignors to Westinghouse Electric and Manufacturing Company. The axle is mounted upon quills, and the motor is resiliently connected to the axle.

896,222. ELECTRICAL MEASURING INSTRUMENT. Paul MacGahan, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A graphic recording meter.



896,217.—WINDING FOR SINGLE-PHASE INDUCTION MOTORS.

896,225. MEANS FOR AUTOMATICALLY RESTORING A TROLLEY WHEEL TO THE WIRE. Charles F. Mehl, Cleveland, Ohio. An auxiliary wheel carried upon a solenoid-operated plunger finds the position on the wire for the main trolley wheel.

896,227. MEANS FOR REGULATING THE SUPPLY OF ELECTRIC CURRENTS. Charles M. P. Montbarbon, Paris, France. One terminal of the generator armature is grounded and electrically connected through contact plates connected to the other terminal of the armature.

896,243. GAS OR VAPOR ELECTRIC APPARATUS. Max von Recklinghausen, New York, N. Y., assignor to Cooper Hewitt Electric Company. A continuous conductor is hermetically sealed in a container in an intervening gas or vapor.

896,249. ELECTRIC MOTOR CONTROL. Girard B. Rosenblatt, Butte, Mont., assignor to Westinghouse Electric and Manufacturing Company. Means for coupling together two asynchronous motors.

896,252. MEANS FOR ATTACHING METALLIC FILAMENTS TO THEIR CARRIER ARMS. Johannes Schilling, Halensee, near Berlin, Germany. The stem is provided with carrier arms.

896,274. ARC LAMP. Guy N. Chamberlin, Lynn, Mass., assignor to General Electric Company. The movement of the electrode automatically varies the rate at which air is supplied to the inner globe.

896,297. ELECTRIC HEATER. Edward M. Hewlett, Schenectady, N. Y., assignor to General Electric Company. The grid-shaped resistance strip is folded back and forth upon itself in parallel sections.

896,300. ELECTRICAL TESTING INSTRUMENT. Cameron De Witt Jarvis, Winthrop, Mass., assignor to American Telephone and Telegraph Company. The contact clips terminate in a cartridge containing a resistance coil and an indicating member.

896,319. CURRENT COLLECTOR FOR ELECTRIC RAILWAYS. Philipp Pforr, Lankwitz, near Berlin, and Paul E. Herkner, Berlin, Germany. The current collectors are operated by fluid pressure mechanisms.

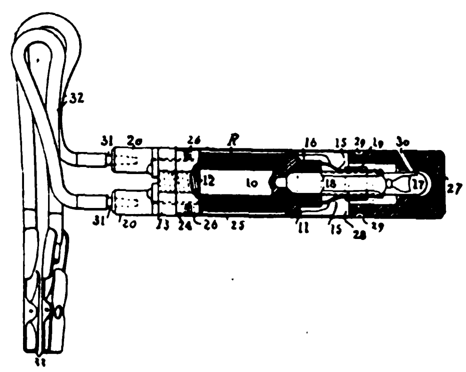
896,321. FIELD-MAGNET STRUCTURE. Henry G. Reist, Schenectady, N. Y., assignor to General Electric Company. The structure is composed of alternate large and small polygonal units each comprising a plurality of lamina riveted together.

896,322. DYNAMOELECTRIC MACHINE. Henry G. Reist, Schenectady, N. Y., assignor to General Electric Company. The laminated pole piece is equipped with removable tips.

896,323. DYNAMOELECTRIC MACHINE. Henry G. Reist, Schenectady, N. Y., assignor to General Electric Company. The field magnet is made up of staggered long and short polar portions.

896,332. AUTOMATIC TRAIN STOP. Hiram G. Sedgwick, Mill Valley, Cal. The stop mechanism on the train is actuated by an electromagnet placed in the roadbed.

896,341. FILAMENT FOR INCANDESCENT LAMPS. Willis R. Whitney, Schenectady, N. Y., assignor to General Electric Company. The filament is formed substantially of a nitride of a rare earth metal.



896,300.—ELECTRICAL TESTING INSTRUMENT.

896,348. CIGAR LIGHTER. Eskil Berg, Schenectady, N. Y., assignor to General Electric Company. The heating unit is contained in a capsule covered by a perforated shield.

896,350. STORAGE-BATTERY ELEMENT. John Bimeler, Zoar, Ohio, assignor of one-tenth to the Zoar Battery Company, Zoar, Ohio. The element is built up of a leaf structure, forming an open-work frame of large active area.

896,397. PENCIL AND APPARATUS FOR PRODUCING THE ARC LIGHT. Isador Ladoff, Cleveland, Ohio, assignor of thirty one-hundredths to Philip C. Peck, New York, N. Y. The electrode is composed of copper and titanium, and an alloy of copper and titanium.

896,416. TELEGRAPHONE. Hermann Schütte, Wheeling, W. Va. The speed of the telegraphone disc is adjusted by a clockwork and spring mechanism.

896,417. ARC LAMP. Ralph Scott, Wilkes-Barre, Pa., assignor to Scott Electrical Company. The feeding mechanism is actuated by a magnet.

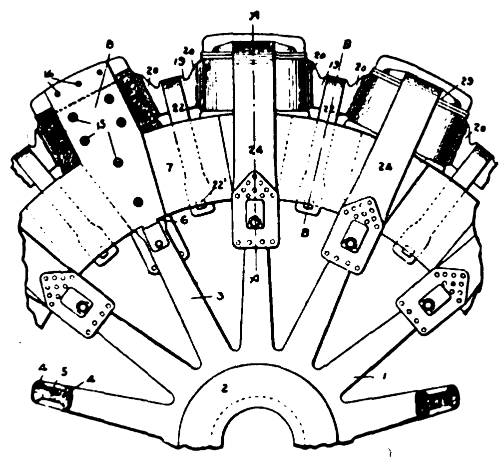
896,429. ELECTRODE FOR ELECTRIC FURNACES. Frederick M. Becket, Niagara Falls, N. Y., assignor by mesne assignments to Winthrop Chanler. The electrode has a metallic body portion, the interior of which is hollow or chambered, and an exterior coat or shell of carbon.

896,463. FIREPROOF SUPPORT FOR ELECTRICAL WIRES IN RAILWAY CARS. Edward T. Robinson, St. Louis, Mo., assignor to St. Louis Car Company, St. Louis, Mo. An insulating molding strip with a conduit for angle and corner work.

896,469. MAGNETIC CIRCUIT-BREAKER. Ralph Scott, New Brunswick, N. J., assignor to Scott Electrical Company. The contact members have recesses and prominences in their opposing faces.

896,476. CRIMPING APPARATUS FOR ELECTRIC WELDING MACHINES. Herbert L. Smith, Clinton, Mass., assignor to Clinton Wire Cloth Company, Boston, Mass. The apparatus is adjustable for making a crimp of any desired proportions.

896,516. MOTOR-CONTROL SYSTEM. Herbert W. Cheney, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. The single controller is arranged so that it can control either of the two motors separately, but is prevented from controlling them both together, and can leave one motor running while it controls the other.



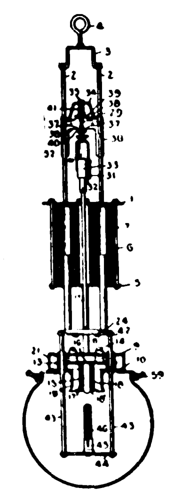
896,323.—DYNAMOELECTRIC MACHINE.

896,555. ELECTROLYTIC CELL. Gilbert C. Landis, York, Pa. A container having a number of removable frames, each frame being provided with a plurality of plates parallel to each other.

896,584. ELECTRICAL APPARATUS FOR TRANSMITTING SIGNALS. Charles Salmon and Henry J. Creffield, Erith, England, assignors to Vickers Sons & Maxim, Limited, Westminster, England. The several indicating stations are in series with the central signaling system.

896,586. MAKE-AND-BREAK DEVICE. Dominic Sandretto, Ladd, Ill. A bar pivotally mounted operates a step-by-step mechanism upon the energizing of an electromagnet.

896,608. ARRANGEMENT OF THE WINDING OF ELECTROMAGNETIC CLUTCHES. Heinrich Ast, Vienna, Austria-Hungary, assignor to the firm of Vulkan Maschinenfabriks-Actien-Gesellschaft, Vienna, Austria-Hungary. The magnet body contains an annular channel-shaped casing adapted to retain the winding.



896,698.—ARC LAMP.

896,617. TELEPHONE SWITCHBOARD APPARATUS. Lewis A. Brinkman, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. An operator's key shelf equipped with listening and ringing key, visual signal, and plugs.

896,630. ELECTRICAL HEATING MEANS FOR MOLDS. Harry E. Diller, Oak Park, Ill. The metal forms a part of the electrical conducting circuit.

896,698. ARC LAMP. Charles P. Steinmetz and John T. H. Dempster, Schenectady, N. Y., assignors to General Electric Company. One electrode is moved by gravity and the other by an electromagnet.

ELECTRICAL REVIEW

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CONTENTS

TANTALUM DETECTOR FOR WIRELESS SIGNALING.

During the past year or two innumerable detectors for electric waves, acting on the imperfect-contact principle, have been devised. Many of these have not been self-decohering, but occasionally a combination of metals or of a metal and some other conducting body is found which is self-restoring. Usually detectors of the latter type employ a compound of a metal, such as a carbide. The arrangements using metal on metal generally call for a mechanical arrangement for restoring the high resistance of the receptive condition. An interesting detector of this type was invented a year or so ago, and used in the Lodge-Muirhead system. This device was formed by rotating a small metallic wheel, the lower surface of which just grazed a surface of mercury covered with a thin film of oil. The rotation of the wheel served to restore the high resistance of the device, which apparently was due to a very thin film of oil adhering to the surface of the disc. This film appears to be so thin that it is punctured by the potentials produced when an electric wave is received by the antenna.

On another page of this issue a wave detector is described which employs mercury as one of the contacts and a tantalum wire as the other. The wire is exceedingly fine, being only about five-hundredths millimetre in diameter; in fact, it is nothing more than a short piece of filament taken from one of the ordinary tantalum lamps. Tantalum is not wetted by mercury, and when this fine wire is just in contact with a mercury surface the contact resistance is from 1,000 to 2,000 ohms. This resistance is not high compared with the receptive resistance of certain other receivers, but when an oscillation is received the resistance drops to about one-eighth of its original value. This ratio can even be increased if desired and the great change gives rise to very loud signals. The inventor of the detector, Mr. L. H. Walter, says that in this respect his detector is superior to most others, although it is not so sensitive as some other types for very weak oscillations. This characteristic he thinks makes the detector particularly suitable for wireless telegraphy, since the oscillation currents used in that system of communication must necessarily be relatively powerful.

Finding the combination of tantalum and mercury so excellent, Mr. Walter tried various other combinations of metals, both with mercury and with other metals; none of them, however, compared with the tantalum-mercury couple. He did find one combination of solid metals, namely, tantalum and oxidized iron, which gave fairly satisfactory results. Such an arrangement would be well adapted for use on shipboard, where the vibration of the mercury surface of the other detectors would render them useless. However, the inventor has devised an arrangement of his mercury-tantalum detector in which the tantalum wire is in contact with a small globule of mercury entirely enclosed, and which therefore does not vibrate.

It is an interesting question as to what gives rise to this high resistance of contact. One would at first attribute it to a thin film of oxide, similar though not so strong dielectrically as the coating of oxide which forms on the aluminum plates used in electrolytic rectifiers or condensers. Such a film might be easily formed if the tantalum and mercury were momentarily separated, but when the surface of contact is entirely below the upper surface of mercury, one would hardly expect such a coating of oxide to repair itself after puncture. Another explanation might be that a thin film of air adhered to the mercury. This would prevent the latter from wetting the tantalum, but the same difficulty of explaining the self-restoring effect is met. If this thin film of air behaved as a liquid, it might be said that its surface tension repaired the break; possibly there is some such effect.

THE BOSTON EDISON RATE DECISION.

After a long investigation of the methods of charging and the rates of the Edison Electric Illuminating Company of Boston, the Massachusetts Gas and Electric Light Commission has gone squarely on record against the modified Wright-demand system used by the company, taking the ground that it is practically impossible to determine accurately the cost of supplying an individual customer, and so to proportion the charges that each customer will bear his proper share of the burden of furnishing him with service. Incidentally, a reduction in rates is recommended, but the broad general interest in the decision of the board lies in the fundamental discussion it presents of the intricate problem of central station rate making.

In summarizing its explanation of electric lighting costs the company has stated that the costs of an electric lighting company are actually the sum of what its customers' costs would be if they supplied themselves under the different conditions under which they consume current, less such deduction as is justified by the use of the plant by different customers, and such deduction as is justified by the greater economy of the company's larger plant. To make costs the basis the company divides its annual expenses into "fixed" and "running" costs. In the latter it includes only those costs which are reasonably certain to vary with the amount of current made and sold, including coal, oil and waste, water, station wages, carbons and incandescent lamps. All other expenses, including dividends, are included in "fixed" costs. The "running" costs are obtained readily by meter and operating expense records. The "fixed" costs for each kilowatt of station demand are obtained by dividing the fixed costs for the year by the number of kilowatts representing the maximum station demand. The customer's maximum demand is determined by the Wright indicator, but to allow for the fact that all the maximum demands do not come at the same time, the company modifies its rates by a so-called "diversity factor," which it defines as the ratio of the sum of its customer's demands to the actual station demand. Feeling that the cost of distributing current to small consumers is proportionally much larger than to heavy consumers, the company has introduced wholesale discounts to relieve the large customers of the excess costs occasioned by the smaller customers. A year's experience with the yearly contract lighting rate shows an average rate of 7.2 cents per kilowatt-hour; with the non-contract lighting rate, 14.2 cents; with the power rate, 5.6 cents, and with the elevator rate, where the demand system is not used, 8.5 cents.

The board points out that the justification of a system of individual rates must rest upon the practicability of ascertaining with reasonable accuracy the cost of supplying each individual customer, and of automatically apportioning this cost to him by the schedule of prices adopted. The board states that the ratio of a customer's maximum demand to the aggregate maximum demands of all customers does not, aside from the practical difficulty of ascertaining the ratio, determine the customer's proportion of the fixed costs, because actual conditions require the recognition of the so-called "diversity factors." In the year ended June 30, 1907, the maximum station load was 35,310 kilowatts as against over 48,000 kilowatts, the aggregate of the customer's demands as nearly as they could be ascertained or estimated. The diversity factors were not based upon the company's experience nor that of others supplying electricity under similar conditions. They are of the greatest importance, introduced to so correct the relation of an individual customer's maximum demand to the maximum demands of all customers that his responsibility for the station peak, and therefore of the company's investment because of it, shall be correctly proportioned. Accuracy in this process, according to the board, requires that before the "diversity factors" are used the "fixed costs" shall be divided as between lighting and power or any portion of the company's business to which they are applicable. "Such a division," says the board, "is obviously impracticable, and without it there is no demonstration that the resulting charge to the individual is proportional to his cost."

In its decision the commission states that even the "diversity factor" assumes that the cost of supplying the individual customer is based on certain average conditions, since the maximum demand may vary widely from time to time. It also criticizes the inclusion of dividends and general expenses of management in the fixed costs, and urges that it is doubtful if it is practicable, even though desirable, to ascertain the costs to the company of its individual customers and to apportion such costs in the prices charged. Finally, emphasis is laid upon the desirability of every public service charge being simple, definite and readily understood and applied.

In accepting the board's recommendation as to rate reduction, President Edgar states that the company does not wish to be understood as admitting the incorrectness of its theory of differential prices or the incompleteness of its proof that its prices are based upon cost. In view of the thorough study of the rate problem which all the parties in interest have given it in Massachusetts during the past year, and in the light of the board's decision, the continued ability of the demand system to stand the test of time will be an interesting matter to observe.

THE TRACKLESS TROLLEY FOR DUNDEE.

A number of interesting traffic problems have arisen lately in Great Britain, one or two of which we have commented upon. One of the newest, worthy of note not because of its importance so much as on account of the proposed solution, is that described in our contemporary, *Electrical Engineering,* of London. It seems that the city of Dundee feels a strong need for some traffic accommodation on the Clepington road. The traffic there is not sufficient to warrant the expense of a street railway, so that various form of motor buses have been under consideration. After a careful investigation made by a subcommittee of the tramway committee of the Dundee Town Council, during which the subcommittee inspected a number of so-called trackless trolley systems in service on the Continent of Europe, it has submitted a report recommending the installation of such a system on the route mentioned.

It will be very interesting, should the recommendations of the committee be followed, to watch the success of this system. Several years ago there was a good deal of talk about the advantages of the trackless trolley for routes where the traffic is light. But, with the exception of three or four installations in Europe, the decision seems always to have been in favor of a railway.

Among the systems inspected by the subcommittee was that at Monnheim, Germany. This connects Monnheim with the railway station of Langenfeld, the distance being about two and one-half miles. It has been in service for a number of years; when first started the traffic was light, but it has since built up a traffic sufficient to warrant the laying down of rails, which is soon to be done. The result here is precisely what was predicted would happen. The inexpensive trackless system saves the greater part of the expense of the street railway; it thus greatly reduces the risk and determines whether there is sufficient need for a railway. An incidental advantage of the system is that it can be so constructed as to make but slight change necessary in the overhead structure when the tracks are laid.

Another system inspected by the committee was that connecting the towns of Ahrweiler, Neuenahr and Walporzheim. This system was put in service a little over two years ago. In many places the streets are very narrow, the paving is rough, though between the towns the roads are fairly good. The motor-car carries baggage and draws a trailer seating twenty passengers. A speed of fourteen miles an hour is made, and it is said that the actual results show a consumption of energy of only 0.67 kilowatt-hour per mile run. This figure seems very low considering the unfavorable road conditions existing in places and the fact that the motor-car draws a trailer.

Still a third system investigated was that at Mulhausen, where it is said the most recent installation exists. This system was installed to connect the zoological gardens of the town with the electrical line. The company operating the latter said that the traffic was too intermittent to make an extension of its system profitable, and at the same time the grades were too steep for a railway to operate successfully, therefore a trackless trolley system was constructed and put in service during last May. The cars are light and well equipped and have been provided with emergency brakes. The subcommittee was so well pleased with the operation of this line that it recommends that a similar system, somewhat modified, be used for Dundee.

The advantages of the trackless trolley system are its suitability for just such conditions as have been described above. The greatest drawback of the system would be assumed to be the large energy consumption due to the fact that the cars do not run on rails, but if the figure given above is reliable, it is evident that a properly constructed car can be operated over moderately good roads without requiring an excessive supply of energy. The system, of course, avoids the expense of laying a track, and does not add this impediment to other traffic. It does, however, require two overhead wires, since a ground return is impracticable, but the overhead structure could generally be light and placed where it is least objectionable. It is evident, from the report to which we have referred, that very good speeds can be obtained. Fourteen miles an hour is fast enough for such light traffic as could be handled by a system of this kind. Possibly, when the success of these foreign installations is better realized, the system itself will receive more attention elsewhere.

A HIGH-TENSION TRANSMISSION DECISION.

Last March proceedings were begun by the Commissioner of Water Supply, Gas and Electricity of New York city against the New York Central & Hudson River Railroad Company looking to the compelling of the railroad company to place under ground its high-tension feeders supplying current to its electrical zone for the operation of its third-rail system. Hearings have been conducted before the Public Service Commission of the First District. While the commission does not approve of aerial transmission lines, it holds that as long as this line is safe, and the testimony and evidence presented, it avers, did not prove it unsafe, it would seem to be a great injustice to the company to compel it to destroy its present lines, and to place its high-tension transmission system under ground. Other suggestions made by the commissioner are either overruled or modified. The decision, on the whole, is favorable to the company and is an indication that this commission is not prepared to indulge in high-handed or arbitrary procedure.

During the hearings it was shown by testimony that in addition to the high-tension system of the New York Central and the Long Island Railroad system there are at present maintained in the city of New York, presumably under permits from the city, five hundred and thirteen miles of overhead line operating at from one thousand to three thousand volts, and forty-seven miles operating at from three thousand to eleven thousand volts, for electric light and railway service and strung along the public streets.

Ohio Electric Light Association.

Fourteenth Annual Convention, Held at Hotel Victory, Put-in-Bay, Lake Erie, August 25, 26 and 27.

THE fourteenth annual convention of the Ohio Electric Light Association, held at Put-in-Bay, Lake Erie, on August 25, 26 and 27, 1908, combined to a larger degree than ever before in the history of this association the social and the business elements. While the committees in charge of the entertainment features, which were many and varied, performed their duties with good taste, energy and judgment, the business features received equally adequate treatment and full preparation, so that the papers read were pithy and suggestive, and above all brief and to the point, and were business-getters. They brought out in nearly all cases full and free discussion. If the work of an association is to be judged by results in increased membership and better turnout of the membership to the conventions every year, the Ohio Electric Light Association is certainly maintaining its position as one of the best of the state associations in the country.

TUESDAY AFTERNOON SESSION.

Secretary Gaskill called the convention to order at two o'clock on Tuesday afternoon, and announced that in the absence of President F. M. Tait, of the Dayton Lighting Company, ex-President W. P. Engel, of Defiance, would preside during the opening session.

The first order of business was a paper by William M. Adams, of Elyria, Ohio, on "Gas Engines in Central Station Work." Mr. Adams advocated very strongly the employment of gas engines in place of steam where gas is available, on account of the decreased cost of operation, and he gave figures covering four years' experience with these engines.

Mr. Adams stated that his company had run two engines since a year ago last April and had never lost any time during that period. Last spring they remodeled the plant entirely and did not shut down one minute. These were two Westinghouse 280-horse-power, three-cylinder, and one Struthers-Wells of 258 horse-power. They use a single system of ignition, with a duplicate set of batteries so as to provide for a battery giving out.

He said that it takes a good man to run a gas engine. They pay more for gas engineers than for steam engineers when they find the right man. Where they could get a steam engineer for $65 they pay $70 or $75 for a gas engineer. The engine was guaranteed for 250 horse-power, twenty-five per cent overload. It ran twenty-five per cent over the guarantee. During one period of twenty-four hours it ran all the way from 250 to 330 horse-power under water rheostat test.

The next paper was entitled "A Report on Gas Producer and Oil Engine Plants," contributed by B. H. Smith, of the Lexington electric plant.

This paper describes a suction gas-producer plant operated by the Lexington Electric Light Company, Lexington, Ohio. This consists of a twenty-five-horse-power suction gas producer and a 100-horse-power producer gas engine. The dynamo is a seventeen-kilowatt, 125-volt, direct-current machine. The producer is an antiquated type built in 1902, using anthracite coal. With an average load of 10.2 kilowatts, and a run of five and one-quarter hours, 271 pounds of coal are consumed, including a stand-over loss of three pounds per hour. Deducting fifty-six pounds for stand-over, the fuel consumption during the run is 215 pounds, or 2.2 pounds per horse-power-hour or four pounds per kilowatt-hour. With coal at $4.90 a ton, the cost for fuel is one cent per kilowatt-hour. The entire cost, including oil, attendance, etc., is four cents per kilowatt-hour. The preparation of the plant for the run takes about an hour. Oiling the engine, cleaning and timing the igniters, cleaning, barring and blowing the fire in the producer, sum up the usual preparatory service. The engine receives the greater part of the attention necessary during the run. The igniters have given but little trouble. The repairs on the producer have not exceeded $5 per year. The upkeep of the engine will probably amount to $30 per year.

S. E. Folk, of Bryan, said he had been operating a Diesel engine for about a year with entire satisfaction. The economy of the engine has been remarkable, current at the switchboard costing three and one-half to four cents per kilowatt-hour, including interest, sinking fund, labor, fuel and all operating expenses. The maintenance has been much less and the labor less than with the steam engine had previously.

Bonds to the amount of $60,000 were sold for the installation of this plant. There is set aside $500 a month, which will pay the face of the bonds in ten years, and $250 a month for interest; so that it is expected to pay for the plant in ten years. The capacity of the plant is 300 kilowatts. The output varies from 900 to 1,500 kilowatt-hours a day, varying with the demand for motor load. The power-factor during the day is seventy per cent.

WEDNESDAY MORNING SESSION.

President Tait opened the Wednesday morning session and delivered his address, saying in part:

There has been a decided tendency during the past year for competitive electric companies in the same territory to consolidate, thereby effecting what is absolutely necessary for complete business and financial success in a public utility of any sort. It is only by the complete and absolute control of the electrical output in any community that a public service corporation can lower its production and distributing costs and thereby benefit the consumer as well as help itself.

Monopoly does not and can not successfully mean disregard for the public rights and welfare. The lighting company's responsibility increases in proportion to its complete and absolute monopoly of the lighting situation in its territory. The municipal ownership idea seems to be gradually falling behind. Each year is bringing the taxpayer to a better realization of the fact that "the public pays the bills."

Announcement was made by Secretary Gaskill that there was being held coincidently at the same hotel a convention of the Astronomical and Astrophysical Society of America, and suggested that the courtesies of the Ohio Electric Light Association be extended to them. The motion carried unanimously and the chair appointed T. D. Buckwell and L. Clifford Anderson as a special committee to wait upon Professor E. C. Pickering, president of the Astronomical and Astrophysical Society and communicate to him the action taken.

Professor Pickering, director of Harvard College Observatory, addressed the convention briefly and with evident gratification at the kindly reception and applause accorded him.

Professor Lord, professor of astronomy, Ohio State University, was also invited to address the association and returned his acknowledgments.

Secretary-Treasurer Gaskill submitted his report for the year, showing gross receipts of $1,815.56 and disbursements of $1,577.64. He congratulated the association upon the very active and successful work accomplished, characterizing the year as the most successful one in the history of the association.

C. R. McKay, of the Toledo Railways and Light Company, presented a paper on "Experience with Luminous Arc Lamps."

This paper describes the installation by the Toledo Railways and Light Company, in February, 1907, of some 547 luminous arc lamps of the General Electric type for series street lighting. This number has been steadily increased, until at the present time about 1,670 lamps are in regular service. The first few hundred lamps were operated from belt-driven Brush arc generators, which machines were gradually removed as the installation of twenty-five-cycle, constant-current transformers with mercury arc rectifiers and switchboard panels progressed. All the street lighting in Toledo is now effected by means of such lamps, which, for the most part, are spaced approximately 600 feet apart in the residence and outlying districts of the city, while in special cases the lamps are nearer together and set upon ornamental iron poles.

The lamps average from 320 to 324 watts per lamp, including line losses, as measured at the direct-current circuit terminals. The present 1,670 lamps, distributed over thirty-seven circuits, are trimmed by three trimmers, each provided with horse and buggy, and about one per cent of the lamps are in the shop as an average for adjustment or minor repairs.

Concerning the life of mercury arc rectifier tubes, there are many which have exceeded 2,000 hours life, and several have exceeded 3,000 hours life. The maximum recorded life of any tube up to June 1 was 3,589 hours and eight minutes. The average life of twenty-three tubes which burned out during May was 1,110 hours.

The chair called attention to the importance of arc-lamp efficiency and invited a full discussion, in the course of which Mr. Glosser (Marion) inquired if the lamps and tubes operated directly on twenty-five-cycle circuits without the use of frequency changers, to which Mr. McKay replied that no frequency changers are used in the operation of these lamps, the twenty-five-cycle current from the turbines being supplied to the constant-current transformers and delivered by them at the same frequency to the rectifier tubes, which in turn change the twenty-five-cycle current to a pulsating direct current.

Mr. McKay said that he doubted whether any motor-generator set would show up an efficiency much better than eighty-five per cent or eighty-six per cent at its full load; whereas the efficiency obtained by the rectifier system, as indicated by the tests given, is considerably higher than that; furthermore, it is to be borne in mind that by the use of constant-current transformers one is dispensing with any additional running machinery other than the generator itself. The attendance required in the operation of constant-current transformers with rectifiers is very little. In the station quoted, having some thirty-four sets, the work of handling the switchboard is done by exactly the same attendants who look after the other switchboard work in that station, which is a station of some 15,000 kilowatts capacity in the various systems. Practically none of their time is spent on the rectifier board except when they are plugging in circuits.

B. H. Gardner, of the Dayton Lighting Company, read a paper on "Best Ways and Means of Getting Out and Keeping Out Private Plants in Central Station Territory."

Mr. Gardner is of the belief that the primary fault to find with central stations is that too many of them still demand excessive rates for their service, these rates being based on quantity only, regardless of the quality of the load. There are still managers who think they can not go below some certain fixed price per kilowatt-hour which may represent average costs, while the truth is that they could afford to take on some kind of business at half the rates they have scheduled. For instance, there was recently a private plant purchased in a large city, although the parties wished to avoid the investment. The load would average from 200 to 300 kilowatts, and would be on from ten to fifteen hours per day. The central station refused to make any concession whatever, insisting on its lowest published net rate of three cents per kilowatt-hour, claiming it would lose money if the business were taken at a lower rate. This stand of the central station, combined with the fact that coal was cheap, explains why one private plant was installed.

To get out a private plant after the plant has once been put in operation is usually a very difficult task. The owner of the plant may be persuaded to close the plant down for a year, using the central station service during that year. It is advisable to take this business for the year's trial at a flat rate, this flat rate to be determined by the costs of the previous year. At the end of the year's test a long-term contract may be entered into at whatever rate the test shows the consumer is entitled to. There are not many people who will go back to a private plant after a year's use of central station service, provided, of course, this service is what it should be.

Mr. Elwell (Sidney) reported that in the case of several factories that were maintaining large steam plants and had their own dynamos he had had difficulty in securing their general lighting business, but had obtained some revenue for their night lighting. In a factory that had something like 200 lights wired up he would give it, say, a thirty or forty-light capacity, limiting the supply by fuse or circuit-breakers so as to avoid getting tied up to the extent of the full capacity, for which he would get no return.

W. C. Anderson reported that they had taken on a planing mill at a flat rate entirely off the heavy lighting hours and where the Edison main passed right by the place. An arrangement can be made with many planing mills not to use power during hours that artificial light is required. Mr. Messer reported that he furnished both power and light for the planing mills at Warren, and they used their refuse under their own boilers to make low-pressure steam for their dry kilns. He had furnished them power for four years.

Papers by J. F. Rothery, of the East Liverpool Traction and Light Company; C. A. Elliott, the Dayton Lighting Company, and H. Engle, Consolidated Gas and Electric Company, Youngstown, were read on the general subject of electric signs, outlining and other special uses of electricity as an adjunct to profitable central station work.

These papers were discussed as an entirety, and some interesting points brought out.

Mr. Buckwell (Toledo) referred to the introduction of motors for ventilating school buildings, an appreciated feature being that they are on from four o'clock in the morning until half-past three in the afternoon. When the school closes the motor is cut out.

Mr. Gaskill reported a similar installation in Greenville. When the schoolhouse was first built two gas engines were installed to operate two blowers, and they gave an unending amount of trouble, first because the janitor knew very little about their operation, second because it is difficult to get reliable small gas-engine units. The speaker, being on the board of education at the time, on tracing the matter up found that the repairs to the gas engine were running about $80 a year, and besides this a charge for gas. The board of education, after carefully considering the matter, decided to substitute electric motors. They are a strictly day load and average to the company about $10 a month. They have not caused the board of education a cent of expense for repairs since their installation.

In the absence of the author, the paper by F. H. Plaice, of Hastings, Mich., on "How Can We Best Increase Our Business?" was read by Secretary Gaskill.

E. D. Strickland, of Buffalo, Statesman-at-Large of the Rejuvenated Sons of Jove, addressed the meeting on the objects of the order.

Luncheon was served in the convention hall, after which the discussion of Mr. Plaice's paper was taken up.

WEDNESDAY AFTERNOON SESSION.

President Tait commented upon the statement by Mr. Plaice that "under the propaganda the addition is platted and the electric wires strung even before the streets are graded, so that when a house is built the service may be installed from the beginning." It may be a question whether the board of directors of the ordinary company would tolerate such an expenditure of money in advance of the business to that extent, but he believed that the majority of the central stations throughout Ohio are too backward in installing service for those who want it. It is certainly detrimental to install service where one is not going to get an adequate return; but he believed that occasionally it is necessary to stretch a point in order to get new business, and it is always possible to find out certainly just how much line one can afford to build, and if necessary to increase the minimum service charge for a year or two till the place grows up, with the understanding that as increasing numbers of the people connect themselves with the circuit the minimum charge will be reduced in proportion.

W. P. Engel related an instance where a line was erected to outlying territory, the consumer agreeing to pay $200 of the expense of erecting the line, with the understanding that as further connections were made he would be given a rebate; and under a flat rate of $1 minimum and ten cents meter charge per 1,000 watts the result was that in less than a year sufficient houses were connected to enable the company to make a complete refund to the original consumer.

Edward F. Gwynn, of the Delaware Electric Light and Power Company, presented the first of two papers on this question, "Should Central Stations Do Wiring" This was followed by a contribution on the same subject by C. C. Custer, of the Miami Light, Heat and Power Company, of Piqua, Ohio.

Mr. Gwynn, speaking from his own experience and especially in smaller cities of, say, 15,000 population and under, states that his answer to the question, Should central stations do wiring? would be, "Yes." He believes that this is necessary to properly serve and protect the company's patrons. Cities of this size (15,000 population) can support but one first-class wiring and construction establishment, and some cities can not do this. It should be the duty of the central station to look after all new buildings and see that the electrical installation is not being overlooked nor neglected. He believes that in small cities the average citizen has more confidence in the central station and prefers to deal with it rather than with a supply house or contractor.

Mr. Custer is of the opinion that the function of the central station is to generate and distribute electrical energy. It is to the central station's interest that house wiring be well done and the wiring business pushed, but this does not mean that the work must be done by the central station, nor that when so done it will be better wiring. It seems to him that this is a field where the central station should be a co-operator instead of a participator. It is possible to get good wiring done by private contractors, and such contractors should have the moral support and co-operation of the central station. When sure of this support he believes it is generally possible to get a sufficient number of responsible private wiremen to enter the field.

W. P. Engel was strongly of the opinion that central stations, whether large or small, should do wiring and should have a trouble man to look after every little detail of residence, store or factory, and in this way give more prompt service and eliminate kicks that this, that and the other was going wrong. He would charge the consumer for every renewal and every supply part used for repair, but there should be no time charge made in the bill.

Mr. Adams (Lorain) quoted the experience of the gas company in the introduction of gas stoves and the fact that by their going into the plumbing business they had so increased the use of gas stoves that they were now selling thirty per cent of their output for heating and cooking. He inquired why the same policy should not be followed with regard to electric wiring.

Mr. Selig (Mt. Vernon) reminded the convention that last year he had expressed himself in favor of central stations withdrawing from the wiring business and turning it over entirely to the contractors. A year's observation had further confirmed him in this opinion. In this way the central station enlists the assistance of the contractor, which often proves valuable.

Mr. Turner stated that in Cleveland about two years ago they initiated an instalment plan of payments for wiring, the wiring being turned over to certain contractors. The first year some 500 houses were wired, but the company was not satisfied with the general results, and had adopted another plan which gave promise of being more successful, and up to this time about 1,000 houses have been wired under it. It accomplishes results and at the same time keeps the central station out of any liability or responsibility, either legal or moral. The company solicits the wiring of houses under a flat price per outlet. The contract is then turned over to any reliable wiring contractor who will work under this plan, *viz.*, that he must undertake any houses turned over to him whether he makes or loses money on them, and his price for wiring can not exceed the printed schedule of flat rates at so much per outlet. The company gives the consumer credit on his electric light bill for fifteen per cent of the cost of wiring and fixtures up to a total of $15; that is, fifteen per cent on his total bill not exceeding $100 worth of fixtures and wiring. The fixture houses agree to sell fixtures also on the instalment plan of payment. The plan has been working out very successfully during the past year, and the incentive for the man wiring houses to do soliciting is that he turns the contracts over for the wiring of houses on a pro rata basis as to the number turned over to us that he has solicited.

J. S. Codman, of Boston, Mass., presented his paper on "Illuminating Engineering."

Mr. Codman believes that in co-operation with customers there is, at least in the lighting field, a good opportunity to bring down the cost, since the waste by customers, not only in converting electrical energy into light, but also in the use of the light itself, is something prodigious. This continual waste, unrealized by customers, leads to the impression that electric lighting is more expensive than is actually the case. The result is that many are afraid even to try it, and the growth of the business is stunted. One of the principal objects of the science of illuminating engineering is to prevent, or at least check, this waste, and some knowledge of its principles is of great value to those connected with the central station business. Much electricity is wasted by customers through the use of cheap lamps of low efficiency. This can best be remedied by the adoption of the wise policy of furnishing lamp renewals to customers, either free or at less than the market price. Another prolific cause of waste is the use of dirty lamps. The use of an unnecessary number of lamps is still another form of waste. Another cause, also common in residences, is the failure to make it easy to turn the lights on and off. There are other ways in which light is wasted which are not so obvious, and to overcome which some knowledge of illuminating engineering principles is necessary.

Professor F. C. Caldwell, of the Ohio State University, discussed in an able manner the leading points in Mr. Codman's paper.

D. L. Gaskill, of the Greenville Electric Light and Power Company, presented a report on the experience of central stations with tungsten lamps.

This paper is a recapitulation of the experience of a number of central stations using tungsten lamps for the last six months of a year. From this summary the conclusion is arrived at that the tungsten lamp has been in use for too short a time to judge fully as to its adaptability for general use. The price at present charged is exorbitant and will prevent its coming into general use unless reduced. The life of the lamp is shorter than that claimed by the manufacturers, or it does not permit of a wide range of conditions such as must be met by any lamp in general use. The brilliancy and the economy of the lamp are particularly good. While fragile, it has borne shipment with fairly good results. Discoloring of the lamps has not been bad, nor has such change affected the quality of the light. It is a valuable adjunct in meeting competition, and, where installed in the proper manner, gives excellent results from the illuminating standpoint. The larger units, as now made, are most desirable. Until the price is reduced the most satisfactory method of disposing of them to the consumers is through the supply houses.

George C. Osborn said that this report was convincing of the fact that the central stations in Ohio are enthusiastic users of the tungsten lamp. Considering the five installations as a whole and not in part, there were twenty-six lamps installed, and of this number eight were shown to have burned out, and eighteen, or seventy per cent of the total mentioned, are still burning. The average life of the early burned out lamps equals 397 hours; and the remaining eighteen, or seventy per cent, were still burning at the end of 382 hours. The total amount paid for the tungsten lamps, considering them at a price of $1.65, would aggregate $42.90; the total that would have been paid for carbon lamps would be $13.28, showing a differential of additional cost for tungsten lamps of $29.62. Five new installations were obtained involving the displacement of gas or gasolene at a cost to the central station at the present time of $6.27, eliminating the rental which will accrue from the seventy per cent of the lamps still on circuit. The report indicates that the installations were used on an average of four hours per day, and at a rate of ten cents per kilowatt-hour the income thus far received has been $100. Surely this is making one blade of grass grow where none grew before. Even with the apparent short-life showing made by this central station it can thus be seen that the use of tungsten lamps was of great benefit.

A successful method of satisfying a prospective customer on the life of tungsten lamps is to show him what the minimum life is that the lamp will pay for itself as compared with an installation of the same candle-power obtained with carbon-filament lamps on free renewal basis. In the above report, where the price of the lamp is given at $1.65 the 100-watt tungsten lamp pays for itself in current saved on a ten-cents-per-kilowatt-hour rate in ninety-two hours; and, therefore, in the average life shown above every lamp had paid for itself four times over, and seventy per cent were still in service.

THURSDAY MORNING SESSION.

Secretary Gaskill announced the banquet for Thursday evening, stating that it was free to all, whether active or associate members or guests. He urged a full attendance, as elaborate preparation had been made to make the occasion an interesting and entertaining one.

The nominating committee submitted their report, and at the suggestion of Secretary Gaskill action on same was laid over until just before the noon adjournment, in order that all might have opportunity to consider the nominations made. Later on in the session the report was taken from the table and unanimously adopted, electing the following as officers for the ensuing year:

President, C. R. McKay, Toledo.

Vice-president, J. C. Rothery, East Liverpool.

Secretary-treasurer, D. L. Gaskill, Greenville.

Executive Committee—F. M. Tait, chairman, Dayton; W. P. Engel, Defiance; M. E. Turner, Cleveland; W. F. Hubbell, Wauseon; L. G. White, Columbus.

Advisory Committee—Samuel Scovil, chairman, Cleveland; F. M. Tait, Dayton; D. L. Gaskill, Greenville.

Publicity Committee—E. L. Booth, chairman, Bellaire; W. A. Wolls, Columbus; W. C. Anderson, Canton.

Finance Committee—T. D. Buckwell, chairman, Toledo; L. C. Anderson, Franklin; T. D. Elwell, Sidney.

Membership Committee—W. J. Hanley, chairman, Cleveland; C. B. Rodgers, Tiffin; H. H. Cudmore, Cleveland; G. E. Miller, Cleveland; C. M. Lott, Hicksville.

The chair announced that the discussion on the tungsten lamp would be resumed at this time and called upon F. W. Willcox, of the General Electric Company, Harrison, N. J., to address the convention.

Mr. Willcox said the central station interests have cause for congratulation that the tungsten lamp is available. There are two features of this lamp that should cause all central station men to rejoice; one is that the efficiency obtained has been secured with a simple form of incandescent lamp. This has not been the case oftentimes in the evolution of a science or device; the tendency is generally to run to greater complication. That means a great deal of saving in investment and writing off of old apparatus, because the lamp simply replaces itself in the ordinary course of renewals, and therefore there is no antiquation. The report heard yesterday is also cause for congratulation as showing that in its inception, the lamp only having been six months in service, as shown by these reports, has acquitted itself so well. We have never had in the history of any developments any lamp that has shown the promise and performance that the tungsten lamp has. Other developments, such as the Gem, tantalum and improvements in the arc lamps have required much longer time and caused a great deal more complaint and dissatisfaction before finally arriving at satisfactory condition. It is now up to the central station to adopt some policy that will insure the lamps being introduced and the consumers given the benefit of it. As far as he can judge it seems that experience so far indicates that the most satisfactory policy will be a monthly maintenance charge for the lamp, which avoids the user having to pay full price of the lamp whenever one burns out.

The twenty-five-watt tantalum lamp should be seriously considered by central stations. This lamp is reasonable in price and, while it has not as large candle-power as the ordinary sixteen candle-power, yet, considering brilliancy, it is fully as satisfactory a lamp as the sixteen-candle-power. It is serviceable and more handy and durable than the tungsten lamp, and in conjunction with the tungsten lamp should find wide use in the improved economy which renders these new lamps necessary. The tantalum lamp has been materially improved in life since its introduction, giving a life on direct current well over 1,000 hours, and on alternating current of sixty cycles or less it is found that the light is about two-thirds of what it is on the direct current. It is reported from abroad that the German manufacturers are at present doing a larger business in tantalum lamps than in tungsten.

J. R. Cravath said that in regard to a question about the equivalent lighting value of the 100-watt tungsten lamps and gas arcs, he had occasion to figure out the probable relative value from theoretical considerations and arrived at the conclusion that under most conditions two 100-watt lamps would easily replace the ordinary gas arc. It would not do it where the gas arc was always maintained under ideal laboratory conditions, but we all know they never are maintained that way; it is a physical impossibility. Unless they are adjusted just right to give the maximum candle-power from hour to hour it can be pretty safely figured that two 100-watt lamps with reflectors will deliver as much useful light in the store as one gas arc.

W. C. Anderson, of Canton, said that in the matter of meeting gas cost, where there is natural gas competition it is absolutely an impossibility to meet the cost of gas; but customers are very glad to pay more money, not only fifty per cent more, but two or three times as much to get a satisfactory light. That has been proven very well, not with the tungsten lamp, because that has only been available a short time, but with other illuminants, the direct-current enclosed arc lamp and the Nernst lamp and the Gem lamp.

President Tait asked Mr. Willcox if it was fair to expect that the tungsten lamp will ever reach a development such that the price will go down proportionately as the price decreased on the carbon-filament lamp? For instance, the latter was bought years ago for $1.25 and they gradually came down to fourteen or fifteen cents during the course of five or ten years.

Mr. Willcox replied that there are so many factors involved that one can not give a definite answer, but from the present outlook it does not seem as if it could; yet that does not mean that something may not develop in the way of a cheapening process that one can not foresee now which will make it possible to bring that lamp relatively as low in cost as the carbon; but central stations must remember that we are dealing with a lamp that runs on one and one-quarter watts per candle instead of three to three and one-half watts per candle, and therefore even at the same cost it is going to be three times as high. Even at the same cost for equal candle-power the tungsten lamp renewal cost per kilowatt-hour will of necessity be three times as high as that of the carbon lamp.

Mr. Osborn said that those central stations that are selling the lamp at a high price are just as aggressive and getting just as many customers as those that are selling cheaper. The subject of rental basis is one that can be scaled down as low as one cares to make it, but the actual selling price of the lamp, if it was reduced in any case ten or fifteen per cent, would not affect its sale. If a reduction in price comes it will be better for a central station to pocket that difference and perhaps be more liberal on the question of early burnouts or trial installations, or a liberal policy generally in handling the proposition rather than to make a corresponding reduction in price which would hardly count for anything. The question of what the life is going to be is often asked; what the minimum life is in which the lamp will pay for itself. A lamp that will cost $1.80 will pay for itself ten times in 1,000 hours, so that it pays for itself at the end of 100 hours' use.

Mr. Gardner said that the Dayton Lighting Company charges a rental for one 100-watt tungsten lamp of twenty cents a month regardless of the number of hours that it may be used. If a man only burns his lamps about two hours a day they would actually get more, taking a basis of 1,000 hours, than it would cost to renew; in other words he would pay for his own renewals. If a man uses his lamps three and one-half hours a day he pays about as much as it costs to renew them on a basis of 1,000 hours. If he burns them ten hours a day it will cost the company about two cents per kilowatt-hour to renew those lamps, and at the same time it is getting eleven cents per kilowatt-hour for ten hours a day service. Twenty-five cents per lamp per month would assure a little better return; burning for five hours per day it would not cost anything for renewals.

H. M. Browne, of the Nernst Lamp Company, described the new Westinghouse Nernst units which are being placed on the market. These new units of single-glower type have screw base renewal and are made in sixty-six-watt, 110-watt and 132-watt sizes, both alternating-current and direct-current, 110 volts; eighty-eight-watt, 110-watt and 132-watt, 220 volts. The efficiency of the new unit on single-glower lamps will range from 1.2 to 1.4 watts per candle, with regular alabaster globes; on the multiple-glower, from 1 to 1.25 watts per candle, depending on the size of the lamp. On the holder of the multiple-glower type lamps we have a wafer heater. This wafer has a longer average life than a heater tube and costs very much less.

D. L. Gaskill read a paper on "Some of the Causes of Failure in Municipal Lighting Stations."

L. Clifford Anderson, of the Franklin Electric Light Company, read a paper on "Grounded Alternating-Current Secondaries."

E. F. Creighton, of the General Electric Company, delivered a very interesting address on the subject of protection from lightning, describing the many measurements made to determine the phenomena and effect of the current induced by lightning discharges and bringing out the main features of the new types of lightning protective devices which have been placed on the market.

After discussion and some routine business a recess was taken until 2.15 P. M., when the paper entitled "Gas and Gasolene Lighting Competition and Best Ways to Meet It" was read by Fred Leslie, of the Muncie (Ind.) Electric Light Company.

There was some further desultory discussion and the convention adjourned to meet when and where it may hereafter be determined by the executive committee.

One of the interesting events of the convention not upon the regular programme was the Rejuvenation of the Sons of Jove on Wednesday evening. The initiation was in charge of Jupiter H. H. Cudmore, of Cleveland, Ohio, and Statesman-at-Large E. D. Strickland, of Buffalo, N. Y. The Sons of Jove now number over 1,700. The initiates were: Charles L. Bogner, Cleveland Electrical Supply Company, Cleveland, Ohio; William A. Baker, American Electrical Heater Company, Detroit, Mich; William R. Collins, New York & Ohio Company, Warren, Ohio; F. R. DuGuay, Erner Electric Company, Cleveland, Ohio; H. O. Dutter, Bucyrus Gas and Electric Company, Bucyrus, Ohio; F. L. Finch, Union Electric Company, Pittsburg, Pa.; Warner Jones, Cleveland Electrical Supply Company, Cleveland, Ohio; T. J. Smith, New Lexington Electric Company, New Lexington, Ohio; E. L. Van Winkle, Post-Glover Electric Company, Cincinnati, Ohio; F. A. Williams, chief engineer Hotel Victory, Put-in-Bay, Ohio.

The annual meeting of the Sons of Jove will be held in Buffalo, N. Y., on October 15 and 16, 1908.

The entertainment committee arranged a number of interesting events for the attending ladies and delegates. Dances were held on Tuesday and Wednesday evenings; a progressive euchre party and a bowling tournament for the ladies on Thursday morning, and a vaudeville performance on Thursday evening, with volunteer talent. The ladies were also conducted on a trip through the caves. Music and songs were rendered on Wednesday evening by a colored quartette.

The following companies made exhibits:

Allis-Chalmers Company; represented by F. C. Colwell, Cincinnati, and S. Wolff, Cleveland, Ohio; exhibiting polyphase and direct-current motors, autostarter and transformer, rotating part of steam turbine showing internal construction.

Diamond Rubber Company; Edwin Williams, sales manager; large-sized National Electric Code cables; issued an attractive postal card.

Duncan Electric Manufacturing Company; Adrian Tobias, sales manager; showed a line of integrating watt and test meters.

The General Electric Company was represented by H. C. Houck, C. R. Wallis, Cincinnati; W. J. Hanley, H. B. Goodloe, Cleveland; L. R. Dunkle, Columbus; G. H. Stickney, Lynn, Mass.; George C. Osborn, F. W. Willcox, Harrison, N. J.; E. F. Creighton, R. E. Russell, Schenectady, N. Y. The exhibit especially emphasized the latest developments in tungsten diffusers. There was an interesting layout of tungsten lamps for church installation, showing fixtures with units grouped in an artistic way; also photographs of other unique fixture designs. Another feature was a new lamp-testing watt indicator for the purpose of making ocular demonstration to prospective customers of the relative watt consumption of metallic and carbon-filament lamps.

The Holophane Company; A. C. F. Keleher, New York; J. S. Codman, Boston, Mass.; line of new prismatic reflectors, giving ten per cent increase of candle-power; concentrators used for window lighting with very high ceilings.

The Ideal Electric and Manufacturing Company; Clarence E. Delafield, S. E. Huenerfauth, Mansfield, Ohio; new single-phase motor.

H. W. Johns-Manville Company; R. R. Braggins, manager electrical department, Cleveland, Ohio; exhibiting insulating material, fuse devices, "Linolite," service and subway boxes, friction tape, etc.

National Metal Molding Company; V. F. Gates, Cleveland, Ohio; metal molding.

Nernst Lamp Company; Max Harris, Pittsburg, Pa.; H. M. Browne, manager, Detroit, Mich.; showing new screw burner Westinghouse-Nernst lamp, made in four sizes, from fifty to 125 candle-power.

New York & Ohio Company; William R. Collins, Warren, Ohio; advertising literature.

The Sterling Electrical Manufacturing Company; W. F. Benedict, J. T. Donahue, Warren, Ohio; presented all comers with souvenir rules, tape measures, handsome celluloid blotting pads, etc.

Wagner Electric Manufacturing Company; Thomas T. Richards, St. Louis, Mo.; Dean Emerson and Paul Sentman, Cincinnati; switchboard instruments, etc.

Western Electric Company; George H. Porter, sales department, Chicago, Ill.; F. M. Shely, Cincinnati; arc lamps and Sunbeam tungsten lamps.

Westinghouse Electric and Manufacturing Company; J. W. Schrantz, Cincinnati; C. E. Miller, R. D. Nye, George S. Vail, Cleveland; H. H. Hughes, Columbus; Charles H. Davis, L. A. Starrett, S. A. Fletcher, J. O. Little, W. B. Wilkinson, Pittsburg, Pa.; fan motors of various sizes, electric irons and heating apparatus, glue pots, meters, etc.

The Ambos-Cudmore Company; H. H. Cudmore, Cleveland, Ohio; Weston Electrical Instrument Company apparatus, Eclipse voltmeters and ammeters, oil switch, Condit oil circuit-breakers, flexible conduit, etc.

The Adams-Bagnall Electric Company; represented by A. J. Mitchell, Cleveland, Ohio, who distributed court-plaster.

The Sanitary Pump Company; duplex reciprocating power pump operated by electric motor, manufactured for pressures up to 150 pounds, and in sizes up to 1,000 gallons per hour.

The Pittsburgh Transformer Company; ten-kilowatt Pittsburgh transformer, with silico-vanadium steel core.

Invincible Electric Renovator Sales Company, Cleveland; apparatus in operation sweeping the carpet in the hotel lobby.

Among other manufacturers and supply and material men in attendance were the following: American Electrical Heater Company; W. A. Baker, B. H. Scranton. American Electrical Works. American Shipbuilding Company, J. E. Ginn. Benjamin Electric Manufacturing Company; H. E. Watson. The F. Bissell Company; Fred Bissell, Frank M. Knierim, A. J. Gray, Joseph E. Lockwood. Bryan-Marsh Company; Fred W. Godfrey. Central Electric Company; W. D. Dunsmore. Cleveland Electrical Supply Company; L. Greisser, sales manager; Warner Jones. Doubleday-Hill Electric Company; Elliott Reynolds, W. D. Shaler. S. K. Elliott Electrical Company; S. K. Elliott, C. P. Billings. Electrical Appliance Company; F. J. Anderson. Erner Electric Company; F. R. DuGuay. Erner & Hopkins Company; H. B. Rogers, William A. Hopkins. Fort Wayne Electric Works; George B. Edgar, A. A. Serva. Federal Electric Company; James M. Gilchrist. Globe Electric Company; J. E. Swisher, A. B. Flagg. Hall Gas Engine Company; Marvin E. Hall. F. D. Lawrence Electric Company; Charles E. Kuntz. McKeever Electric Company. W. N. Matthews & Brother; V. L. Crawford. W. G. Nagel Electric Company; Harry E. Adams, A. I. Carney. National Carbon Company; N. C. Cotabish, A. G. Summerell, A. B. Pyke. Post-Glover Electric Company; Edwin L. Van Winkle. Robertson Electric Company; E. D. Strickland, manager publicity department. Standard Underground Cable Company; Le Loyne L. Parkinson. A. L. Swett Electric Light and Power Company; Arthur J. Howard, manager. Toledo Electric Company; Charles E. Yost. Union Electric Company.

French Cable Company Fined in Venezuela.

The Civil Court of the First Instance at Caracas, Venezuela, has handed down a judgment declaring the French Cable Company guilty of complicity in the Matos revolution against President Castro. The company is condemned to pay damages of nearly $5,000,000 and a further amount to be assessed later by experts. The company will probably appeal.

THE TEST-METER METHOD OF TESTING SERVICE METERS—IV.

BY JOSEPH B. BAKER.

COMMERCIAL TEST METERS OF THE MOWBRAY TYPE—THE GENERAL ELECTRIC AND FORT WAYNE TEST METERS.

It should be stated at the outset that by "test meter of the Mowbray type" is meant any specially constructed test meter of the type described in former articles having a number of field coils giving equal torque for any given percentage of full load on each coil, thereby enabling the meter to be used for testing through a wide range with constant high accuracy. Test meters so designed and used are to be distinguished from "portable standard" meters, either of ordinary construction and fixed capacity, as employed in the early days of meter testing, or of special construction and variable capacity, as exemplified in the Westinghouse portable standard integrating wattmeter. In using the term "Mowbray type" the author does not mean to pronounce upon the matter of priority of invention, patent rights, etc.

Fig. 7.—Thomson High-Torque Induction Test Meter.

ADVANTAGES AND COMMON FEATURES.

The General Electric Company and the Fort Wayne Electric Works are now putting out alternating-current test meters of the Mowbray type, which will be described in the following. Only the individual features of each will be dwelt upon in text and illustrations. For general discussion of the test meter the reader is referred to the matter on preceding pages.

In introduction, it may be well to rehearse very briefly the need which the test meter fulfils in the testing of consumers' meters, and the advantages claimed for the Mowbray type, the fundamental features of design which must be incorporated to obtain these advantages, and the features of operation common to all makes.

In regard to the need filled by the test meter, it is only necessary to call attention to the enormous increase in the number of consumers' meters in service and the higher standard of accuracy in the measurement of electric energy which is now insisted upon in modern central station companies.

While the General Electric and Fort Wayne test meters (see Fig. 7 to Fig. 15) differ in details of design and features of operation, certain fundamental features of design are common to both.

The most important is the composite field winding for obtaining a wide range of operation at maximum precision by securing a high torque in the moving element, constant for every field winding—*i. e.*, the same for any given percentage of full load on one winding as for the same percentage of full load on every other winding. Thus it is claimed for one of these test meters that the torque when using the smallest coil with one ampere passing is equal to that produced by using the largest coil with twenty amperes. The disposition and range of the composite winding and the method of effecting its various connections in order to adapt the test meter to the testing of different capacities of consumers' meters, differ between the two manufacturers.

Another important feature is the electrical method of starting and stopping the test meter—by a switch in the potential circuit.

The use of a register for counting the revolutions of the test meter against the revolutions of the meter under test is the outgrowth of the simple disc and pointer of the earlier test meters. While differing in actual design, the register is in both cases of simple (horizontal) form, with three dials, giving sufficient range of registration for practical testing purposes. It is located in the top of the test meter, with good-sized dials adapted for easy reading. The main dial is divided into hundredths, and its pointer is fixed directly on the meter shaft.

Portability of the test meter and accessibility of its parts have been sought. In both makes a neat carrying case, with lock and strap, are provided, and considerable ingenuity has been exercised to facilitate inspection and repairs. The arrangement of keeping the moving element out of contact with the jewel in transportation is regarded as a necessary feature of the test meter as a portable piece of apparatus. A simple and positive "locking device," operated by a thumbscrew, is employed.

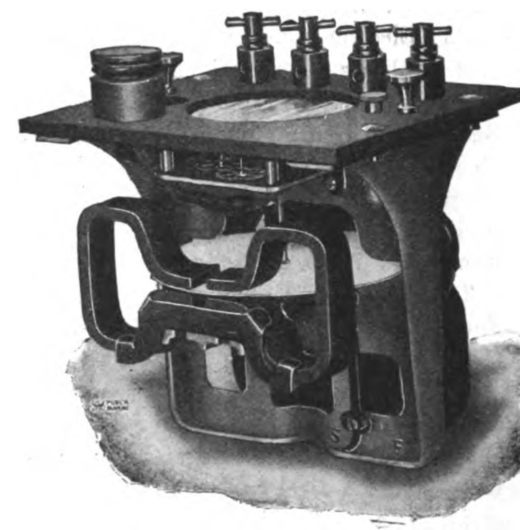


Fig. 8.—Working Parts of Thomson High-Torque Induction Test Meter.

In regard to the bearings, the manufacturers have realized the importance of providing minimum friction and maximum durability in order to maintain the maximum ratio of torque to mechanical friction. Both the General Electric and the Fort Wayne test meters of the present day are equipped with spring-supported cup-diamond jewel step bearings and removable pivots. The top bearings and shaft construction, however, differ in the two makes. The usual care in providing damping magnets of the greatest strength consistent with permanency, and a moving element of minimum weight are exercised in these test meters as in other modern commercial meters.

Certain other features of the several

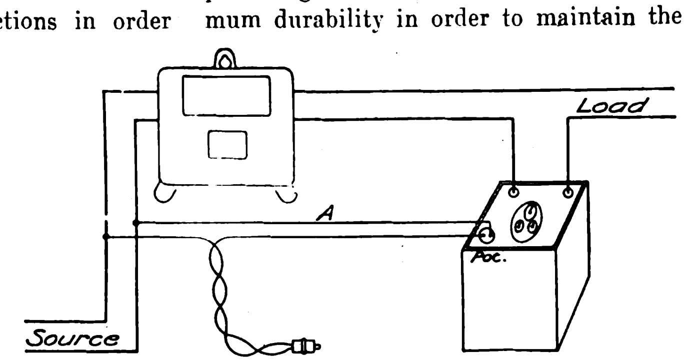


Fig. 9.—Connections in Using Thomson High-Torque Induction Test Meter.

commercial test meters, as meters, are common to all makes.

The operation of both the General Electric and Fort Wayne test meters is the same and may be described briefly as follows:[1]

The test meter should be placed convenient to the consumer's meter and the rotating element lowered onto the jewel. After making the proper connections for test meter and consumer's meter and ascertaining by temporarily starting the test meter (by closing the switch, which is in the potential lead for alternating-current meters) that its disc rotates in the counter clockwise direction, a reading of the register should be taken. Or, the main pointer may be brought to zero by manipulating the switch. The test meter should be started for the test simultaneously with the beginning of the count of the revolutions of the consumer's meter, and stopped after the desired number of revolutions has been taken. The register should then be read again, and the difference between the readings will give the total number of revolutions. The watt-hours registered by each meter are simply the product—quickly obtained on the slide rule—of its respective revolutions and calibrating constant. Since the constant is the watt-hours registered per revolution, the relative accuracy of the meter under test is shown by the ratio of the watt-hours registered by the two meters. A sufficient number of revolutions should be taken to make negligible any error in reading the test meter. As already stated, after the test has once been started it need not be stopped until the desired number of revolutions has been taken, as any change in the external circuit affects both meter under test and the test meter equally.

Fig. 10.—Calibrator with Cover Open.

In checking the test meter the same rules are followed as in testing standard meters, with the possible exception of the formula, which, with the constants usually furnished with the test meter by the manufacturer, becomes:

$$\frac{3600 \times \text{revolutions} \times \text{calibrating constant}}{\text{seconds}}$$

= watts registered by test meter.

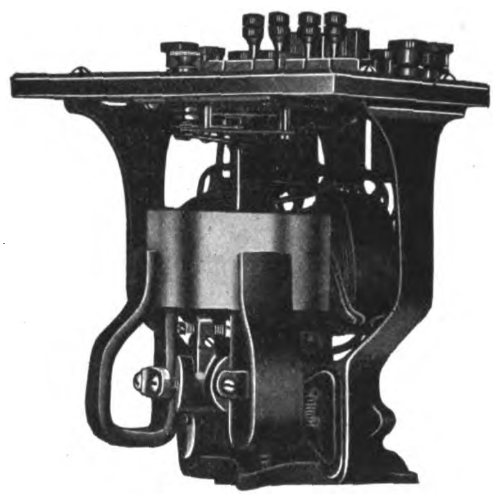


Fig. 11.—Calibrator Removed from Case.

Calibration of the test meter is most readily done in the test room by the indicating-instrument and stop-watch method, the necessary adjustments being made in the same way as in the regular consumers' meters of each manufacturer; any special devices are described.

GENERAL ELECTRIC COMPANY TEST METER.

The Thomson high-torque induction test meter, type IB-2, manufactured by the General Electric Company (Fig. 7 to Fig. 9), is designed for testing 110-volt alternating-current meters of three-ampere to twenty-five-ampere normal capacity.

Special features of this test meter, described in detail below, are the simplicity of the connections to the test meter and of the general design, extremely high torque, astatic magnet system, and special calibrating devices.

The test meter is contained in a case nine and one-half inches by eight inches by seven inches, with hinged cover. The register has three dials and the ratio between gears is ten to one, so that the second dial reads in units and the third in tens of revolutions. The units and tens dials are placed inside the main dial. The standard three-dial register permits a three-minute test at full load to be made, as the full-load speed of the test meter is lower than thirty-five revolutions per minute. No current leads for connections between test meter and consumer's wiring are provided, but the potential circuit is wired to a receptacle in the top plate of the test meter, and a flexible lead is provided having a plug at one end for inserting into the receptable and a pendent snap switch near the other end by means of which the potential circuit may be closed and opened from a distance.

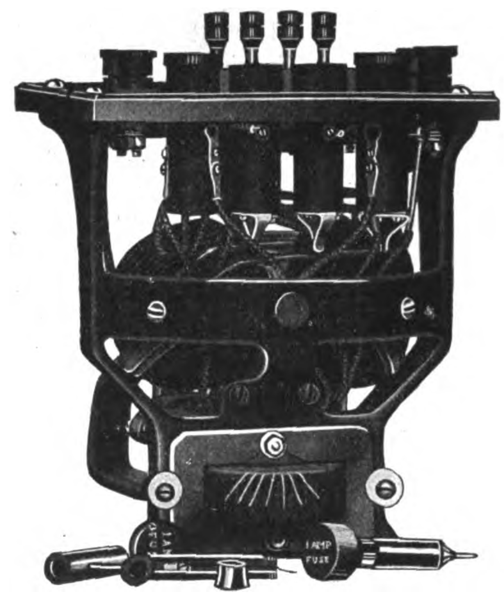


Fig. 12.—Back View of Calibrator Removed from Case.

As shown in Fig. 7 and Fig. 8, the test meter is assembled on a central frame hung from the plate which forms the top of the test meter when the cover of the case is opened. The register dials are in the middle, and along the rear edge are four heavy binding-posts for the current connections. The binding-posts are of simple and rugged pattern, adapted for making "solid connections" with ordinary wire leads. A little to the right of the dials is the thumbscrew for the locking device, and at the left is the receptacle for the potential plug. By means of a pair of buttons, one at each side of the top plate, the test meter may be lifted bodily from its case to make it accessible for calibration or repairs. As shown in Fig. 8, when removed from the case the test meter may be set down resting stably, in a vertical position, on the botton rib of the frame casting. The single-potential winding with which the test meter is equipped may be used on voltages ranging ten per cent on either side of normal (110

[1] The appropriate current coil—i. e., the coil of capacity nearest approximating the load under which the consumer's meter is being tested—should be connected in series with, and between, the meter under test and the load, and the potential coil should be connected across the line between the mains and the meter under test.

volts). There are three current coils, one end of each being connected to a common binding-post, and the other ends to each of the three remaining current binding-posts, marked with the respective ampere capacities of the coils, one, ten and twenty.

In general construction, the Thomson high-torque induction test meter compares well with any make of test meter, as may be seen without need of lengthy description, by an inspection of Fig. 8. Calibrating on full load is effected by loosening the two clamping screws that hold the magnet shoe and then moving the magnets bodily. This illustration shows the general accessibility of the parts. Light-load adjustment is obtained in the usual way by moving a lever at the bottom of the test meter to the right or left, thereby shifting a small rectangular conductor in the space between the potential winding and the disc; the distortion of the flux thus produced accomplishing the desired result without affecting the full-load calibration. The top bearing is a simple hole drilled in the bottom plate of the register.

It is stated by the maker of this test meter that it possesses a constant accuracy throughout a range of 200 to 1, *i. e.*, from a two-kilowatt load down to a ten-

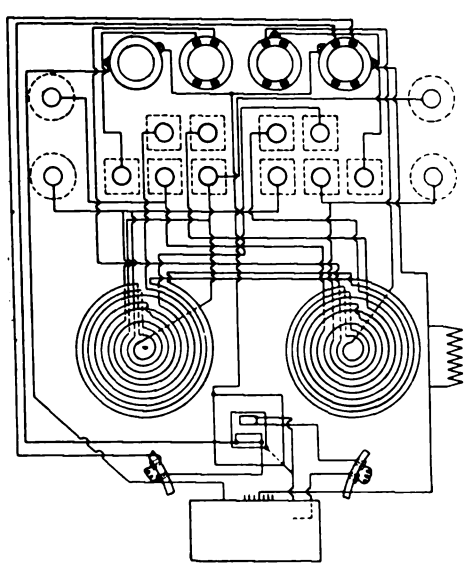


FIG. 14.—WIRING OF CURRENT-COIL SECTION TO PLUG SWITCH.

watt load, and that negligible error is introduced by ten per cent changes in voltage or frequency.

The correct connections of the Thomson high-torque induction test meter for testing a regular two-wire, three to twenty-five-ampere type I Thomson high-torque induction meter are shown in Fig. 9. The testing procedure is the same as already described in the general discussion of commercial test meters of the "Mowbray type."

THE FORT WAYNE ELECTRIC WORKS TEST METER.

The Fort Wayne type of test meter, the portable wattmeter calibrator, type

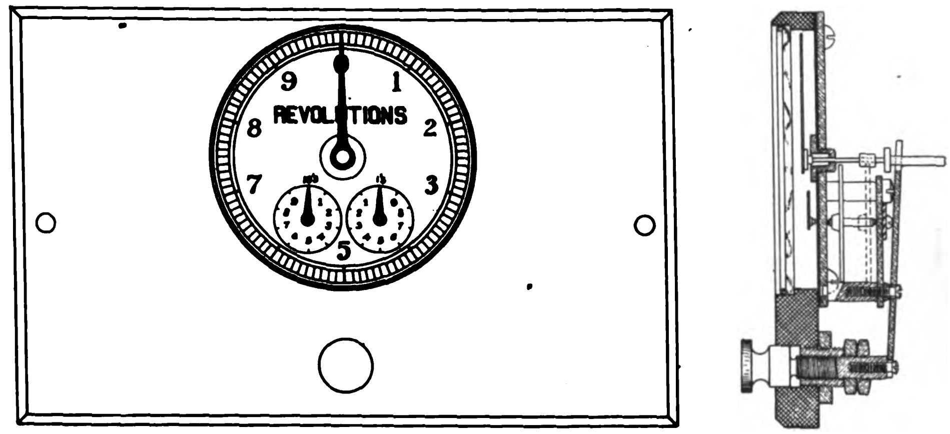


FIG. 13.—REGISTER MOVEMENT AND DIAL OF CALIBRATOR.

KM-1, manufactured by the Fort Wayne Electric Works, is one of the most recent additions to the growing family of test meters.

This "calibrator," which is shown in the general views, Fig. 10 to Fig. 12, is designed for testing alternating-current meters, covering the range of most 110-volt and 220-volt meters in service on two-wire and three-wire circuits from light load to full load. Special features of the calibrator, described in detail below, are its wide range, the plug-switch method of cutting in the different field-winding combinations, the provision of fuses to protect the one-ampere field winding from accidental overloads, the use of the Fort Wayne type of "cap" instead of the flat disc that is employed in meters of other types, and the general accessibility of the calibrator.

The calibrator is contained in a mahogany carrying case eight inches by eight inches by ten and three-quarters inches. The register (Fig. 10 and Fig. 13) is in the front section of the top plate, and consists of a main dial two and three-quarters inches in diameter, and two smaller ones within the main dial. The ratio between gears is ten to one, so that the second dial reads in units and the third in tens of revolutions. Flexible current and potential leads are provided, the former being a four-conductor cord with punched meter terminals at one end and cable connectors at the other end, all stamped with distinguishing letters to facilitate the making of correct connections with the calibrator and the consumer's wiring, respectively; and the latter a two-conductor cord with a pendent snap switch cut in on it for closing and opening the potential circuit of the meter, and having plugs at one end for connection to the potential receptacles on the meter and spring clips at the other end for connecting to the line. One of the cable connectors of the current leads and one of the line connectors of the potential leads are stamped plus (or minus), to facilitate the correct poling of the calibrator.

Referring to the illustrations, the calibrator is fitted with a hard-rubber top

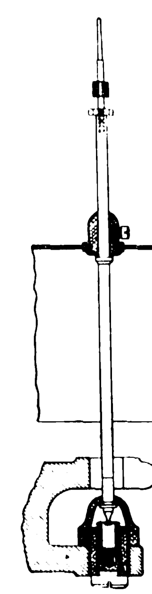


FIG. 15.—STEP-SHAFT BEARINGS.

plate, in two sections, which contains all of the devices used in the operation of the calibrator in the testing of meters.

The front section, which contains the register, as already described, is supported by the frame of the meter, which in turn is supported on the bottom of the carrying case. Directly in front of the register is located a knurled thumbscrew for operating the "locking device." Turning this screw to the right raises the rotating element and locks it firmly for transportation, out of contact with the jewel, and turning the screw to the left lowers the rotating element onto the jewel. The rear section which is supported by the frame, like the front section, contains the four current binding-posts (two at each end of the plate) and the two potential receptacles (in the middle of the plate) one for use on 110 volts and the other for use on 220 volts, both provided with caps to prevent dust from entering the calibrator when the plug of the potential lead is removed. On each side of the potential receptacles is a receptacle for a one-ampere fuse, consisting of a piece of ordinary fuse wire mounted in a fuse chamber of special design. The front middle part of the plate is occupied by the plug switch which is used for effecting the various combinations of the two current coils with which the calibrator is equipped to give the latter the necessary range of capacity. The current coils are wound in sections which may be connected by means of the plug switch in series, series parallel, or parallel in conjunction with the cable connectors on the current leads. The wiring of the current-coil sections to the plug switch is shown in Fig. 14. The windings selected as most suitable for meter testing are of one, two, five, ten and twenty-ampere and 110 and 220-volt capacity. With these windings meters up to and including twenty-five amperes, two wires, either 110 or 220 volts, and up to and including twelve and one-half amperes, three wires, 220 volts, may be tested.

The top and step-shaft bearings are shown in Fig. 13 and Fig. 15. The top bearing is located in the top plate of the register and is easily accessible by removing the glass, which is held in place by a spring brass ring and the pointer over the large dial. The top bearing may then be unscrewed for inspection. It consists of a simple brass stud tapped into the register plate and drilled for the reception of the upper end of the shaft.

As already stated, accessibility is a feature of this test meter. The entire meter may be lifted out of the case by removing the screw under the strap in the bottom of the case. All of the connections are made on the rear section of the top plate, so that the register and rotating element may be removed without interfering with the connections or altering the calibration. The shaft is made in three sections as shown in Fig. 15, the top-bearing pivot, the shaft proper and the jewel pivot. The joint between the top-bearing pivot and the main portion of the shaft is made just below the bottom plate of the register.

The Care and Maintenance of Storage Batteries.

If the operator in charge of storage batteries, says F. A. Warfield, will always remember that his batteries will do so much in a given time and no more; that they must be used and treated as carefully as an engine and generator; that any attempt to make them do more than the company which furnished them guaranteed will only involve failure, dissatisfaction and expense, he will have mastered the substance of the best set of instructions for their care. A potential of 2.15 volts per cell is required to start the charge and the author has usually obtained the best results by charging at fifteen per cent above the normal rate, maintaining this rate until the voltage reaches approximately 2.5 per cell. At this point the current should be reduced to the normal rate and the charge continued until the voltage stops rising. When charged in this way the voltage will rise rapidly from 2.15 to 2.25 during the first hour, then slowly until 2.45 volts per cell is reached, then it jumps to nearly the maximum value, at which point it remains practically constant, giving off gas freely at the positive and negative plates, while the solution remains perfectly clear. Under ordinary operating conditions a battery may be considered fully charged when the voltage reaches a constant value, but at least once a week this method of determining the state of charge should not be relied upon. There are three ways of determining when a battery is fully charged: When the voltage reaches a constant value; by the color of the plates, and by the specific gravity of the electrolyte reaching a maximum constant value. It is very important that the battery be fully charged, but it is just as important that it be not overcharged, and to prevent this the specific gravity of the individual cells should be taken at least once a week with a hydrometer as a check upon the voltage readings. Usually a charge twenty per cent in excess of the normal discharge is required. And about once in two weeks an overcharge should be given. This is done by charging normally until the full charge has been given; then the current should be dropped to one-half the normal rate and continued for three or four hours. While doing this the specific gravity will be found to rise for an hour or more after the voltage has become practically constant and the overcharging should be continued until the specific gravity itself becomes constant. If, in case of an emergency, it becomes necessary to charge more quickly than usual, the charge may be started at twice the normal rate and continued until the battery commences to gas and the voltage reaches 2.6 per cell. At this point the electrolyte will have a milky appearance and the battery will be gasing freely. The current should then be reduced to one and a half times the normal rate and the charge continued until the voltage reaches 2.6 again, when the charging current should again be lowered. When a battery is used spasmodically or is kept floating on the line it is a good plan to discharge it at least once every two weeks and then overcharge. The temperature of the cells should never be allowed to go above 100 degrees Fahrenheit, the temperature of the cells near the middle of the battery being watched to prevent this. The best results are obtained when charging with the temperature between seventy and ninety degrees. The electrolyte should be maintained at least one inch over the tops of the plates and the specific gravity should be between 1,200 and 1,225 when fully charged. The following rules should be observed: Never discharge a battery below 1.75 volts; never adjust the specific gravity by adding acid until the cause of the low specific gravity is known; never allow the acid to get below the standard level; always maintain the acid at the standard specific gravity; never let the battery stand in a discharged condition; at frequent and regular intervals give the battery a good overcharge at a low rate; keep the battery and all connections clean; keep all connections tight; remedy all trouble immediately, and use only pure water and pure acid for the electrolyte. —*Electric Journal* (*Pittsburg*), *August.*

The Telephone in Advertising a Play.

During the week a novel use was made of the telephone directory in New York city to advertise the play "Paid in Full." The scheme was to call up every regularly listed telephone subscriber and use a set form of message in apprising the called party of the play and an invitation to be sure to see it. In elaborating the scheme lists of the newly arrived guests at all the leading hotels were secured, and they, too, were reached by telephone.

The Korn System of Image Transmission.

A Detailed Description of the New Apparatus.

By C. L. Durand.

IT will be remembered that Dr. Korn brought his image-transmitting apparatus from Berlin to Paris last year, where it was set up in the offices of the illustrated weekly *L'Illustration* in order to make a public demonstration as to sending the photographs over a wire, and this was quite successful over a long-distance line. Since then the journal decided to take up Dr. Korn's system on a practical scale for newspaper work, and it accordingly had a set of improved apparatus constructed by the Carpentier firm, the successors of Ruhmkorff, who are noted for instrument work on the Continent. One of these instruments is now set up in the building of *L'Illustration* at Paris, where it occupies a special laboratory devoted to this purpose, with a dark room for developing the photographs which are received. The corresponding instrument is in operation at London in the office of the *Daily Mail*. The Paris apparatus is also in connection with one of Dr. Korn's instruments which is set up at Berlin. The transmission between Berlin and Paris is all that can be desired at present and a transmitted photograph of Dr. Glatzel, who is in charge of the Berlin station, is shown herewith. Owing to the compensating selenium method, which is one of the original features of Dr. Korn's method, the details of the photographs are reproduced with great clearness, and the views can be sent within a reasonable length of time. The line between Paris and London includes a telephone cable across the channel, and owing to the inductive effects of the cable the results have not as yet been all that might be expected, but it is hoped to secure a good transmission in the near future.

The station at Paris is in charge of Jules Chatenet, who has kindly furnished the writer with the following points about the new apparatus. Dr. Korn's compensating method, which has not been well understood up to the present, is here described in full, and it is of great interest from a physical standpoint as well as of a considerable practical value. No doubt it will be used in the future by all inventors who are at work upon image-transmission devices. There seems nothing left to be done in the way of transmission of photographs, as Dr. Korn has now solved the problem in a thoroughly practical manner and with remarkable results, but there still remains the attractive and difficult problem of direct vision at a distance, which is far from being solved at the present time.

Each of the complete apparatus contains a transmitter and receiver, and these are mounted side by side upon a suitable support with a motor placed underneath. By changing a lever, the motor mechanism is made to drive either the transmitter or the receiver.

REPRODUCTION OF ELECTRICALLY TRANSMITTED PHOTOGRAPH.

Referring to the outline diagram of the transmitting apparatus, which is shown in Fig. 1, the beam of light is furnished by a lamp which is enclosed in a sliding tube L. For this purpose a Nernst lamp is preferred. By means of a large lens M, placed in front of the lamp, the beam is sent along the chamber to the left, where it reaches a second sliding tube B. This tube contains a lens and at the farther end is a small diaphragm opening which allows a beam of very small size to pass through. The photographic film or positive image which is to be transmitted is wrapped around a glass cylinder A, and this is rotated in a regular way by means of the shaft E. The synchronous motor is made to drive the vertical shaft by means of a suitable mechanism. At the same time the shaft is raised gradually by a screw thread which it carries at the lower part, thus giving a rotating and a vertical movement to the cylinder after the manner of a phonograph cylinder. In this way the beam of light is made to cover all parts of the photographic film. Generally a positive film is used for the transmission, as this will give a negative image at the receiving end. However, a negative film can be employed if desired, in which case the effect is reversed. After passing through the film the beam is received in a total-reflecting prism C, which directs it vertically and allows the light to fall upon the selenium cell D, the light being diffused over the whole surface of the cell. In this way the opaque or transparent parts of the film come into the path of the beam and this action causes more or less of the light to be stopped off. The selenium cell thus receives varying intensities of light which correspond to the different portions of the photographic film.

The receiving apparatus (Fig. 2) is mounted parallel to the transmitter and, like it, consists of a main horizontal chamber with a vertical chamber at one end which receives the rotating cylinder. The mounting of the lamp tube L and the lens M is the same. From this point the beam passes along the chamber and first traverses the galvanometer device W, which is used for cutting off more or less of the beam, according to the amount of current passing in the line. The prism F is not in use when the receiver is being operated, and in this case it is moved to one side and out of the path of the beam so that the light is made to pass through the diaphragm opening E and the adjustable tube D, which contains a lens for concentrating the beam upon the receiving cylinder. The latter cylinder is shown at A, and it is considerably smaller than the transmitting cylinder. Around it is placed a sensitive photographic film which receives the beam, narrowed to a point by a diaphragm. Means must be provided to keep the cylinder A in the dark, after the manner of a roll holder. This is carried out by a tight box B, which contains the cylinder, and the shaft which rotates the cylinder is connected by a coupling piece K to a short piece of shaft which passes through the bottom of the box. As the cylinder has an upward movement like that of the transmitter cylinder, there is provided a long sliding cover CC which is permanently fixed on the end of the tube D and it runs in a groove in the box so as to keep it always covered. There is also a slide which is placed on the box between the cylinder and the tube D (not shown here), so that by closing it the box as a whole can be removed for developing the film.

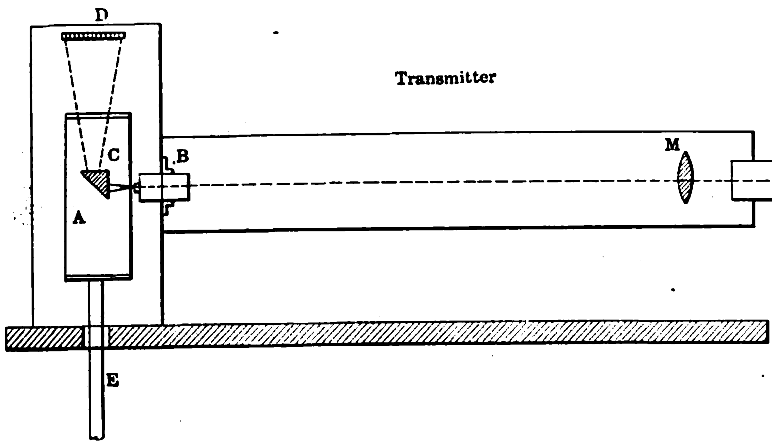


FIG. 1.—THE KORN TRANSMITTER FOR IMAGE REPRODUCTION AT A DISTANCE.

For intercepting a greater or less amount of light, according to the current sent into the receiver, a device which was designed by Dr. Korn is used. It is shown at W, and consists of an electromagnetic shutter which has a small screen moving back and forth in the path of the beam. The movable part T is inserted from the top and lies between the poles of the strong electromagnet N. Openings in the poles allow the beam to pass through. Referring to the detail view of the part T (this can also be seen in one of the photographs), it consists of a supporting rod *a a* upon which is mounted a double stretched wire *b*. For this purpose a fine platinum wire is used. In the middle is mounted a small square of aluminum foil which is exceedingly light. The current coming from the line is made to pass in the platinum wire, and as it is placed in the strong magnetic field the system is displaced to one side and away from the centre as the current passes. The amount of the deflection depends on the strength of the current, but it is not proportional to the latter, as will be mentioned further on. The lack of proportionality is compensated for by a diaphragm placed in the path of the beam at E, which has a triangular opening, so that the amount of light falling on the photographic film is nearly proportional to the current in the line; that is, to the amount of light which has passed through the varying parts of the original image, causing the resistance of the selenium cell to vary in the usual way. Hence, for each part of the original image, light or dark, we have a corresponding resistance of the selenium cell and a corresponding current in the line, giving a greater or less amount of movement to the electromagnetic shutter and hence a corresponding impression on the receiving film.

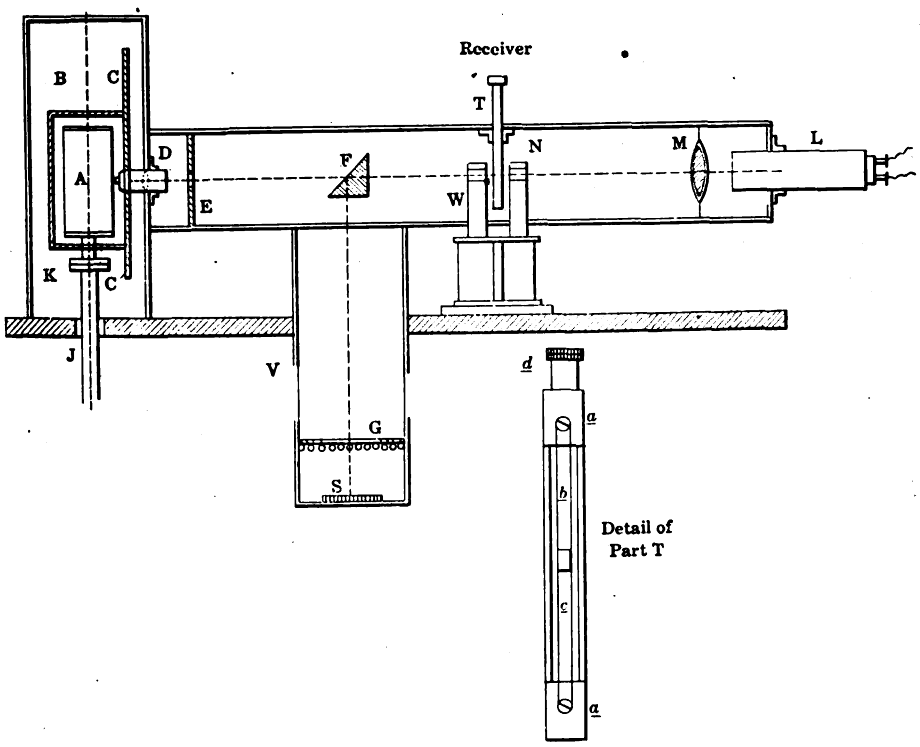
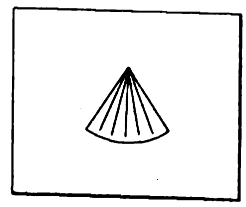


FIG. 2.—RECEIVER OF KORN SYSTEM OF IMAGE TRANSMISSION AT A DISTANCE.

The portion of the apparatus shown at V, including the prism F, does not properly belong to the receiver, but is used in connection with the transmitter when the receiver is not working. This part forms the compensating device which is one of the most ingenious parts of Dr. Korn's apparatus. It is found a great advantage to use a second selenium cell in connection with the main cell in order to overcome one of the main difficulties which is found in the use of selenium, that is, the "inertia" of the cell. As is well known, the cell does not respond at once to the effect of the light which falls upon it, but there is a certain interval of time, or lag, in the change of resistance which takes place. Again, when the light is removed the cell does not come back at once to the original state. This inertia of the selenium has been a serious drawback in the use of selenium cells for the transmission of images, both as concerns the sharpness of the image and the rapidity of transmitting. In order to overcome the effects of the inertia Dr. Korn uses a second selenium cell which is connected electrically with cell No. 1, both cells being placed at the sending station. Cell No. 2 receives light at the same time as No. 1, and the light sent upon both cells depends upon the thickness of the film, but cell No. 2 does not receive the light directly. For this purpose an electromagnetic shutter and a second beam from a lamp are used to throw light on cell No. 2. The



TRIANGULAR DIAPHRAGM PLACED BEFORE THE LENS TUBE (AT E) FOR CORRECTING THE LACK OF PROPORTIONALITY IN THE ELECTRO-MAGNETIC SHUTTER.

shutter receives current from the circuit of cell No. 1. In this way the effect on cell No. 2 is somewhat the same as if it had been lighted directly from the image. The combined current from both cells is now sent into the main line, as will be explained below, and the result is that such current shows but a small amount of lag with reference to the moment of changing the light upon the selenium cells and this practically overcomes the inertia of the cells when in combination, although each of the cells is unchanged and possesses the usual amount of inertia. The method of compensating can only be explained clearly by the use of curves in order to show the resulting effect. The main points as to the compensating method will accordingly be brought out in the theoretical account which follows.

Each of the instruments, transmitter and receiver (Fig. 3 and Fig. 4), is operated by a synchronous motor which will be observed in the engravings. To the motor shaft is connected the mechanism which is used for operating the cylinder in each case. The gearing which drives the cylinder shaft is arranged so that it can be varied by shifting a lever so as to give the normal speed or a slower speed. Usually the normal speed is employed, which gives the transmission of the image in about twelve minutes. Each of the synchronous motors is operated from a local storage battery by direct current. The armature of the motor carries also a ring collector at the other end, and from it can be taken alternating current. Such current is used for operating the frequency indicator. This latter instrument is shown in its essential parts in Fig. 5. A main electromagnet carries the coil W, and the laminated pole-pieces P P′. Attached to the pole-piece P are three tongues of spring steel, A, B, C, which are separated from the second pole-piece by an interval. The tongues are made to vibrate on the passage of alternating current, provided they are tuned so that their normal vibration period corresponds to the frequency of the current. In practice the three tongues are tuned so as to vibrate at 99, 100 and 101 periods, respectively. The upturned ends of the tongues are made to face a dial plate with the corresponding numbers engraved upon it, as will be seen on the right. When the frequency is at ninety-nine cycles, only the first tongue will vibrate. For 100 cycles the second tongue vibrates, etc. For ninety-nine and one-quarter cycles No. 1 vibrates in a smaller amplitude and No. 2 in a still smaller one; at ninety-nine and one-half Nos. 1 and 2 vibrate at a reduced and an equal amplitude. In this way the speed of the motor can be adjusted at each station so as to correspond. As usual in running synchronous motors the motor of station No. 1 (transmitter) is run somewhat slower than motor No. 2. When the cylinder shaft of No. 2 has completed its revolution, it thus arrives at this point somewhat before No. 1, and it is stopped automatically by a pawl. As soon as No. 1 comes to the same point, a current is sent into the line which operates the release of No. 2 by means of an electromagnet. Therefore both shafts start together for the succeeding revolution, and so on. Motor No. 1 is set by the synchronizer at say ninety-nine, while the second operator sets his motor at 101. The stop in the revolution of No. 2 is exceedingly short and does not affect the transmission. At this time a battery current is sent over the line and it is received in a sensitive relay which operates the electromagnet of the releasing device. At the same time the current

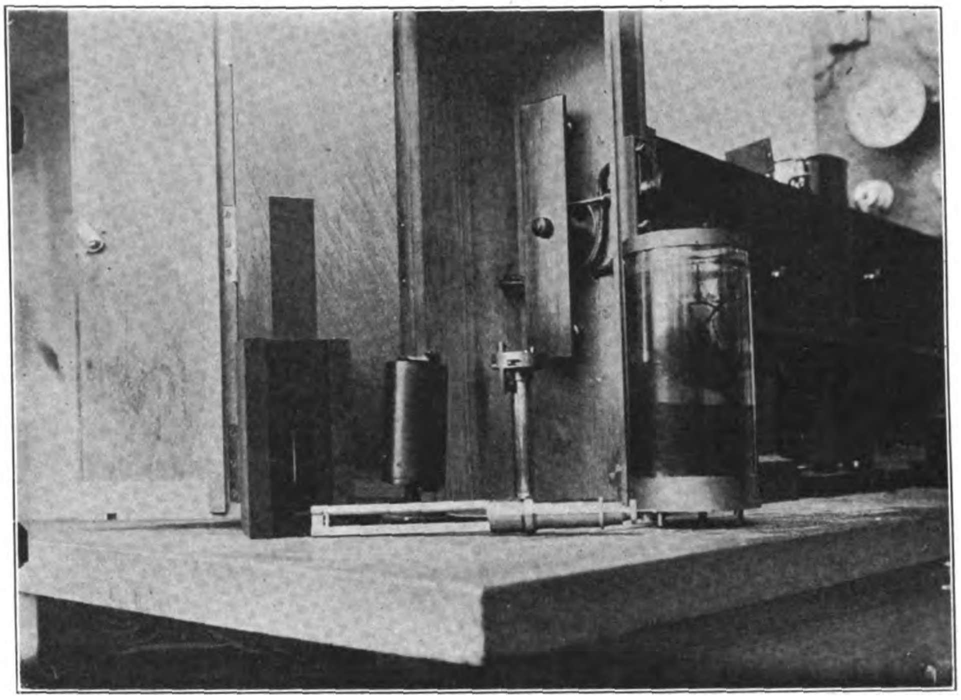


Fig. 3.—One End of the Receiver, Showing Transmitter Cylinder, Motor Shaft, Cylinder, Electromagnetic Shutter and Dark Box.

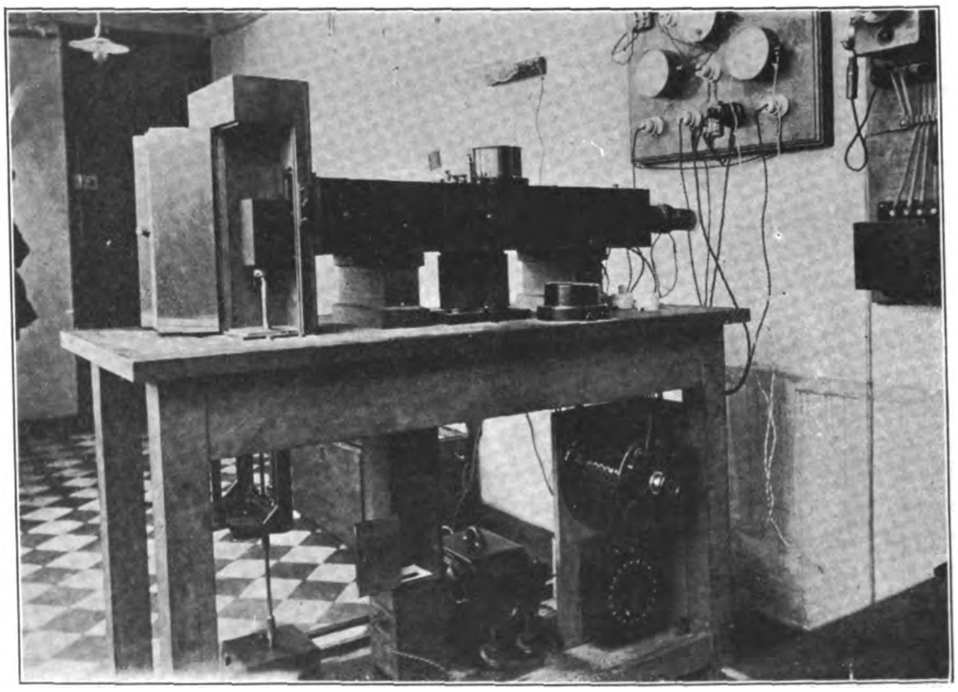


Fig. 4.—Receiver with Dark Box in Place. The Vertical Column is Seen Below, with the Compensating Cell.

from the selenium upon the line is broken automatically for an instant and the receiving electromagnetic shutter is likewise cut out.

The compensating method which was devised by Dr. Korn is of considerable interest, seeing that it is one of the main factors in the success of the present apparatus, owing to the fact that it over-

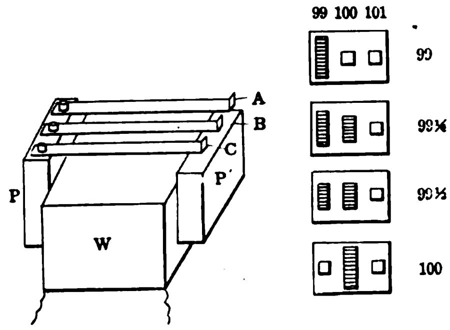
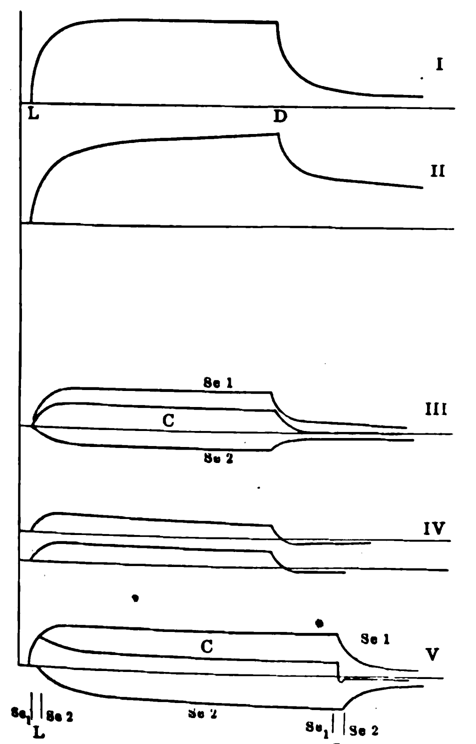


Fig. 5.—Frequency Indicator.

comes the inertia of the selenium cell to a great extent. The result is that the image at the receiving end is much clearer, and at the same time the speed of sending the image can be reduced within a reasonable time, seeing that the



Characteristic Selenium Curves.

impulses of current in the cell can be made in a more rapid succession than could be done were the cell to have the usual amount of inertia.

Curves I and II[1] show the inertia of selenium cells when lighted and then darkened. When lighted (at L) the current rises, but not instantly. When the light is cut off (at D) the current value falls somewhat rapidly at first and then very slowly. In order to secure an abrupt rise and fall of the curve Dr. Korn employs two selenium cells which are of a different character as regards their physical properties and at the same time can be differently lighted if desired. By con-

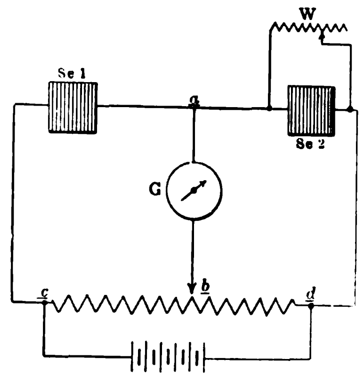


Fig. 6.—Connections of Selenium Compensator.

necting these two cells in opposition in a circuit on the Wheatstone bridge principle he is able to overcome the inertia to a great extent. The connection must be such that the differential current from the combination of the cells is greater than zero when the cells are lighted, and must be zero when in the dark. Referring to Fig. 6, he connects the cells Se^1 and Se^2 in a Wheatstone bridge circuit with the galvanometer G and battery. The bridge is balanced so that in the dark there is no current in the galvanometer circuit *a b*. Taking two cells having a different physical character, it is found that upon lighting them the resistances do not change equally, so that the bridge, balanced in the dark, will be unbalanced when the cells are both lighted at once, and a current will flow in *a b*. Such current will be stronger as the lighting is higher, within certain limits, and it is the difference of the currents which flow in the bridge arms Se^1 and Se^2; it also depends upon the difference of potential in *bc* and *bd* which form the other arms of the bridge. By displacing the contact arm at *b* we can find the best point for the compensation by experiment, and when this is found we proceed to balance the bridge (when the cells are in the dark) by means of the extra resistance W, which is connected across the cell No. 2. As this somewhat alters the first compensation adjustment, we make another adjustment at the other resistance. The result of this combination is shown in curve III, using the oscillograph to take the curves in the different arms of the bridge. In the curves marked Se^1 and Se^2 are shown the usual curves of current rise and fall for each of the two selenium cells taken separately. Here the inertia is large, especially at the drop of the curve. However, the differential current in the galvanometer shown at C is of a different character. The curve rises somewhat more rapidly, but at the drop the fall is much more rapid than usual, and the current value reaches zero very quickly. This effect can be further increased by the use of an over-compensa-

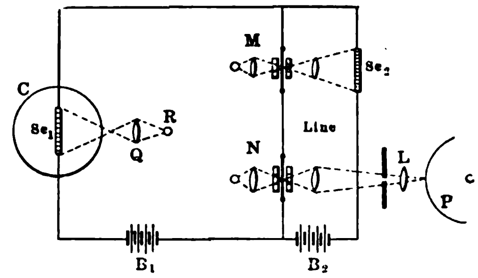


Fig. 7.—Another Means of Securing the Compensating Effect.

tion, so that the curve takes the forms seen in curve IV. Here the current falls below the zero line and consequently the drop is more rapid than before. The current in the galvanometer circuit, which is the one used in practice on the line, should be as large as possible and we should make the best choice of the differences of potential in *ab* and *bc* to carry this out. At the same time the current can be increased by lighting the two cells differently but still at the same moment.

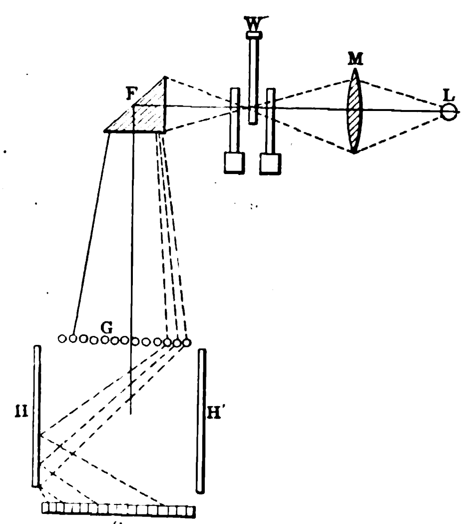


Fig. 8.—Detail of Prism and Diffusing Chamber.

As mentioned above, the two cells must have different physical properties. Dr. Korn employs in general the form of cell which consists of a flat plate of insulating material having wrapped around it a number of turns of double platinum or other wire. Between the wires there is spread a layer of selenium in the usual way. Such a layer may be made thick, and in this case the resistance of the cell

[1] These curves were obtained by Dr. Glatzel of Berlin, to whom the accompanying description is due.

is less. But on the contrary the inertia is greater, as the effect of the light appears to take some time before reaching the under part of the selenium. For a thin layer of selenium the resistance is higher but the inertia is lower. Thus in curves I and II, the former shows the inertia of a 500,000-ohm cell, and the latter the inertia of a 70,000-ohm cell, and it is seen that the low-resistance cell has a much higher inertia. In carrying out the Wheatstone bridge combination just referred to we use a cell Se^1 which has a low inertia and high resistance, while Se^2 is a low-resistance and high-inertia cell.

By the use of the following methods Dr. Korn was able to secure a still better compensating effect. At the transmitting end (see Fig. 7) we have the cell Se^1 which is lighted through the photographic film by the lamp R and lens Q. Cell Se^2 (the compensating cell) is lighted by means of a second lamp and an electromagnetic shutter M, of the type which we have already described. At the receiving end is the electromagnetic shutter N, which causes light to fall upon the photographic film P. The three parts M, N and C are connected on the Wheatstone bridge principle upon the main line. When Se^1 is lighted the bridge balance is destroyed and a current is sent into M. This causes Se^2 to be lighted in turn, but nearly at the same time, the only difference lying in the very slight inertia of the electromagnetic shutter. Se^2 will thus be lighted somewhat later than Se^1. As seen in curve V, curves Se^1 and Se^2 are somewhat displaced and the result is the compensated curve C, which represents the current in the line. This curve has a quicker rise, and it also falls at a faster rate than the former compensated curves. Owing to this fact the instrument is affected by small variations in the lighting, that is in the image, which would be lost in the above method, so that the resulting photograph is finer in the details and therefore much superior.

In practice this is carried out by using the electromagnetic shutter of the receiver which is placed at the transmitting station. When sending the image it is out of action. In this case the reflecting prism F (Fig. 2) is shifted in the path of the beam so as to send it down into the chamber V. Here is placed the compensating cell S. Above it is a screen composed of a set of parallel glass rods G, for diffusing the light over the surface of the cell. This is shown in detail in Fig. 8, where L is the lamp, M the lens, F the prism and W the shutter. At G is a set of glass rods which act as cylindrical lenses. The two plane mirrors H H′ act in connection with the rods to give the diffusion of the light on the cell S.

THE DIRECT PRODUCTION OF COPPER TUBES, SHEETS AND WIRE.[1]

BY SHERARD O. COWPER-COLES.

The numerous processes involved in the production of suitable copper and its subsequent conversion into copper sheets, tubes and wire by a series of operations, such as rolling, drawing and annealing, would occupy too much time to be referred to even briefly; therefore the author has limited the paper to the direct production of copper tubes, sheets and wire by electrolysis from impure copper.

The methods described are all based on the work of Davy and the law of electrolysis established by Faraday in 1833, namely, that when a current of electricity is passed through a solution containing metallic salts and two or more electrodes, one of which is soluble in the solution, a known quantity of metal is transferred from one electrode to the other for a given quantity of electric current; that is to say, if the soluble electrode (the anode) is connected to the positive pole, and assuming the metal and the electrolyte employed to be pure, a weight of metal will be deposited upon the cathode connected to the negative pole, corresponding to the amount dissolved from the anode. If the anode is of impure metal many difficulties are introduced, and if the current is increased to a sufficient density to enable the metal to be deposited at such a rate as will give commercial results, other serious difficulties arise. Electrometallurgists have been working for thirty years or more devising methods to overcome the difficulties experienced in applying Faraday's law to the commercial production of copper tubes, sheets and wire from comparatively impure copper having the physical properties of wrought copper, when deposited at a sufficiently rapid rate.

The refining of copper by electrolysis has now assumed vast proportions, and the annual output of electrolytic copper in the year 1907 has been estimated at 400,000 tons, equal to fifty-six per cent of the world's production, and the capital sunk in the industry at about $75,000,000. The whole of the copper thus produced is in the form of rough slabs or cathode plates which have to be smelted and worked to the desired forms.

Electrometallurgists have been striving for many years to devise a process which does away with the smelting of copper after it has been electrolytically refined, and to electrodeposit copper after the refining operation in such a form that it can be placed direct on the market as finished sheets, tubes and wire.

[1] Abstract of a paper read at the Bristol meeting of the Institution of Mechanical Engineers, July.

WILDE'S PROCESS.

It was observed shortly after Elkington practically applied Faraday's law to the refining of copper in the year 1865, that the electric current density, or the rate at which the copper is deposited, could be considerably increased by circulating the electrolyte or moving the electrodes. It was soon found that circulating the electrolyte alone was unsatisfactory, and that the best results could be obtained with a vertical mandrel revolved in the electrolyte. Wilde was one of the first to use a cylindrical cathode, his object being to deposit copper on iron rollers suitable for textile printing purposes, for which he took out a patent in the year 1875. The anodes consisted of copper cylindrical tubes, and the iron cylinder to be coated with copper (the cathode) was placed in the centre of the cylindrical vat and caused to rotate on its axis. Such an arrangement, in conjunction with a circulating propeller placed in the electrolyte, insured an even distribution of copper over the whole surface uniformly along the length of the roller by means of the motion imparted to the solution, and the equal density thus maintained. The current density was low, considerably under twenty amperes per square foot.

ELMORE'S PROCESS.

The next development of importance was the Elmore process, which consists of using horizontal mandrels on which copper sheets or tubes are deposited, while agate burnishers travel continuously over the copper, so as to consolidate it, and at the same time prevent the growth of copper trees or nodules. Even with the use of a burnisher the current density could not be increased beyond thirty amperes per square foot, and the mechanical difficulties introduced by the burnisher are considerable. Large works were erected to operate this process near Leeds and on the Continent, and are principally engaged in the production of large tubes and cylinders for special purposes.

DUMOULIN'S PROCESS.

Dumoulin introduced, at a later date, a process for burnishing copper during deposition with sheepskin as a substitute for agate, and claimed that the process had also the advantage of insulating any projections that might be formed on the deposited metal, the sheepskin impregnator coating all projecting parts with a film of animal fat, thus preventing further deposition until the surrounding depressions are raised to the common level. It was also claimed for this process that a current density of from thirty to forty amperes per square foot of cathode surface could be employed at a voltage of about 1.6 per vat. This process was tried on a large scale in England but was soon abandoned.

OTHER PROCESSES.

Attempts have been made at various times to further increase the rate of deposit by Swan, Elmore, Thofehrn, Graham, Poore and others, by impinging jets of the electrolyte against the cathode surface. The quality of the copper is liable to vary in density if impinging jets alone are employed; it is therefore necessary to move the cathode, otherwise the copper is deposited in the form of annular rings of varying density and smoothness.

The author, when carrying out some experiments on the production of copper tubes and sheets by electrodeposition on rotating cathodes, observed that when the speed was greatly increased entirely new results were obtained, and that a current density of 200 amperes or more per square foot could be employed, the copper remaining smooth and having a tensile strength equal to the best rolled or drawn copper, and in some cases a tensile strength some fifty per cent higher than that obtained by the ordinary process of casting and rolling, the tensile strength increasing with the rate of rotation of the mandrel. The result of revolving a mandrel at a comparatively high speed is that every molecule, as it is deposited, is burnished or rubbed down so as to produce a tough fibrous copper, the usual order of things being reversed, the present practice being to put the mechanical work into a mass of copper by rolling or drawing instead of treating each molecule separately.

CENTRIFUGAL PROCESS.

This observation led to further experiments, which resulted in evolving the process now known as the centrifugal copper process for the manufacture of sheets, tubes and wire, which will now be described in detail, together with the results obtained.

After a long series of experiments had been made to determine the best composition for the electrolyte and the most economical current density to employ, the critical speed was accurately determined by means of revolving cathodes in the form of cones. By observing the point at which the copper remains smooth, and by measuring the circumference of the cone at that point and multiplying it by the number of rotations per minute, the critical speed is readily determined; 200 amperes per square foot is found to be the most economical current density, although a current density up to 500 amperes per square foot can be employed by increasing the rate of rotation, but the increased cost due to increased voltage renders such a current impracticable for ordinary commercial work.

One of the chief difficulties inherent in any electrolytic or wet process for the production of copper tubes and sheets is having any working parts, such as bearings, in an acid copper sulphate solution, and this was one of the first troubles encountered when working the centrifugal process on a commercial scale. This difficulty was eventually overcome by constructing vats in the form of an annular ring, as shown in Fig. 1. It will be observed that by such an arrangement all

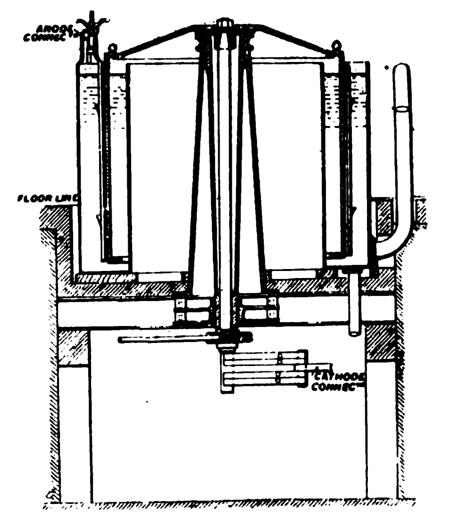


FIG. 1.—VAT USED FOR CENTRIFUGAL PROCESS.

working parts are outside the vat and do not come into contact with the electrolyte, so that the bearings can be lubricated in the ordinary way; only the actual face of the mandrel on which the copper is to be deposited is immersed in the electrolyte. The cathode consists of a steel or cast-iron cylinder closed at one end, to which is attached, on the inside, a steel rod projecting below the edge of the mandrel to guide it into position; the cylinder can be five or six feet in diameter or even larger so as to produce a copper sheet of say twenty feet long by four or five feet broad. Anodes composed of crude copper are placed around the mandrel with intervening spaces and are fed forward by suitable mechanical means as the copper dissolves away so as to keep the voltage constant.

One great advantage of the centrifugal process is that a very low voltage is required even when employing a very high current density; for instance, only 0.8 of a volt is required at the terminals of the vat when working at a current density of 200 amperes per square foot of cathode surface. The effect of revolving the cathode is fivefold: Firstly, it keeps the electrolyte agitated, so that there is always a fresh supply of copper ions in proximity to the cathode; secondly, each molecule of copper as it is deposited on the cathode is burnished or rubbed down by means of the skin friction between the revolving cathode and the electrolyte; thirdly, the rotation prevents any foreign matter that may be in suspension in the electrolyte settling on the cathode and becoming entangled by further copper being deposited around or over it; fourthly, it brushes away any air-bubbles on the cathode, which are the cause of nodules forming; and fifthly, the rotation of the cathode insures the thickness of copper being uniform even when a mandrel of say eight feet in length is employed.

The method of making tubes by the centrifugal process is as follows: A mandrel somewhat smaller than the finished internal diameter of the tube is prepared by coating it with an adhesive coating of copper by first depositing copper upon the surface from an alkaline solution and then thickening it up in an acid solution, the surface being highly burnished and treated chemically to insure the easy removal of the deposited tube. The mandrel thus prepared is then placed in a vat as shown in Fig. 1, according to the diameter of the tube and its length. When the desired thickness has been obtained the mandrel is removed and placed in a horizontal or vertical lathe, and a round-faced roller run over the surface so as slightly to expand the deposited copper, which can then be readily drawn off.

Copper sheets are prepared in a similar manner, the only difference being that the mandrels are of much larger diameter, and a narrow insulating strip is fitted down one side so that the sheet can be easily removed by inserting a tool under one of the edges of the deposited copper. It is no more costly by the centrifugal process to make thin sheets than thick ones; copper foil can be made like the samples exhibited in five minutes direct from crude copper.

Copper tubes produced by this process without any drawing have given a maximum stress of seventeen tons, and tubes after drawing have withstood a pressure of 3,000 pounds per square inch without showing any signs of distress.

Sheets made without any rolling have given a maximum stress of twenty-eight to thirty tons and more per square inch according to the peripheral speed at which the mandrels were revolved.

The formation of copper trees and nodules was another difficulty that had to be overcome, but which has been reduced to a minimum in the centrifugal process, for the reason that impurities held in suspension in the electrolyte have no opportunity of settling on the cathode, and all gas bubbles are swept from the surface on which the copper is being deposited.

The percentage of free acid employed in the centrifugal process is high, amounting to twelve or thirteen per cent. The electrolyte, the usual composition of which is 12.5 per cent of copper sulphate and thirteen per cent of sulphuric acid at a temperature of forty degrees centigrade, is kept in the cupric state and the impurities in suspension separated by means of a centrifugal filter provided with arc lights and an atomizer for breaking the solution up into a fine spray, as shown in Fig. 2 and Fig. 3, respectively. It has been found that by subjecting the solution to a strong light the impurities are more easily precipitated, and the solution is kept in the cupric state.

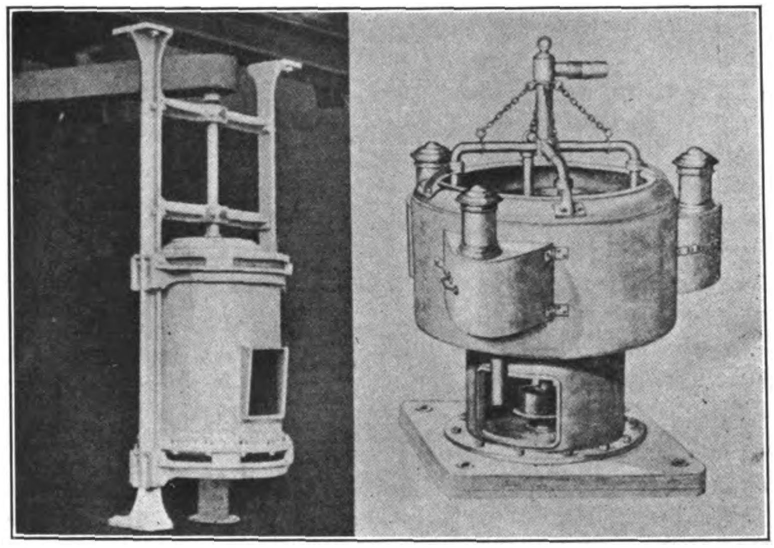
The production of copper wire by electrolytic means is a more difficult problem than the production of copper tubes and sheets. Various processes have been suggested and tried from time to time, such as the electrodeposition of copper on thin wire, until it has obtained a considerable thickness, and then drawing the thickened wire down to a comparatively fine wire. Swan and Saunders have both experimented with such processes, but so far they have not been worked commercially.

Elmore's process consists of producing copper tubes by his burnishing process, cutting them into long spirals and then drawing them into wire.

Other experimenters have tried placing an insulated spiral strip on a cylindrical mandrel so as to produce long copper spirals, but such an arrangement only allows of a very low current density being employed, on account of the nodules which form on the edges of the strip, even at very low current densities, rendering the strip unsuitable for drawing down into wire.

Copper wire is made by the centrifugal process in the following manner: A mandrel similar to that used for making copper sheets is employed, around which a spiral scratch is made, the pitch being determined by the size of wire required.

The effect of the spiral scratch (which need only be very light but must be angular) is to cause the crystalline structure of the copper to form a cleavage plane, as shown in Fig. 4. It will be observed that the copper divides exactly at the apex of the scratch, that is, the copper deposited in the scratch is equally divided and forms a small V-shaped fin on two sides of the copper strip. If the scratch is not angular, but rounded at the base, the copper will not divide, as the crystals are radial. After the desired thickness has been obtained, approximating the pitch of the spiral scratch, the mandrel is removed from the depositing cell and placed in a vertical position on a lathe and the copper strip is unwound at an angle of about forty-five degrees to the face of the mandrel. During the process of unwinding the small fin or burr is removed by passing the wire through a suitable die and then through a wire-drawing machine provided with three or more draw-plates to reduce the strip to the desired diameter. By employing a mandrel of six or seven feet in diameter, lengths of wire four or five miles long can be made in one operation.



FIGS. 2 AND 3.—ATOMIZER AND FILTER.

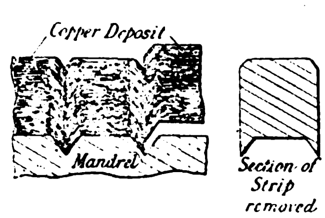


FIG. 4.—DIAGRAM SHOWING METHOD OF FORMING WEAK LINE OF CLEAVAGE DUE TO CRYSTALLINE STRUCTURE.

CONCLUSION.

The advantages of an electrolytic process as compared to a smelting process are many and the day is not far distant when copper will no doubt be leached direct from the ore and electrolyzed with insoluble anodes, to produce finished copper sheets and tubes in one operation direct from the ore without the intermediate process of smelting and refining.

The centrifugal process is a step in this direction, as it is capable of depositing copper from its solutions by using insoluble anodes in the form of finished tubes or sheets in one operation. The centrifugal process is at least ten times faster than any existing electrolytic process, and a high current density can be employed without deteriorating the quality of the copper. There is no risk of lamination, as no burnishers are employed. The plant is simple and free from mechanical complications, and the amount of copper locked up for a given output is small compared to other processes.

APPENDIX.

The following is a typical analysis of the copper produced by the centrifugal process:

Iron	0.0189
Arsenic	0.0015
Lead	0.0013
Antimony	0.0010
Bismuth	0.0008
Silver	absent
Nickel	absent
Sulphur	absent
Copper (by difference)	99.9765
	100.0000

Under favorable conditions the theoretical weight of copper is obtained, and the table (I) gives the weights and thicknesses of copper deposited in an hour at the current densities usually employed.

The capital expenditure of a plant for the centrifugal process both for the manufacture of sheets, tubes and wires, compares very favorably with an up-to-date rolling mill and wire-drawing plant. The cost of such a plant, with buildings, is about $400,000 for an output of 100 tons per week or 5,000 tons per year. The following is an estimate of the cost of a plant for the centrifugal process capable of dealing with 10,000 tons of tubes, sheets and wire per annum:

ESTIMATED COST OF PLANT FOR PRODUCING 10,000 TONS OF TUBES, SHEETS AND WIRE PER ANNUM BY THE CENTRIFUGAL PROCESS.

Cost of ninety-five vats and accessories	$320,000
Machinery for finishing tubes, sheets and wire	25,000
Cranes and lifting gear	7,500
Building	75,000
Plant for mandrel-making	10,000
Machinery for fitting shop	7,500
Pumps, atomizers, filter tanks	25,000
Driving machinery for vats	25,000
Conductors and electrolyte	25,000
	$520,000
Floating capital for copper	150,000
	$670,000

TABLE I.

TABLE GIVING THE WEIGHT AND THICKNESS OF COPPER DEPOSITED PER HOUR AT VARIOUS DENSITIES WITH METRICAL EQUIVALENTS.

Current Density in Amperes per Square Foot.	Weight of Copper Deposited per Hour per Square Foot. Pound.	Thickness of Copper per Hour. Inch.
150	0.3893	0.00872
160	0.4153	0.00930
170	0.4413	0.00988
180	0.4672	0.01046
190	0.4932	0.01105
200	0.5191	0.01163
210	0.5451	0.01221
220	0.5710	0.01279
230	0.5970	0.01337
240	0.6230	0.01395
250	0.6489	0.01453

ESTIMATE OF COST PER TON OF PRODUCING COPPER TUBES, SHEETS AND WIRE BY THE CENTRIFUGAL PROCESS DIRECT FROM CRUDE COPPER.

Power per ton (2,240 pounds), 1,015 kilowatt-hours at 0.55 cents per kilowatt-hour	$5.58
Wages at 16 cents per hour, 18½ hours	2.96
Management	1.25
Interest on copper lock-up	.25
Depreciation on plant and building	2.50
Heating electrolyte	.25
Finishing and gauging	1.25
Cost per ton	$14.04

These figures represent the actual working cost on which there would be a further reduction of the precious metals recovered and if $7.50 be deducted from the above cost, which may be taken as an average difference between Chili-bar and electrolytic copper, the cost per ton is reduced to $6.62.

Chicago Street Railway Accidents.

The Chicago City Railway Company announces that the number of fatal accidents for the first half of 1908 was the lowest on record, there being only one killed in every 4,172,727 passengers carried. This is stated to be a direct result of the use of the new pay-as-you-enter cars.

Electric Smelting by the Lash Process.

In the summary report of the mines branch of the Canadian Department of Mines for the 1907-1908, recently published, some attention, says the *Iron Trade Review*, is given to the solution of the problem of the direct production of steel from the ore, in connection with which technical difficulties have been encountered. It is thought that these may be overcome by the application of the Lash steel process in an electric furnace, and the Canadian Lash Steel Process Company, of Niagara Falls, furnishes a description of its working. Successful experiments with this process in the case of the open-hearth furnace on a commercial scale indicate its possibilities with regard to electric smelting. In this process finely divided ore is mixed with carbon, a certain quantity of finely divided carboniferous iron, such as cast-iron borings, or granulated pig iron, sawdust and fluxes suitable for the iron ore under treatment. The working of the process can best be explained by comparison with the open-hearth "ore process," which consists in forming a bath of molten pig iron and then adding thereto a sufficient amount of ore (iron oxide) to reduce the carbon content of the metal to the desired amount. The oxygen of the ore, combining with a certain amount of the carbon in the pig iron, forms carbon monoxide gas and sets free the iron of the ore to mix with the bath of molten metal. Thus a mixture of approximately seventy-five per cent pig iron and twenty-five per cent ore can be worked up. But in the Lash process the proportions are very different, for a large proportion of ore can be used with a small percentage of carboniferous iron. A typical mixture has the following percentage composition:

	Per Cent.
Iron ore	54
Cast-iron borings or granulated pig iron	27
Sawdust	4
Limestone	4
Coal tar	3
Coke	8
	100

These constituents are finely divided and intimately mixed, and when heated to a high temperature the reactions that occur are similar to those found in the open-hearth furnace using the ore process. The cast-iron borings correspond to the molten bath of pig iron and react with the ore, but the latter being in large excess it is necessary to supply a certain amount of free carbon in the form of coke for the complete reduction of the ore. The great economy of the process lies in the substitution of a large amount of ore for pig or scrap iron. In using the Lash mixture in the open-hearth furnace it is necessary to have a bath of molten metal, as otherwise it would not be practicable to heat it to the reacting temperature without losing carbon in the mixture by combustion. If, however, the charge is put into an electric furnace, no difficulty of the kind is experienced, since the gas in an electric furnace is neutral, in contradistinction to the oxidizing atmosphere of an open-hearth furnace. Experiments using the Lash mixture have been made in the electric furnace on a small scale with successful results. It was found that the yield of metal amounted to ninety-eight per cent of the metallic content of the mixture. The average cost of the materials in Canada for the production of 100 tons of steel ingots in the regular open-hearth furnace is $20.79 per ton, and it is claimed that by using the Lash mixture in the electric furnace this can be reduced to $16.22 per ton, and that the technical difficulties which have been encountered in the production of steel directly from the ore by electricity will disappear. Different electric furnaces are being tested to ascertain the type most suitable for the application of the process.

Functional Organization for the Central District and Printing Telegraph Company of Pittsburg.

A new form of organization, similar to that being put into effect by the New England Telephone and Telegraph Company and other large Bell subsidiaries, has been adopted by the Central District and Printing Telegraph Company, of Pittsburg, Pa. The organization was effective September 1 in Allegheny County and will be extended to the balance of the company's territory at as early a date as practicable. M. C. Rorty has been made general superintendent, S. P. Grace general superintendent of plant, and F. O. Hale general superintendent of traffic.

The Pennsylvania Electric Association.

The first convention of the Pennsylvania Electric Association will be held at Eagles Mere, Sullivan County, Pa., September 8 and 9. Arrangements for the accommodation of those attending the convention have been made at the Forest Inn Hotel, Eagles Mere Park. The secretary of the association is E. L. Smith, of Towanda, Pa.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Rose Recording Target.

A form of recording target which requires only three wires and yet reproduces the record of the shot at the point of fire, showing the point where the bullet hit within one-sixteenth of an inch, is described here. It is the invention of S. A. M. Rose, of Melbourne, Australia. By this instrument much time and possible misunderstanding and considerable expense may be avoided. In its simplest form the target is intended for showing the results of single shots, but it can be adapted to volley firing by the addition of a cable which takes the place of the three wires. The advantages of this target are its simplicity, as compared with other automatic recording targets; the fact that no more or less delicate mechanisms are subjected to the violent impacts of the bullets, and the actual targets can be preserved for record if desired or may be patched up for immediate use again. The target is printed on a roll of paper or cloth at regular intervals, and means are provided for exposing a new target by winding off the roll on to a drum. This traversing of the paper is effected by some means which gives absolute synchronism at the firing point with a smaller roll of paper, upon which the record is reproduced. As the target is rolled off it passes under a row of contact fingers, each finger of the set being connected to a point of a resistance in an electric circuit running to the recording station. When a hole in the target passes under these fingers certain ones fall through and make contact on a bar underneath. The position of the fingers determines the strength of the current which flows, and this current at the receiving recording station draws up the core of an electromagnet to a corresponding height, thus bringing a pencil or other marking device to the position on the record corresponding to the hole made by the bullet. Two guide marks are punched on the target and are marked on the record in their proper positions and enable a transparent gauge to be placed upon the record and show the exact locations of the shot. This target could be used for volley firing and would show correctly any number of shots at once if not more than one shot fell in line with the contact fingers at once. In that case the recording pencil could not record properly. To reproduce properly such a record it is necessary to run a wire from each contact finger to the recording device, where there is a magnet and stylus for each finger. When these styluses are drawn against a ribbed back they tear slits in the record showing exactly the location of holes in the original target. These tears can not be obliterated or imitated. With a target six feet square and contact fingers a sixteenth of an inch apart, 1,152 wires are required for Rose's apparatus, but since this cable is used intermittently only it could be used for a large number of targets. Other recording systems to give an equivalent record would require the square of this number of wires.—*Abstracted from the Electrical Engineer (London), July 31.*

The Tantalum Wave Detector.

A description is given here of a new electric-wave detector, devised by L. H. Walter, the idea being to make use of the indifference of tantalum to the atmosphere and to mercury and the spontaneous decohering property of mercury. This combination has been made practical by the introduction of the tantalum lamp, since before this tantalum was not procurable. The first experimental detector was made by passing two tantalum wires taken from an ordinary tantalum lamp through two capillary tubes of glass, allowing the wires to project about one-twentieth of an inch and their points just to touch the surface of a small pool of mercury. Trials of this detector gave good results and it was found that both the liquid dielectric and the insulating sheathing could be dispensed with. The actual device consists of a glass stem through which two platinum wires are sealed, similar to the arrangement used in incandescent lamps. One of these wires is longer than the other and is allowed to project down into the mercury. The shorter one is formed into a clip into which a short piece of tantalum wire is inserted. The whole is enclosed in a small glass bulb into which enough mercury is poured to make contact with both wires. The bulb is then sealed up. It may be exhausted if thought desirable. With this arrangement connections are easily made by means of the platinum leading-in wires. The tantalum wire is about 0.05 millimetre in diameter and should have its lower end just immersed in the mercury. When thus constructed the device appears to be permanent and not to deteriorate and is not too fragile to transport. Detectors of this form have been tried in actual wireless work. They do not seem so sensitive as the electrolytic or magnetic detectors for very weak signals, but for slightly stronger signals they give sounds several times as strong as the electrolytic, which is itself more sensitive than the magnetic. With the second detector made, signals were obtained from a distance of seventy miles over sea without any attempt at tuning. These sounds were louder than those given by an electrolytic detector with the aid of a step-up oscillation transformer and careful tuning. One of the less satisfactory of a later model of this detector has given satisfactory signals at a distance of 450 miles from an ordinary ship installation of two kilowatts. By means of the resistance substitution method it has been found that in the receptive condition the resistance is only 1,200 or 1,800 ohms (the electrolytic is 30,000 or more), and this low resistance should be beneficial for tuning. When oscillations are acting the resistance drops to anything from 250 ohms for strong signals to perhaps seventy ohms for very strong signals. The ratio of the current when oscillations are acting to that in the normal condition is from 3 to 1 to 8 to 1, and may be as much as 30 to 1. On account of this characteristic the inventor thinks the tantalum detector is particularly adapted to wireless telephony since here the use of microscopically weak signals is out of the question, and it is here that the superiority of this detector for moderately strong signals will be useful. The form of detector described above, while suitable for fixed stations, does not work well when it is subjected to shaking or mechanical shocks, as experienced on shipboard. To meet this requirement a form in which the mercury is rendered immobile has been developed. The platinum wire with the clip is sealed into a minute glass bulb, to which a capillary tube is attached. The tantalum wire passes through this tube. The whole is exhausted and sealed. Then the tube is carefully heated until it collapses on the tantalum wire. The tube is then ground off so as to present the end of the tantalum wire. This tube is slipped through an ivory plug, which is in turn inserted in a second glass tube about five-sixteenths of an inch in diameter. A little mercury is poured into this tube, so as to be in contact with the exposed end of the tantalum wire, and the tube is closed with a second ivory plug through which a platinum wire passes. The outer tube is then placed in an ebonite tube for protection and is mounted so as to be rotatable about a horizontal axis. The most sensitive position is with the tantalum wire at the top. The outer glass tube should be about five-thirty-seconds of an inch in diameter. A larger tube would be more sensitive and constant but not free from the effects of vibration. A smaller tube gives a less sensitive and more variable detector. Although tantalum, the first metal tried, gave such good results, a number of others were experimented with, such as iron, nickel, tungsten and certain alloys, but all of these gave perfect contacts and were therefore not suitable. No effect was obtained with vanadium, molybdenum, cobalt, manganese, tellurium, zirconium, ferro-silicon, ferro-manganese, ferro-nickel, antimony or bismuth. But a fairly sensitive and moderately loud detector can be made, using pure tantalum on several solid metals. Oxidized iron seems to be the best, but an equally sensitive, though not so loud, instrument is given with tantalum on tellurium. None of these arrangements at all compares with the tantalum-mercury instrument. — *Abstracted from Electrical Engineering (London), July 3.*

On Earth Currents and Magnetic Variation.

The relation between earth currents and magnetic variations is very far from being known thoroughly. The main question, according to Dr. L. Steiner in this article, is whether the magnetic variations are entirely, or at least partly, due to the electromagnetic action of earth currents, or whether they are in turn induced by the magnetic variations. It has not yet been satisfactorily answered. Many investigators are inclined to accept the former view, relying mainly upon observations made at times of magnetic storms. The few data at our disposal concerning the daily variations on calm days have not yet settled the question. The elaborate investigations dealing with this subject—the well-known investigations of Professor Weinstein—advanced the problem considerably, but they do not lead to final results. If the earth currents are the primary causes of the daily magnetic variations, then we should expect that the west-east components of the currents are connected with the north components of the magnetic variations, and the north-south components of the currents with the west-east components of the magnetic variation. The observations at Paris seem to confirm such a connection for the west-east currents, but the connection for the north-south currents is not so evident. Schuster, von Bezold, and Fritsche have shown that the daily variation of terrestrial magnetism is to be ascribed to two causes, one outside, the other inside the earth. The numerical separation of the two, as far as the data permitted, has been done by Fritsche. A tabulation of his results, which is given, shows an obvious parallelism between the east-west earth current and the north-south magnetic variation, but no connection between the north-south current and the east-west magnetic variation. Deriving, however, the differential coefficients for the latter variation, a direct variation apparently results. If we imagine the earth current contained between two plates in the earth is closed somehow in the interior of the earth, then an increase of the magnetic force to the west induces—in conformity with Maxwell's rule—an earth current in the north-south direction, and a decrease of the force to the west, an earth current in the opposite direction. The table of coefficients shows these characteristics. The extreme values and the changes of sign occur in the differential coefficients at the same time, or a little earlier, than for the earth currents, which seems favorable to the supposition that these currents are induced by the changes in the earth's magnetism. The agreement is not so close for winter as for summer, which is not surprising when all the complex factors entering into the phenomena are considered. By tabulating Fritsche's and Weinstein's results for the Berlin-Dresden line and the Berlin-Thorn line a loose agreement between the earth currents and the north-south magnetic variation only is found for the latter line, while the former shows a remarkable agreement between the earth currents and the differential coefficients of magnetic variation. This seems to prove that a part at least of the daily magnetic variations is related to the earth currents in such a way that the north-south magnetic variations are partly electromagntic actions of the east-west currents and the north-south earth currents are partly induced currents caused by the variations of the east-west magnetic variation. If these remarkable connections be real then the relation of the earth currents and the magnetic variations is more complicated than would at first be supposed, and the physical explanation of it seems to present great difficulties. Why should the east and west currents act as primary causes and the north-south currents behave like currents induced by the east-west magnetic variation? The sun may have something to do with this, as the temperature gradient caused by its daily action is greatest in the east-west direction, and may thus give rise to earth currents in the same direction. These currents may be looked upon as primary currents. The unsymmetrical distribution of the stream lines in the east-west direction allows us to expect a magnetic force in the same direction, and the variation of this component will induce currents in the north-south direction. This explanation, however, is easily attacked, and the above apparent connections still await explanation. Schmidt has put forward the hypothesis that the earth currents are due to induction in the wires. Weinstein holds the contrary view. It seems possible that, so far as the inner agencies of magnetic force are considered, there may be a difference between the north-south and the east-west currents with regard to their origin.—*Abstracted from Terrestrial Magnetism and Atmospheric Electricity (Baltimore), June.*

A New Smokeless Fuel.

A patent fuel has recently been brought out by a French inventor, designated as "charbonnette." This fuel, it is stated, can be produced for about two-thirds the cost of coal. It lights easily and, rapidly becoming incandescent, no smoke is emitted, while at the same time it gives out intense heat and leaves very little ash. It is manufactured in briquettes, and its main features are cleanliness in handling and the absence of odor. It is understood that the preliminary tests have been so satisfactory that a manufactory is to be erected.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

SUCTION GAS PRODUCER POWER.

AMERICAN PRODUCERS FOR AMERICAN COALS AND LIGNITES.

BY L. P. TOLMAN.

The early history of producer gas dates as far back as the year 1509, at about which time the "Fulen Heitzen" first became known, and were described by H. Brunschwyk in his book "Ars Distillandi de Compositis," or "The Art of Distilling Compounds," which was published in Strassburg, Germany.

The first plant similar to those now in use was built by Emerson Dowson, who has the distinction of introducing, in England, in 1878, the first practical gas producer for power. This was of the "pressure" type. A small steam boiler was necessary, as well as a large gas holder.

Then followed the invention of Herr C. Wiegand, of Hanover, Germany, who in 1895 took out the first patent (No. 88,044, German) on the principle of the modern suction gas producer. The importance of this invention was not realized in Germany until some years later.

In France, during the same year, Benier built what is believed to be the first practical suction gas producer. This was a success as soon as the necessary changes had been made in the gas engine to adapt it to the "suction" system. It is surprising in this case, as with most other great inventions now in general use, that an apparatus so simple and easily understood was not developed long before.

About five years ago American manufacturers began to take a live interest in the success of European, and especially German, suction gas power plants. factory installations already in operation on American coals. It is estimated that there are over 500 producer power plants in this country, having an aggregate of 150,000 horse-power. Of these, about eighty-five per cent are of the "suction" type and fifteen per cent of the "pressure" type. The suction plants average approximately 100 horse-power each while pressure plants are usually built in sizes larger than 1,000 horse-power.

This article deals with suction gas power plants in single units of 200 horse-power, or smaller, and complete plants made up of a number of such units, 1,000 horse-power or larger. This range of sizes covers the requirements of the great majority of power users.

Fig. 1 illustrates a suction gas producer power plant. The apparatus is simple, reliable and economical. With

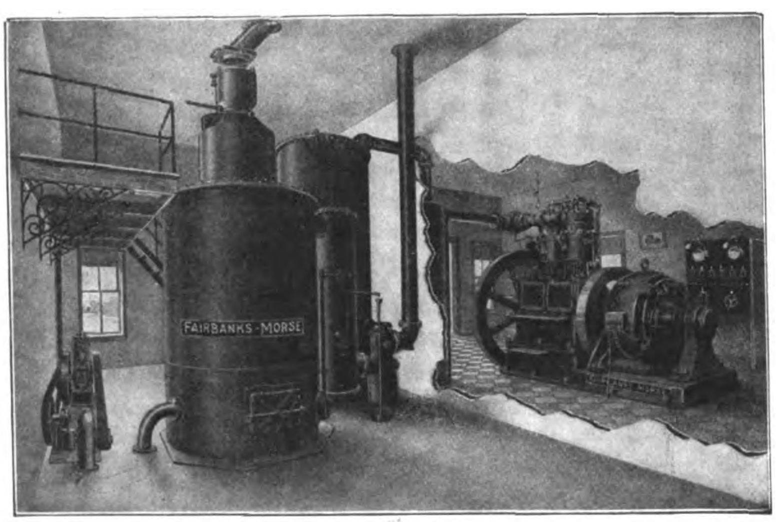


FIG. 1.—COMPLETE PRODUCER-GAS POWER PLANT, WITH ENGINE DIRECT-CONNECTED TO DYNAMO.

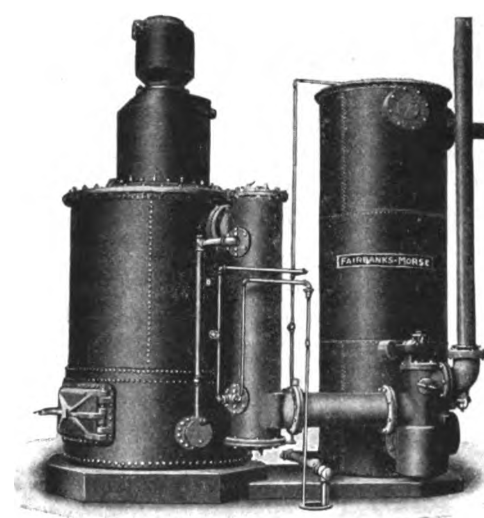


FIG. 2.—FAIRBANKS-MORSE SUCTION GAS PRODUCER.

Mr. Dowson's plants were successful and are still in regular service. Anthracite is the usual fuel.

The next substantial progressive step was taken when Dr. Ludwig Mond, in England, in 1889, developed the first successful soft-coal producer. This became a standard for sizes of 250 horse-power and larger but proved too elaborate and expensive for use in smaller sizes. With this plant a large gas holder is needed, also a steam boiler and an elaborate system of gas washers, purifiers and economizers.

American engineers visited Europe and in this way learned at first hand what was being done abroad. As early as the year 1904 it is estimated that there were over 10,000 suction gas power plants in Germany alone. They had come into general use and were found in the finest hotels, stores, factories, etc., for electric lighting and other power purposes. The actual users of the plants were enthusiastic over the results.

That producer-gas power is a pronounced success in the United States is evidenced by the large number of satis-

this plant eighteen per cent of the total energy of the fuel is converted into useful work. (Varies according to conditions from fifteen to twenty-one and one-half per cent.) This means that a suction gas producer plant uses from one-half to one-fourth as much coal for a given amount of power as a steam plant.

A 150-horse-power suction producer plant, running two-thirds load, 3,100 hours per year, uses approximately one and one-half pounds of coal per brake horse-power per hour. (Tests have been made showing a consumption of less than one and one-quarter pounds at two-thirds load and less than one pound at full load.) With anthracite at $5 per ton the fuel alone costs $1,162.50 per year. Furthermore, the cost of attendance can be reduced materially with a producer plant, as the operator can spend part of his time in other useful work.

Much valuable information is given in the report of the United States Geological Survey concerning the fuel testing plant at the Louisiana Purchase Exposition, St. Louis, Mo. For three years the government experts conducted a series of tests on many samples of coal from mines all over the country. Briefly, the apparatus included a non-condensing Corliss engine steam plant with water-tube boiler and a pressure type producer with three-cylinder vertical gas engine.

From the summary of results obtained from a long series of tests, the fuel consumption in pressure type producer plant varied from 1.18 to 3.47 pounds per brake-horse-power per hour, the average being approximately one and three-quarters pounds. The average with the Corliss steam plant was found to be approximately four and one-half pounds, using similar fuels. With lignite the consumption in pressure producer plant was from 1.95 to 3.47 pounds, the average of five samples actually figuring 2.60 pounds. With Corliss steam plant using lignite the average consumption of "coal as fired" (not "dry coal") was approximately seven pounds.

Fig. 2 illustrates an exterior view and Fig. 3 a sectional view of a Fairbanks-Morse anthracite suction gas producer. All of the principal features are clearly shown. Coal is admitted to the producer through a hopper at the top. This has double closure, so that fuel can be introduced without at the same time admitting air. In the process of partial combustion which takes place producer gas is generated.

The hot gas passes through a vaporizer in which a small amount of steam is formed which, with a limited amount of air, passes under the grate of the producer. In the smaller sizes the vaporizer is at the top of the producer where it uses the waste heat from the escaping gas and where, at the same time, the water keeps the top from getting too hot. In the larger sizes the vaporizer is separate and connected to the producer by piping.

From the vaporizer the hot gas flows through the scrubber, which is merely a cylindrical-shaped tank filled with coke over which a spray of water is constantly sprinkled. The large contact surface of the coke effectually cleanses the gas of dust and impurities carried over from the producer, and also acts to cool the gas, which is essential in order to prepare it for use in the engine.

With certain fuels, especially when much tar is encountered, it is also necessary to add a sawdust purifier in order to abstract the last traces of tar from the gas. While not absolutely essential, yet it is always advisable to use a gas tank between the scrubber and the engine, in which a certain amount of gas is stored for ready use in the engine. This is especially desirable where the loads are variable.

In the care of the producer, the principal attention needed is to poke the fire every few hours, according to quality of the coal, in order to break up and remove clinkers, which would otherwise interfere with the making of sufficient gas. Poke holes are provided so that every part of the fire can be reached conveniently.

Anthracite in "buckwheat" or "pea" sizes, lignite, coke and charcoal are the fuels commonly used. In many sections these small sizes of anthracite can be bought cheaply in car lots. For example, in Chicago the car-load price of "buckwheat" anthracite is usually about $3.75 per ton. In some of the states west of Chicago the price varies from $5 to $7 per ton. At some points in southern

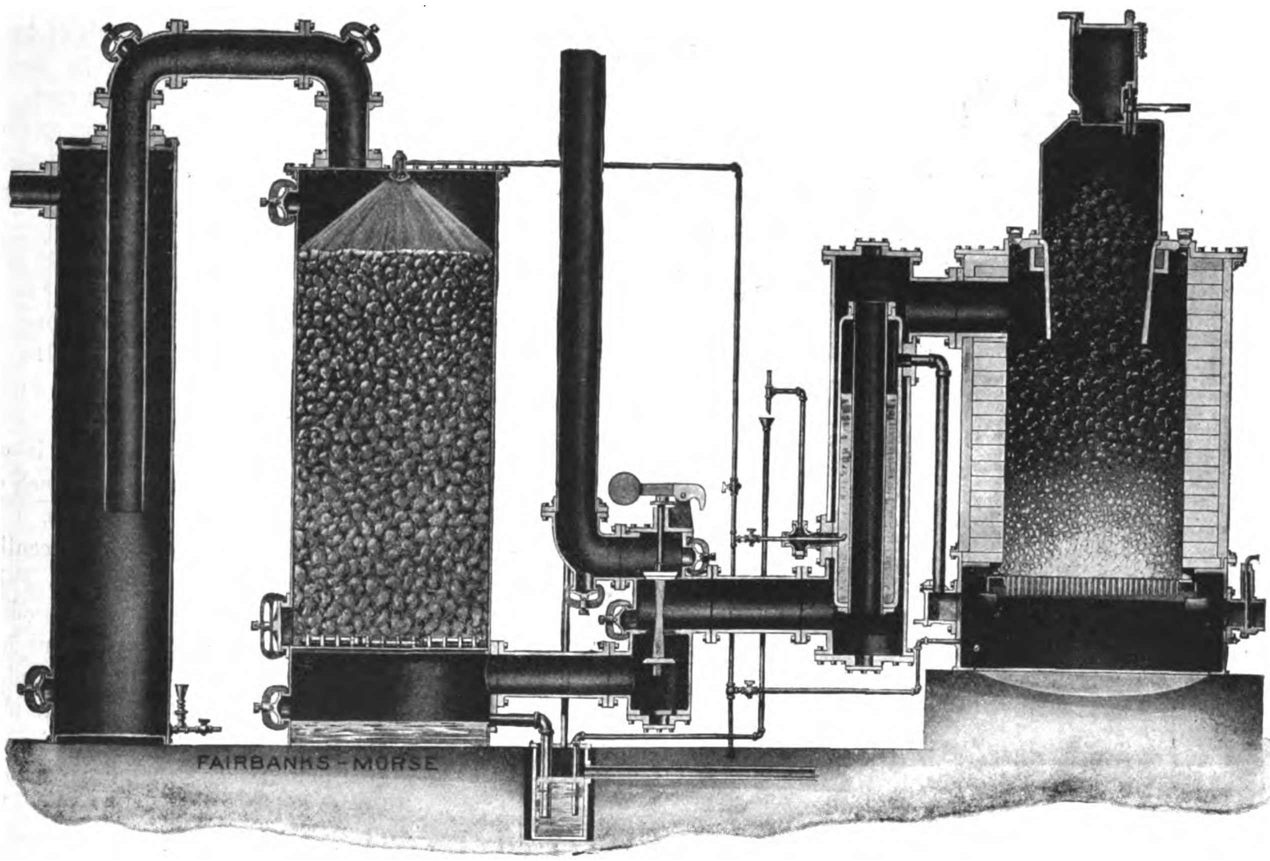


FIG. 3.—SECTIONAL VIEW OF FAIRBANKS-MORSE SUCTION GAS PRODUCER.

Canada these small sizes of Pennsylvania anthracite can be bought for from $3 to $4 per ton. In some of the eastern states, which are nearer the source of supply, the prices are even less.

The lignite producer offers a wonderfully cheap and reliable power in sections where this fuel is available. This can usually be had at a price of from $1 to $3 per ton. At Smithville, Tex., where a 150-horse-power lignite producer plant is installed, the cost is $1.70 per ton. Lignite is of little value for steaming purposes, mostly due to the large amount of moisture, but it makes a most excellent fuel for the producer and in some respects is easier to handle than anthracite.

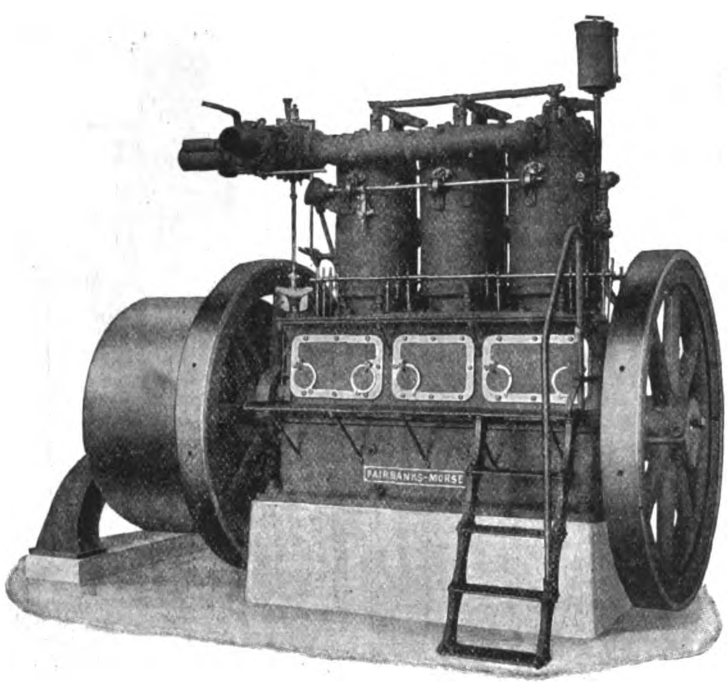


Fig. 4.—Multi-Cylinder Vertical Producer Gas Engine.

Coke and charcoal are economical fuels in some sections and can be used separately or mixed with anthracite.

Producer gas engines of the vertical type are made in sizes of 200 horse-power and smaller. By combining several units plants of 800 to 1,000 horse-power or larger have been installed. Fig. 4 illustrates a thoroughly modern Fairbanks-Morse engine of this type. It may be of interest to engineers to note briefly a few of the carefully developed features in the design of these engines.

The present system of ignition is a great improvement over the methods formerly used. The make-and-break igniter is so constructed that it can be adjusted to spark as early or as late as desired, when the engine is running or at rest, by means of a convenient hand lever. A single lever controls the time of ignition for all cylinders. This is a feature of much importance, especially with producer gas, as it permits timing the ignition to give the greatest possible power and economy with any particular grade of gas and when the engine is running. In addition, there is an independent adjustment for each igniter which is operated by drop cam.

Igniters can be removed, inspected and cleaned without interfering with other working parts, and they are located most conveniently. As the successful operation of a gas engine depends largely upon the igniter the value of these features can not be emphasized too strongly.

Both valves are mechanically operated from a single cam shaft, which is located inside the crank case. This minimizes the amount of noise, and furthermore the two-to-one reduction of gearing includes a pinion which is made of alternate layers of steel and red fibre. These features insure a quiet running engine.

The simple fly-ball governor is of a most carefully designed pattern. This operates a balanced disc valve which is so constructed that there is no frictional contact or surface to become fouled by any impurities in the gas. This is especially important with engines operating on producer gas. The governor insures very close regulation, adapting the engine for electric lighting and other service requiring uniform movement.

Lubrication is effected by means of a single elevated oil reservoir which is provided with separate brass pipe with individual sight feed for each bearing. This is a most effective system of engine lubrication and has been adopted as the best to be had. The drip from the different bearings collects in the base of the engine, which is drained by means of a small pump. The oil is run through a filter and is then used over again.

Each engine is fitted with a hand-operated speed regulator, by means of which speed can be reduced when the engine is running.

One cylinder of each engine is fitted with automatic compressed-air starting gear. This can be thrown into or out of action by the movement of a single lever, and the engine is started automatically on compressed air.

From report on fifty-horse-power plant used in operating marble works in Tennessee, statement is made that they use only eighteen ordinary hods of buckwheat anthracite per day of nine hours at a total cost of $1.39 for the coal. At this plant they poke the fire once in the morning before starting and once at night after shutting down. Outside of this the plant requires very little attention.

One of the largest suction gas producer plants in the United States comprises six 150-horse-power engines and one 200-horse-power engine—1,100 horse-power in all—complete with suction gas producers, using anthracite as fuel. This plant is in Wisconsin and is operated twenty to twenty-four hours each day, excepting Sundays and holidays.

A series of tests has recently been made on a 150-horse-power Fairbanks-Morse engine and anthracite producer, for continuous runs of twenty-four hours, at one-quarter load, one-half load, three-quarters load and full load, the object being to determine the comparative economy at different loads. The coal used was an ordinary grade of buckwheat Pennsylvania anthracite, running rather high in ash, the analysis being as follows:

Fixed carbon	78.9 per cent.
Volatile	5.3 "
Ash	13.0 "
Moisture	2.7 "
Sulphur	0.77 "
B.T.U. per pound as fired, 13,590.	

Some of the results of these tests, including the coal consumption per brake-horse-power-hour, are given below:

Load.	B.H.P. on Engine.	Speed. R.P.M.	Coal in 24 Hours.	Coal per B.H.P. per Hour.	Cooling Water per B.H.P. Hour. Gals.	Steam per pound of Coal. Lbs.
Full	149.4	224	3838	1.07	5.0	0.48
¾	113.1	226	3185	1.13	5.6	0.45
½	75.4	226	2369	1.3	6.8	0.41
¼	38.0	228	1590	1.74	13.1	0.35

A New Line of Cigar Lighters for Continuous and Intermittent Service.

Cigar lighters for both continuous and intermittent service are now being manufactured by the General Electric Company and may be obtained in the pendent, desk or table types. These cigar lighters are suitable for operation on either alternating or direct-current circuits and may be readily connected to any ordinary lamp socket.

For intermittent service, both the pendent and table types are available, but the pendent type only is suitable for continuous operation. Those for intermittent service are equipped with a push-button for closing the circuit during the period of operation, which is generally from four to six seconds. The continuous service lighters are normally left in circuit but have a small switch for turning the current off when not in use.

The heating unit is somewhat similar in appearance to the ordinary fuse plug, and for intermittent service consists of several lengths of coiled wire lightly cemented to a thin sheet of insulating compound. The ends of the wire are connected to terminal screws in the porcelain plug base which is screwed into a socket in the body of the lighter. A thin piece of perforated mica, placed in a metal cap fitted to the porcelain plug base, protects the heating coils. To light the cigar or cigarette it is only necessary to place the end against the perforated disc, the hot air, drawn through the holes in the mica, igniting the cigar even before the mica disc becomes red.

The intermittent desk type, as shown in the illustration, is compact and simple in design, the heating element being similar to that used in the intermittent pendent type.

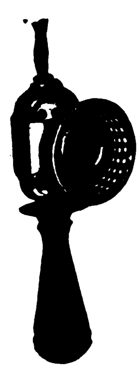
The construction of the plug for continuous service is similar to that for intermittent service, except that the coils of wire are completely filled with cement between turns. With this unit no mica covering is used, as a perforated insulating compound placed on the top of the heating unit conducts the heat to the cigar. As will be noted in the illustration, these plugs are surrounded by a perforated metal mouthpiece which protects the plug and also prevents the liability of any one being burned by coming in direct contact with the heating element. In this type of cigar lighter the heating plug can not be removed without the use of a special spanner. This feature is of special importance when the lighters are used in public places such as hotels, cigar stores, etc.

These cigar lighters are made for voltages from ninety-five to 125 volts. The power consumption is very low, being seventy-five watts for the intermittent type and twenty-five watts for the continuous type. The cost of operation and the life have been determined after a series of careful tests. It was found that with the intermittent type 1,000 lights

DESK OR TABLE TYPE CIGAR LIGHTER FOR INTERMITTENT SERVICE.

could be obtained at an approximate cost of one cent where power is sold for ten cents per kilowatt-hour. The continuous-service lighter can be operated at a cost of about three cents per day. The durability tests show that the intermittent type will give about 22,000 lights before deterioration of the heating element occurs. Tests now being conducted on the continuous-

PENDENT TYPE CIGAR LIGHTER FOR INTERMITTENT SERVICE.



PENDENT TYPE CIGAR LIGHTER FOR CONTINUOUS SERVICE.

service types show a maximum of over 5,000 hours at the present time. These tests are still in progress, so that this value will be exceeded.

The cigar lighters of the intermittent type are finished in oxidized copper, the continuous-service types being given a nickel-plated finish. All types are furnished with a suitable cord and attaching plugs.

The American Association of Electric Motor Manufacturers.

A meeting of the American Association of Electric Motor Manufacturers will be held at the Frontenac, Frontenac, N. Y., in the Thousand Islands, on September 9, 10 and 11. This association was organized at Hot Springs, Va., a few months since, the membership consisting of three classes, as follows: Class A, manufacturers of direct-current motors up to and including fifty horse-power; Class B, manufacturers of alternating-current motors up to and including fifty horse-power; Class C, manufacturers of all types of motors above fifty horse-power.

The following officers have been elected: President, S. L. Nicholson, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; vice-president, Class A, C. F. McGilvray, Robbins & Myers Company, Springfield, Ohio; vice-president, Class B, R. J. Russell, Century Electric Company, St. Louis, Mo.; vice-president, Class C, F. S. Hunting, Fort Wayne Electric Works, Fort Wayne, Ind.; secretary, J. C. McQuiston, Westinghouse Companies' Publishing Department, Pittsburg, Pa. Executive committee: C. W. Holtzer, Holtzer-Cabot Electric Company, Brookline, Mass.; C. H. Roth, Roth Brothers & Company, Chicago, Ill.; B. C. Kenyon, Diehl Manufacturing Company, Elizabethport, N. J.; J. C. Hobart, Triumph Electric Company, Cincinnati, Ohio; James Burke, Burke Electric Company, Erie, Pa.; W. A. Layman, Wagner Electric Manufacturing Company, St. Louis, Mo.; J. W. Ham, General Electric Company, Schenectady, N. Y.; A. H. Whiteside, Allis-Chalmers Company, Philadelphia, Pa.; A. L. Doremus, Crocker-Wheeler Company, Ampere, N. J.

Business Getting with the Tungsten Lamp at Lowell, Mass.

J. H. Hunnewell, general superintendent of the Lowell (Mass.) Electric Light Corporation, is conducting an energetic business-getting campaign, using the rental of tungsten lamps and free wiring as his most important persuasions. General Electric tungsten lamps are being rented on a basis of twenty-five cents per month per lamp using 100-watt, eighty-candle-power, and the sixty-watt, forty-eight-candle-power sizes. The rental price includes the lamp, shade and holder and whatever pendent or fixture is necessary. The plan is working so successfully that at present there have been in the neighborhood of 700 lamps installed and the business is increasing rapidly.

Current Electrical News

DOMESTIC AND EXPORT.

POWER PLANT ON COOSA RIVER—A water-power development is proposed at Lock No. 2, on the Coosa River, near Gadsden, Ala. The company behind the scheme is the Coosa River Electric Power Company, of Anniston, Ala. Roswell H. Cobb, a banker of Anniston, is the president. A survey of the Coosa River at Lock No. 2 is being made by Captain Harley B. Ferguson and a corps of engineers for the purpose of securing data for the War Department in connection with the development of the proposed new company. It is planned to develop 30,000 horse-power. The next convening Congress will be asked for certain privileges in connection with this proposition.

LOUISVILLE RAILWAY COMPANY TO ISSUE NEW STOCK—Following the action taken at a meeting of the stockholders of the Louisville (Ky.) Railway Company, several months ago, authorizing an increase in the capital stock of the company, amended articles of incorporation have been filed by the company increasing the capital stock $500,000. The increase is for the purpose of reimbursing the Louisville Traction Company for funds advanced to the Louisville Railway Company several months ago. The new capitalization will be common stock, of a par value of $100. The articles of incorporation contain the names of T. J. Minary, president of the company; John Stites, Charles T. Ballard, Harry Bishop, Sam Casseday and Alex. P. Humphrey.

TO BUILD MONTANA ELECTRIC LINE—Articles of incorporation of the Billings & Cooke City Electric Railway Company have been filed. The capital stock of the organization will be $5,000,000, the principal place of business Billings and the terms of its legal existence forty years. The company will build and equip an electric railroad which will extend from Billings to Cooke City, Mont., passing through Laurel, Park City and possibly Columbus, up the Stillwater Valley to the mining camp. Those interested in the company are: J. B. Clayberg, of Helena; M. E. Estep, of Chicago, Ill.; E. M. Hosky, of Helena; George E. Savage, of Butte; Thomas Harney, of Galena, Ill., and A. L. Babcock, B. G. Shorey and Theodore Martin, of Billings.

MINNESOTA POWER PROJECT—The Backus-Brooks interests at International Falls, Minn., have sold their water-power holdings at the falls to eastern parties, and it is understood that the development hereafter will be carried on with capital furnished by the steel interests. W. H. Cook, president of the Duluth, Rainy Lake & Winnipeg road, has notified Minneapolis lumber interests that work will begin at once looking to the completion of works that will produce 30,000 horse-power within a year. This, it is understood, will be followed by the completion of new railroad lines in the district. It is understood that the Backus-Brooks company will concentrate its efforts upon the completion of a paper and pulp plant on the American side at International Falls. Pulp wood is plentiful in that locality, and the mill is to be finished by the time the power is ready to be delivered. The plant will have a capacity of 500 tons of paper a day.

CONSOLIDATION OF MEXICAN ELECTRICAL COMPANIES—It is announced that the Mexico Street Railway Company and the Mexican Light and Power Company are to be amalgamated, and one company is to control the light and power supply of Mexico City. Plans for the amalgamation are now being prepared, and a special stockholders' meeting of the light and power company will be called in the near future to arrange the details. The Mexican Light and Power Company was organized about two years ago as a consolidation of all the light and power companies in the city. There is a small power-house at Noanalco, while the main power plant is at Necaxa, on the state line between Hidalgo and Puebla, 100 miles east of Mexico City. The company is to build a second power plant near Necaxa. The stock of the company is held largely in Scotland and Germany. It is a Canadian concern. The Tranvias Electricas Mexicanas, or the street railway company, is a Canadian corporation, but the stock is owned largely by F. S. Pearson, of New York city. The company was originally largely British, Wehrner, Beit & Company, of London, owning a controlling interest. It was this company which sold out its interest to Pearson and his associates.

ELECTRIC LIGHTING.

LIMA, OHIO—The city council has passed an ordinance providing for a $105,000 municipal electric light plant.

NEWARK, N. J.—The local water company is considering the installation of machinery to furnish electric light to the village.

CANTON, N. Y.—The Canton Electric Light and Power Company has purchased land upon which it will erect a transformer substation.

BENBOW, ILL.—The Benbow village board has granted a twenty-year franchise to the Benbow City Light, Heat and Power Company. A $60,000 plant will be erected.

SAN BERNARDINO, CAL.—The Redlands Gas and Electric Company has applied for permission to run transmission lines over the county roads between this city and Redlands.

SPRINGFIELD, MASS.—The new power plant of the United Electric Company, which cost approximately $300,000, has been placed in operation, adding 3,000 horse-power to the company's capacity.

HUNTSVILLE, ALA.—Fred A. Howe, a business man of this city, has secured a franchise from the city council of Gurley allowing him to establish and operate an electric light and power plant in that town.

CENTER, TEX.—Fire on August 13 destroyed the electric light plant, planing mill and 150,000 feet of lumber belonging to Redditt, Fleshman & Hardrider. There was no insurance and the loss is about $150,000.

BUCYRUS, OHIO—The Bucyrus city council has decided to build a municipal lighting plant. The proposition means the investment of $90,000. Bonds will be issued to cover the cost and the plant will be started at once.

ELWOOD, IND.—The sale of all property of the Citizens' Heat and Light Company has been ordered by Judge Greenlee, of the Superior Court. The sale will be made by the receiver, the Elwood Trust Company, at the court-house on September 18.

DODGEVILLE, WIS.—The Dodgeville Electric Light and Power Company will build a plant on the railroad land just south of the Illinois Central passenger station. The building will measure forty by seventy feet. It is likely that a heating plant and an ice plant will also be operated.

FREEHOLD, N. J.—David H. Smith, of Jamesburg, as receiver of the Manalapan Light Company, sold the property of that corporation at public sale to W. J. Lansley, of Perth Amboy, the promoter and one of the largest creditors of the concern, on a bid of $500. There is $25,000 worth of bonds outstanding.

OLYPHANT, PA.—Five prominent business men of Olyphant have been appointed by the borough council to operate the municipal lighting plant. There has been a movement to sell or lease the plant. It was claimed that the borough would have to issue $15,000 worth of bonds to put the plant in good shape.

DANVILLE, PA.—The borough council has decided to grant a franchise to C. F. Kloss and Joseph M. Watts, promoters of a new electric light company which purposes to transmit to this city electricity generated on the West Branch of the Susquehanna, the plant to be in operation within two years of the granting of the franchise. The company will furnish light to business places at a rate not to exceed six cents per kilowatt-hour and to private residences at a rate not to exceed eight cents per kilowatt-hour.

DOVER, N. J.—The new ten-year street lighting contract with the Dover Electric Light Company has been signed by the mayor, town clerk and the officials of the electric light company. The agreement requires the town to use at least seventeen arc lamps at $85 each and 240 incandescent lamps at $17 each a year.

LOGANSPORT, IND.—Professor J. Walter Esterline, of Purdue University, who has been preparing plans for a municipal light plant for Logansport, has completed his work and submitted his report. The plans call for the expenditure of $39,540, and an ordinance has been passed by the city council appropriating this amount.

HARTFORD, WIS.—The city is preparing the site of the municipal electric light plant for the erection of the building by moving the Raaschke House. The work of putting up the power-house will be commenced as soon as the contracts are let, which will be in a short time. City Engineer Maltby has completed work on the plans.

BATH, N. Y.—C. K. Tower, of the Citizens' Electric Service Company of Bath, which has had its application for permission to build a new electric power and light plant here granted by the Public Service Commission, states that the company will proceed at once to build its power plant and to do the necessary wiring for the street lighting service.

BARNESVILLE, GA.—The city council has accepted the contract for the installation of the new electric light plant, and the new machinery will be shipped and set up within the next fifty days. The city has twice outgrown its plant, and larger generators, electric and water machinery were required. The cost of the new equipment will be about $7,000.

ALBANY, ORE.—Articles of incorporation have been filed for the Lebanon Electric Light and Water Company, which will henceforth own and operate the light plant and water system in Lebanon. The incorporators are S. P. Bach, Samuel M. Garland, J. C. Mayer, P. M. Scroggins and S. I. Stewart. All of the incorporators except Mr. Stewart are residents of Lebanon.

SAN ANGELO, TEX.—Al Reynolds, of Oklahoma, announces his intention of applying to the city council for a franchise for an electric light system in San Angelo. He represents an Ohio company, and states that if a franchise is obtained the company will expend $150,000 on the plant, which he will manage. Mr. Reynolds is superintending the electric work on the street-car system.

HASTINGS, NEB.—A report has been made by the city treasurer showing that the city electric lighting plant, since it was established by the city in 1901, has twice paid for itself. The city during that time has saved $56,000 in street lighting alone, while the profit on lighting private residences and business concerns has been sufficient to not only maintain the plant, but also to make numerous extensions and install new machinery from time to time. There is a balance of $12,000 now to the credit of the lighting fund.

HICKORY, N. C.—A meeting of the citizens of Hickory was held recently for the purpose of submitting the proposition of developing the water power at what is known as the Horseford Shoals on the Catawba River, two and one-half miles from Hickory. A stock company was organized a few weeks ago to develop this power and engineers employed to make surveys. It is considered possible to develop 6,000 horse-power at a minimum cost owing to the adaptability of the site for such development. All the stock necessary, with the exception of $20,000, has been subscribed to develop 3,500 of the 6,000 horse-power available.

IOWA CITY, IOWA—Franklin Benjamin, of Galesburg, Ill., the new owner of the American Cereal Company's plant at Coralville, proposes to take on the Iowa City municipal contract to light the city with electricity and gas. He desires to build an electric light plant at Coralville and a gas plant in Iowa City. Mr. Benjamin offered the city council the entire equipment of the electric light plant, as a bonus, after twenty-five years, the gift of the poles, wires, equipment, etc., being limited to sufficient to supply the city's needs, as they stand at the end of twenty years. If the city prefers Mr. Benjamin agrees to deposit $1,000 a year in a bank (he to draw the interest thereon), and at the end of the twenty-five years the $25,000 is to go to Iowa City if he retains the plant.

ELECTRICAL SECURITIES.

For a brief period, early in the week, it appeared as if there might ensue a break in prices, due to the bewildering turn affairs had taken when in a terrific effort to bear the market one large brokerage firm brought down suspension from the Stock Exchange upon its head. The heavy interests, however, were able to meet the raid and prices were maintained, with everything proceeding in a most orderly manner all through the week. The most favorable indications at present are the feeling of general hopefulness for an early activity in business, the excellent condition of freight railroads to cope with any reasonable improvement in tonnage, the little real damage suffered through storm and flood by the crops, and the large surplus being stored up in banks all over the country—in fact, all over the world, as is reflected in recent reports.

Dividends have been declared upon the following electrical securities: Louisville (Ky.) Railway Company; semiannual dividend of 2½ per cent on the preferred and a quarterly dividend of 1 per cent on the common, payable October 1. Galveston-Houston (Tex.) Electric Company; semiannual dividend of $3 per share on the preferred stock, payable September 15. General Electric Company; regular quarterly dividend of $2 per share, payable October 15 to stock of record September 9. Rochester (N. Y.) Railway and Light Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable September 1. Mackay Companies; regular quarterly dividends of 1 per cent on the preferred and 1 per cent on the common, payable October 1 to stock of record September 12. Northern Ohio Traction and Light Company; two quarterly dividends of ¼ of 1 per cent each, payable on the $8,938,900 capital stock on September 15 and December 15, 1908, to holders of record September 1 and December 1, respectively. This reduces the annual rate to a 1 per cent basis, comparing with a 2 per cent rate maintained from June 15, 1906, to June 15, 1908.

ELECTRICAL SECURITIES FOR THE WEEK ENDED AUGUST 29.

New York:	*Closing.*
Allis-Chalmers common	11¾
Allis-Chalmers preferred	35½
Brooklyn Rapid Transit	53¾
Consolidated Gas	145½
General Electric	146
Interborough-Metropolitan common	11¾
Interborough-Metropolitan preferred	33¾
Kings County Electric	122
Mackay Companies (Postal Telegraph and Cables) common	68
Mackay Companies (Postal Telegraph and Cables) preferred	68
Manhattan Elevated	139
Metropolitan Street Railway	30
New York & New Jersey Telephone	110
Western Union	55¼
Westinghouse Manufacturing Company	74
Boston:	*Closing.*
American Telephone and Telegraph	126½
Edison Electric Illuminating	225
Massachusetts Electric	47
New England Telephone	117¼
Western Telephone and Telegraph preferred	70
Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	37
Electric Storage Battery preferred	37
Philadelphia Electric	9¾
Philadelphia Rapid Transit	14
United Gas Improvement	87¾
Chicago:	*Closing.*
Chicago Telephone	—
Commonwealth Edison	105
Metropolitan Elevated preferred	40
National Carbon common	69
National Carbon preferred	108

NEW INCORPORATIONS.

CLEVELAND, OHIO—Buffalo Valley Telephone Company, Cumberland. $1,000.

DENVER, COL.—Municipal Lighting Company. Incorporators: Carl Christensen and Carl Vogt. $100,000.

NEWARK, N. J.—Arcade Block Lighting Company, Newark. To manufacture electricity, etc., for light, heat and power; fixtures, etc. $40,000. Incorporators: J. O. Sharpe, T. A. Phillips, F. J. Greenberg, Newark.

PERSONAL MENTION.

MR. WALTER P. SCHWABE has resigned as superintendent of the Rutherford (N. J.) office of the Public Service Corporation of New Jersey.

MR. W. D. SHALER has been elected secretary of the Doubleday-Hill Electric Company, Pittsburg, Pa., to fill the place made vacant by the decease, recently, of his brother, Mr. H. G. Shaler.

OBITUARY NOTE.

MR. JOHN JAMES GREENOUGH, inventor and former superintendent of the Patent Office at Washington, died recently at the home of his daughter in Brookline, Mass. He was the first to take out a patent on a sewing machine, invented the first shoe-pegging machine and assisted in the construction of the first electric locomotive. He held the position of superintendent of the Patent Office from 1837 until 1841. In 1853 he commenced the publication of the *American Polytechnic Journal*. He was born in Boston, January 19, 1812.

ELECTRIC RAILWAYS.

HUNTSVILLE, ALA.—The city council has granted Ed. L. Pulley and associates a franchise to construct and operate an electric car line.

RIVERSIDE, CAL.—The Riverside & Arlington Railway Company has been granted a franchise by the city council. This includes a freight-carrying privilege.

SALT LAKE CITY, UTAH—The Utah Light and Railway Company is planning extensions of its lines throughout Salt Lake and Utah valleys and as far south as Provo.

PITTSBURG, PA.—The Pittsburg & Beaver Street Railway Company, which proposes to construct a line from Pittsburg to Beaver on the populous south side of the Ohio River, has increased its capital from $60,000 to $235,000.

YAZOO CITY, MISS.—A street railway is now assured for Yazoo City. The bonds which were issued about a year ago have been signed and delivered and the money paid over to the city treasurer. In ninety days it is thought the road will be in operation.

BLOOMINGTON, ILL.—General Manager Fischer, of the Illinois Traction System, is authority for the statement that in two years' time the traction system will be connected with Terre Haute and extended on into Indiana, transferring to the Indiana interurban lines.

DUNKIRK, N. Y.—The Buffalo & Lake Erie Traction Company has awarded to Peter B. Colgan, of this city, the contract for excavating and clearing the roadbed for trolley extension from Cassity's Woods to Sheridan to connect with the main line from the belt line system.

ALBANY, N. Y.—The Public Service Commission, Second District, has granted the application of the Western New York & Pennsylvania Traction Company for permission and approval to construct an extension of its road in the village of Salamanca to and into the village of Little Valley.

SALISBURY, N. C.—The Piedmont Electric Car Line Company, of this city, has been granted a franchise to build an electric line skirting Salisbury on the north and west, the work to begin within six months. The same company proposes to connect Spencer and East Spencer by an electric line.

MOBILE, ALA.—Within sixty days engineers will begin work surveying the proposed route of the electric line from Citronelle to Mobile, and inside of one year cars will be operating into Mobile from Citronelle, according to George S. Bressler, of Gulf Crest, Ala., who is interested in the proposition.

DUNKIRK, N. Y.—A syndicate of Buffalo capitalists is said to be planning the construction of the long-awaited Cassadaga Valley trolley line over the proposed route from Dunkirk as far south as Sinclairville. According to the report, the new trolley line will take in all the villages down the Cassadaga Valley, including Stockton.

CHILLICOTHE, OHIO—The Scioto Valley Traction Company is completing the work of extending its line to the business section of Chillicothe. The overhead work is now being put up, and within a short time the company will be operating cars from Columbus to the business district of the city.

WASHINGTON, PA.—Burgess A. V. Lewis, of Donora, has returned to the council with his signature the ordinance granting a franchise to the Donora-Eldora Street Railway Company. The company has thirty days in which to file its bond of $5,000, three months in which to start work and one year in which to complete the road from Donora to Eldora.

HUNTSVILLE, ALA.—The question of building an electric railway from this city to Monte Sano is being agitated. Several business men have secured eighty acres of land on the top of the mountain and it will be divided into 200 lots and sold. The funds realized from this sale will be used as a nucleus with which to push the electric railway project.

BERKSHIRE, MASS.—The Berkshire Street Railway Company has petitioned the State Railroad Commission for authority to issue $80,000 additional capital stock, $40,000 each for extensions in Pittsfield and improvements to the line between North Adams and Williamstown. With the petition of April 28 this would make $365,000 new stock. The market value is fixed at $100 per share.

NORTH VANCOUVER, B. C.—At a meeting of the district council, at which there were present Acting General Manager T. W. Glover and Local Manager W. B. Bunbury, of the British Columbia Electric Railway Company, arrangements were completed for the extension of the lines of the company up Capilano Valley to the second cañon. The line will be in operation next spring.

HOUGHTON, MICH.—The Houghton County Traction Company, of Houghton, Mich., has contracted with the Stone & Webster Engineering Corporation for the extension of its lines from Wolverine to Mohawk, Mich. The contract includes the construction of the track, bridges, overhead work, a car barn, a small substation and the purchase of some new cars. The work as planned will cost about $125,000.

SEYMOUR, IND.—The Seymour & Brownstown Construction Company has been organized to construct an electric railway between Seymour and Brownstown, a distance of twelve miles. Indianapolis and Marion men are interested with local men in the enterprise. The company has asked for right of way through this city. The proposed line will connect with the Indianapolis & Louisville traction lines in Seymour.

MARQUETTE, MICH.—According to the officers of the Marquette, Negaunee & Ishpeming Interurban Railway Company, an active start will be made with the grading of the right of way between this city and Negaunee within the next few weeks. Some work has already been done at the Marquette end of the right of way. The operations now projected, however, are to be carried out on a large scale, and it is hoped that they will result in having the line ready for traffic by June of next year.

NEW CASTLE, PA.—The Mahoning & Shenango Railway and Light Company has secured the passage of an ordinance extending its franchise thirteen years, making it expire in twenty-five years. For the extension the company gives a rate of twenty-five tickets for $1, universal transfers and a partial guarantee of better service. It also agrees to extend the transfer and city fare. The present traction franchises have a life of twelve years, and on the Park and Falls line there is a fare of twenty-seven tickets for $1. On other lines the fare is twenty-two tickets for $1.

MINNEAPOLIS, MINN.—Articles of incorporation of the Electric Short Line Railroad Company have been filed. The principal place of business is given as Minneapolis. The incorporators are: Severen Solverson, who is secretary of the Phoenix Loan and Investment Company; E. C. Hinde, of Sioux Falls, S. D.; Frank E. Reed, of Glencoe. In order, they hold the offices of president, vice-president, and secretary. It is stated that the purpose is to put in good form the properties of an organization which has been in existence for five years, and that the incorporation has no significance as to any immediate activity of the company in railroad building.

BUTLER, PA.—Surveys of a route for an electric line projected by Butler, Pittsburg and Franklin capitalists to connect Butler and Conneaut Lake have been begun. The proposed line will be seventy miles long and will form the conecting link between Pittsburg and Erie and Buffalo by trolley. It is asserted that the backers of the venture are friendly with the interests owning the Pittsburg & Butler Street Railway Company. The route already selected from Butler is by way of Oneida, Queens, Euclid, Slippery Rock, Grove City, Greenville, to Conneaut Lake, with a branch to Franklin to connect with the Oil City line. From Conneaut Lake to Erie is a continuous line over the roads through Saegertown and Cambridge Springs to Erie and Buffalo.

SAN JOSE, CAL.—The Southern Pacific Company has purchased from L. S. Hanchett, of San José, the Santa Clara Interurban Railroad Company's property, including rights of way for a railway between Santa Clara and San Mateo. The purchaser intends to build at once and to operate an electric railway between Santa Clara and San Mateo, thus giving San José electric railway connection with San Francisco. The rights of way purchased by the Southern Pacific constitute a private property. The Santa Clara Interurban Railroad Company built and equipped the electric railway system in Palo Alto. This system, including a power-house and all the tracks, rolling stock and other property connected with it, was purchased by the Southern Pacific. The estimated value of this property is about $500,000. The Southern Pacific proposes to build first between Santa Clara and San Mateo. Between Santa Clara and Palo Alto the route of the private right of way is along the county road. It is not stated just when the construction of the first portion of the road will begin, but it will be at an early date. Later the line will be extended between San Mateo and San Francisco. For this line the route of the old steam line by Mission Hill, that was in use by the Southern Pacific before the building of the Bay Shore cutoff, will be utilized.

DATES AHEAD.

Pennsylvania Electric Association. First meeting, Eagles' Mere, Pa., September 8-9.

American Association of Electric Motor Manufacturers. Next meeting, Frontenac, N. Y., September 9-11.

Association of Edison Illuminating Companies. Annual meeting, Lenox, Mass., September 15-17.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Arkansas Association of Public Utilities Operators. First annual convention, Little Rock, Ark., September 17-18.

Old Time Telegraphers' and Historical Association, and Reunion of Military Telegraphers, Niagara Falls, N. Y., September 16-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 5-6.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Pittsburg, Kan., October 8-10.

American Street and Interurban Railway Association. Annual convention Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annal convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

Railway Signal Association. Next meeting, Chicago, Ill., September 8. Annual meeting, Washington, D. C., October 13-15.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Order of the Rejuvenated Sons of Jove. Annual meeting, Buffalo, N. Y., October 15-16.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

EDUCATIONAL NOTE.

EVENING TECHNICAL COURSES AT THE POLYTECHNIC INSTITUTE OF BROOKLYN—The Polytechnic Institute, of Brooklyn, N. Y., announces evening technical courses in its College of Engineering for the season of 1908-1909. There will be a series of evening and Saturday courses in engineering, chemistry, physics, mathematics, drawing, history, economics and languages, especially designed to afford men in active practice opportunities for professional study. The term of study begins on Thursday, October 1, and continues until the various courses are completed. These courses may be taken independently or in connection with the regular work of the courses in engineering leading to the degrees of civil engineer, electrical engineer, mechanical engineer, chemical engineer or bachelor of science in chemistry.

NEW PUBLICATIONS.

THE STUDY OF SCIENCE BY YOUNG PEOPLE—A very interesting paper, entitled "The Study of Science by Young People," by Dr. William S. Franklin, of Lehigh University, has been reprinted from the proceedings of the twelfth annual meeting of the New York State Science Teachers' Association.

BIBLIOGRAPHY OF ELECTROCHEMISTRY AND ALLIED SUBJECTS—A bibliography of electrochemistry and allied subjects has been prepared by P. F. Mottelay. This compilation constitutes Appendix I of the author's "Bibliographical History of Electricity and Magnetism," which will shortly appear in book form.

INSTITUTION OF ELECTRICAL ENGINEERS—The *Journal of the Institution of Electrical Engineers*, of Great Britain, published under the supervision of the editing committee, and edited by George C. Lloyd, secretary, has been published by the house of E. & F. N. Spon, 57 Haymarket street, London, S. W. The New York publishers are Spon & Chamberlain, 123 Liberty street. The present volume contains the proceedings of March 19 and April 2, 9, 23 and 30. There are published as a supplement the accessions to the library from January 1 to June 30, 1908.

INDUSTRIAL ITEMS.

FOX BROTHERS & COMPANY, 126 Lafayette street, New York city, have published a handsome series of bulletins devoted to "Polar" flaming arc lamps, "Carbone" lamps, "Radiante Economy" and "Radiante" lamps, standard show-window lighting, technical data, and tungsten incandescent lamps.

THE HOLOPHANE COMPANY, New York city, in the August issue of "Holophane," makes an interesting special announcement concerning the Holophane D'Olier metal reflector. The Holophane Company has acquired, and will hereafter have exclusive control of, the metal reflectors designed by, and manufactured under the patents of, Henry D'Olier, Jr.

THE GENERAL ELECTRIC COMPANY, Schenectady, New York, has issued bulletin No. 4,597, devoted to Thomson astatic instruments for continuous-current switchboards. Bulletin No. 4,575 is devoted to Type F, Form K-7 oil-break switches. Bulletin No. 4,596 is devoted to enclosing globes for arc lamps. Copies of this bulletin will be furnished to those interested upon request.

THE ROCKWELL FURNACE COMPANY, New York city, has published two handsome catalogues devoted, respectively, to portable heaters for heating work which is too bulky or inconvenient to remove to a furnace, and where it is desirable to take the heater to the work, such as annealing, hardening, expanding, bending, brazing, skin-drying, lead melting and rivet heating; and to melting furnaces for melting all metals, tinning, galvanizing, tool hardening, and all operations requiring molten metal and other heated baths.

THE CONSOLIDATED ELECTRIC LAMP COMPANY, Danvers, Mass., announces that although its main factory and stock were seriously damaged by the fire which occurred on August 14, it is in a position to take care of orders from its Pine street factory. The company has already perfected plans for a larger and thoroughly equipped building, to be completed before the winter sets in. As the fire occurred in the quiet season, the company was not so greatly inconvenienced as it otherwise would have been. The loss caused is estimated at $20,000, partially covered by insurance.

THE BRISTOL COMPANY, Waterbury, Ct., is issuing two new bulletins, No. 91 and No. 93, which, with bulletin No. 92, cover the list of Bristol recording thermometers for all temperature ranges up to 800 degrees Fahrenheit. As a result of the consolidation of the business of William H. Bristol with that of the Bristol Company the latter company also manufactures William H. Bristol electric pyrometers together with the three classes of recording thermometers, which are described in the bulletins above mentioned. Copies of these bulletins will be furnished to those interested upon request.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has published a little brochure entitled "The Way to Forget." After treating the subject in a rather airy fashion the reader is made acquainted with the fact that the best way for a manufacturer to forget is to select everything in the plant, from the motor to the manager, of a character that will not, under ordinary conditions, do anything but the work intended. The only way to avoid experiences that create unforgettable memories is to get the right sort of a motor. The suggestion is, of course, that the right motor or dynamo is built by the Triumph Electric Company.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing its new bulletin describing the P.-A. electrically operated remote-control switch for use in controlling lights and power from a distance. A full description is given of the switch mechanism, together with some of the various applications. The company is also distributing bulletin No. 10, illustrating and describing the "O. K." fuse block cover, for use by central stations in preventing theft of current. This block is manufactured to fit standard size Edison plug fuse blocks. A flier is also being distributed, illustrating and describing the type "B" oil switches for entrance and motor service. This switch has been designed to meet the demands for a small-capacity medium-priced oil switch for use in connection with motor and lighting circuits up to and including 3,300 volts.

THE BELDEN MANUFACTURING COMPANY, Chicago, Ill., has issued catalogue No. 4, in convenient pocket size. This catalogue contains 124 pages, is printed on fine paper, and is profusely illustrated. Great pains have been taken to procure a simple and comprehensive book on wires, cables, cordage and other electrical raw material required, particularly by users of wire. Each article listed is described and illustrated with half-tone engravings wherever possible, showing the construction and the manner in which it is prepared for shipment. A feature of special interest to electrical supply dealers is the putting up in paper cartons of such products as will permit. Annunciator wire, gas-fixture wire, resin-core solder and table push-button cords are put up for shipment in neat paper cartons. In the back of the book there are twenty-five pages devoted to wire tables and formulas useful in the design of electromagnets, resistance coils, cables, etc. Copies of this catalogue will be sent to those interested upon request.

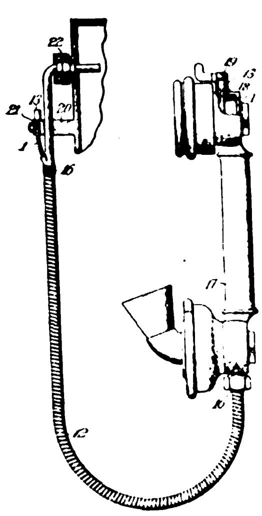
Record of Electrical Patents.

Week of August 18.

896,700. ELECTRICAL CONDUCTING CORD. George F. Atwood, East Orange, N. J., assignor to Western Electric Company, Chicago, Ill. A metal-armored cable arranged upon a strand of high tensile strength for a microphone telephone instrument.

896,705. PROCESS FOR HARDENING TANTALUM. Werner von Bolton, Charlottenburg, Germany, assignor to Siemens & Halske A. G. The process consists of heating tantalum in the presence of carbon.

896,715. FORMING OF FILAMENTS OUT OF VISCOSE OR SIMILAR VISCOUS MATERIAL. Charles A. Ernst, Lansdowne, Pa., assignor to Silas W. Pettit, Philadelphia, Pa. The cellulose xanthate is partly dissolved without precipitation in an alkaline solvent and then spun in a neutralizing solution.



896,700—ELECTRICAL CONDUCTING CORD.

896,738. REGULATOR FOR DYNAMOELECTRIC MACHINES. William C. Mayo and John Houlehan, El Paso, Tex., assignors of one-third to George E. Briggs, Barstow, Tex. A mechanical power regulator and a solenoid attachment for varying the effect of the superimposed current.

896,740. ELECTRIC TRACK BRAKE. William C. Mayo, El Paso, Tex., assignor, by direct and mesne assignments, of two-thirds to himself, and George E. Briggs, Barstow, Tex., and one-third to John Houlehan, El Paso, Tex. The electromagnet operates the brake shoe.

896,749. ELECTROCHEMICAL CONCENTRATION OF LIQUIDS. George W. Nistle, North Muskegon, Mich., and Robert L. Gifford, Chicago, Ill. The electrochemical effect concentrates the liquid.

896,752. MALTING PROCESS. Alfred Oertel, Godesberg, Germany, assignor to Diechmann & Cie., Cologne, Germany. The grain is subjected to the action of dark electric rays.

896,754. ELECTRIC SNAP SWITCH. Johann G. Peterson, Hartford, Ct., assignor to the Arrow Electric Company, Hartford, Ct. A quick-break push-button switch.

896,755. HORSE-POWER-HOUR METER. Johannes Picht, Halle-on-the-Saale, Germany. The current is varied through one coil in proportion to the pressure in the engine cylinder and through another coil in proportion to the speed of the engine.

896,764. CIRCUIT-BREAKER CONTACT. William M. Scott and Harry C. Campion, Jr., Philadelphia, Pa.; said Campion assignor to said Scott. The contact has an active member and an inactive member connected by a reinforcing electro plate.

896,784. NON-SYNCHRONOUS RECEIVING PERFORATOR. Milton T. Weston, New York, N. Y. The perforating hammer is alternately engaged and freed by electromechanical means.

896,793. ANNUNCIATOR. Edward Baum, Baltimore, Md. A combination of a visual and auditory signal.

896,796. TELEPHONE APPARATUS. Sidney A. Beyland, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. A tubular metal desk stand and support.

896,802. ELECTRODE FOR LIGHTNING ARRESTERS. Frank B. Cook, Chicago, Ill. The carbon block is finished with rough protrusions, between which is embedded a non-conducting, adhesive mixture.

896,808. RELAY. Frank L. Dodgson, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. The cores have enlarged and rectangular-shaped ends or poles, and means are provided for securing the cores to the carrying plate.

896,809. RELAY. Frank L. Dodgson, Buffalo, N. Y. Two permanent magnets are pivoted so as to swing in a plane at right angles to the cores of the electromagnet.

896,811. METALLIC FILM FOR USE WITH STORAGE-BATTERY ELECTRODES AND PROCESS OF PREPARING THE SAME. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. Nickel or cobalt films with minutely roughened or matted surfaces are provided for admixture with the active material.

896,812. STORAGE BATTERY. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. The supporting plate is fitted with a plurality of tongues which may be bent so that the pockets of active material may be separately removed from the plate.

896,828. SELECTIVE MECHANISM FOR TESTING DEVICES. Albert B. Herrick, Cleveland, Ohio. Plug connections are made through the medium of a punched disc and corresponding terminals, and the circuit-closing switch is interlocked with the disc.

896,830. TELEPHONE METER. Newman H. Holland, Brookline, Mass., assignor to Charles Bate, Boston, Mass. The registering meter is actuated in response to the closure of the telephone circuit at one station prior to the insertion of the plug and again upon the change in character of the current.

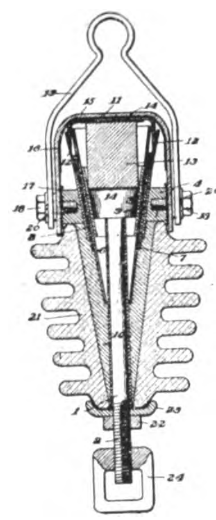
896,831. SIGNALING. Mark H. Hovey, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. A single signal-controlling circuit actuates a lock-controlling circuit, lock, track relay and signal.

896,832. SELECTIVE CALL APPARATUS. John A. Hullt, Topeka, Kan. A balance bar, actuated by a main lever, is adapted to throw off the holding pawl, co-operating with a ratchet selectively arranged for preventing the balance bar from throwing off the holding pawl.

896,836. TELEPHONE SYSTEM. John J. Kelly, St. Louis, Mo. Means are provided for signaling the central exchange without affecting the signal devices at the exchange.

896,838. ELECTRICAL APPARATUS. Charles J. Klein, New York, N. Y., assignor to Ralph Abraham Schoenberg, New York, N. Y. A water-tight floor receptacle.

896,839. ALARM SYSTEM AND APPARATUS. John M. Latimer, Flushing, N. Y., assignor to the Consolidated Fire Alarm Company, New York, N. Y. A closed-circuit system which operates upon interference with the normally grounded condition.



896,934.—INSULATOR.

896,840. ALARM TRANSMISSION. John M. Latimer, Flushing, N. Y., assignor to Consolidated Fire Alarm Company, New York, N. Y. A combination of rotating main character and supplemental character contacts actuated by a driven spring.

896,842. RAILWAY SIGNALING APPARATUS. William Macomber, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Means are provided for forcing a signal to normal and holding the signal locked.

896,868. ELECTRICAL CLUTCH OR THE LIKE. Abram P. Steckel, Buffalo, N. Y. Oppositely disposed magnetized poles are provided in the opposing clutch members.

896,874. HOT-BOX INDICATOR. Henry Williams, Chicago, Ill. A fulminating cap actuates a contact-making device upon heating.

896,882. VIBRATORY MASSAGE DEVICE. Asa H. Arnold and Albourne F. Furbush, Poughkeepsie, N. Y. The vibratory movement is provided by the reciprocal action of the armature.

896,886. CONSTRUCTION OF ELECTROMAGNETS. Arthur F. Berry, Ealing, England. The magnetic circuit is built up of plates having axially parallel limbs connected together to embrace the inner and outer peripheral surfaces and inner end of the winding.

896,921. TORPEDO BOAT. Edward J. Kelley, Washington, D. C., assignor of one-eighth to Robert L. Nutt and one-sixteenth to Robert A. Hutchins, Jr., Portsmouth, Va. Means are provided for steering the torpedo, for actuating a visible signal, and for changing the color of the signal from a distant point.

896,930. ALARM CLOCK. Elijah McComb, Johannesburg, Transvaal. The alarm clock, cells and actuating mechanism are fitted in a cabinet with a hinged door.

896,934. INSULATOR. John P. Nikonow, East Pittsburg, Pa. The core is provided with an enlargement and a collar surrounding the enlargement, and a rain-proof insulating cap.

896,935. ARC LAMP. Ludvik Ocenasek, Prague, Austria-Hungary. As the end of a fusible pin is melted, the carbon is fed downward.

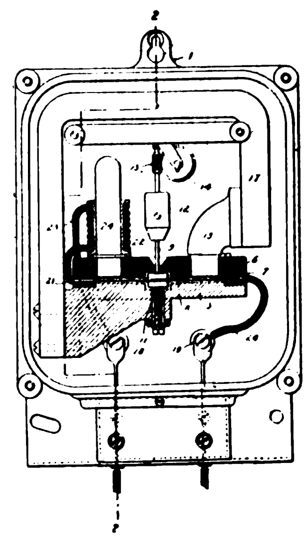
896,951. SOLDERING MACHINE FOR COMMUTATORS. Harry Stone, Wilmerding, Pa., assignor to the Westinghouse Air Brake Company, Pittsburg, Pa. The soldering tool is provided with a grooved surface, and is held in a heated receptacle equipped with means for rotating.

896,973. CHARGING SYSTEM FOR STORAGE BATTERIES. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. An automatic switch is adapted to connect the batteries alternately to a charging conductor or to a discharging device.

896,979. FIELD REGULATION FOR MOTOR-GENERATORS. Charles E. Eveleth, Schenectady, N. Y., assignor to General Electric Company. Means are provided for simultaneously varying the speed of the motor and the field strength of the generator.

896,980. RECTIFIER PANEL. Samuel Ferguson, Schenectady, N. Y., assignor to General Electric Company. Two panels are provided on standards, one containing the rectifier apparatus and the other the circuit-connecting and measuring devices.

896,983. TRANSFORMER-CORE CONSTRUCTION. John J. Frank, Schenectady, N. Y., assignor to General Electric Company. The lamina are interleaved at the joints, and a portion of the lamina has notches located dissymmetrically at the interleaving ends.



896,999.—METER.

896,984. CONDUIT FOR ELECTRIC WIRES. Horace C. Freeman, St. Paul, Minn. A trough and a plurality of removable cover sections.

896,993. CONTROL SYSTEM FOR MOTOR-DRIVEN RECIPROCATING DEVICES. Leopold Janisch, Berlin, Germany, assignor to General Electric Company. The reciprocal motion of the motor is controlled between predetermined points.

896,999. METER. William J. Lloyd, Rugby, England, assignor to General Electric Company. The meter is equipped with a receptacle containing a conducting liquid.

897,013. METHOD OF GENERATING AND DISTRIBUTING ALTERNATING CURRENTS. Edward B. Raymond, Schenectady, N. Y., assignor to General Electric Company. Means are provided for deriving alternating current by driving the machine by mechanical power at a speed in any direction so that it runs greatly in excess of the speed corresponding to synchronism with the exciting current.

897,019. ELECTRIC CLOCK MECHANISM. George H. Rupley, Schenectady, N. Y., assignor of one-half to Frank J. Seabolt, Schenectady, N. Y. The motor circuit is closed for a predetermined period, and means are provided for disconnecting the motor from the winding mechanism when the motor circuit is opened.

897,020. ELECTRIC CLOCK WINDING MECHANISM. George H. Rupley, Schenectady, N. Y., assignor of one-half to Frank J. Seabolt, Schenectady, N. Y. The clock mechanism is connected with the motor, whether the motor circuit is open or whether the motor circuit is closed.

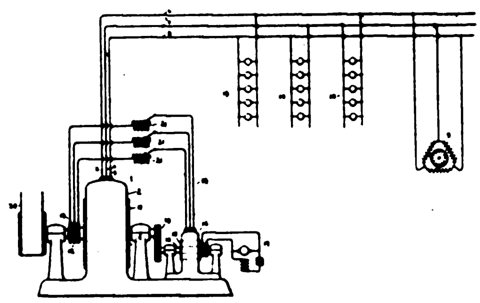
897,024. SYSTEM OF ELECTRIC METERING. Ernest Schattner, Schenectady, N. Y., assignor to General Electric Company. Means are provided for connecting the field coils in series with one or another set of translating devices.

897,028. CIRCUIT SYSTEM FOR TELEPHONE REPEATING APPARATUS. Herbert E. Shreeve, Newton, Mass., assignor to American Telephone and Telegraph Company. A combination of reinforcing circuit with an input coil.

897,031. SYSTEM OF CONTROL. Emmett W. Stull, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. The magnet opens the switch to break the motor circuit, the magnet being energized only when the controller is moved backward to its first operative position.

897,039. PROCESS FOR PURIFYING AND FILTERING WATER. Alfred Vogelsang, Dresden, Germany. The material to be purified has small quantities of ozone added to it.

897,042. TELEPHONE SYSTEM. Alfred H. Weiss, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A central-energy visual-signal telephone system.



897,018.—METHOD OF GENERATING AND DISTRIBUTING ALTERNATING CURRENTS.

897,062. CABLE TERMINAL. Frank B. Cook, Chicago, Ill. A can-top terminal with means for facilitating the holding of the cover piece in place during examination.

897,084. APPLIANCE FOR USE WITH TELEPHONE TRANSMITTERS. Orrin H. Goodrich, Castleton Corners, N. Y., assignor to Edward F. Hutton, New York, N. Y. A cabinet for enclosing a telephone transmitter.

897,085. SPRING JACK FOR TELEPHONE SWITCHBOARDS. Georg Grabe, Wilmersdorf, Germany, assignor to Siemens & Halske Aktiengesellschaft, Berlin, Germany. The spring jacks are mounted on very small spacing centres.

897,110. ELECTRIC INCANDESCENT LAMP. Hans Kuzel, Baden, near Vienna, and Richard Hoke, Vienna, Austria-Hungary; said Hoke assignor to said Kuzel. A plurality of horseshoe-shaped metal filaments is supported by insulating holding devices and connected to supply wires.

897,119. TELEPHONE SIGNAL. Charles Mahler, New York, N. Y. Each branch telephone is equipped with a bell of individual tone.

897,138. SIGNAL SYSTEM. Robert Pfeil, Grunewald, Berlin, Germany, assignor to Siemens & Halske, A. G., Berlin, Germany. The setting lever has normal, intermediate and full-controlling positions.

897,147. ELECTRIC REGULATOR. Thomas M. Pusey, Kennett Square, Pa. The combination of an insulating liquid and a conducting liquid lighter than the insulating liquid resting thereupon.

897,149. BRAKE SETTER. William A. Rideout, Sr., Oshkosh, Wis. The signal is provided with a movable contact adapted to be engaged by contacts on the car.

897,166. ELECTRIC MOTOR. Wilfred Shurtleff, Moline, Ill. The groups of three poles comprising the field magnets have two small poles flanking the larger central pole.

897,186. ELECTRIC WATER HEATER. Joseph R. Ayotte, Montreal, Quebec, Canada, assignor to Jean Baptiste Albert Martin, Montreal, Canada. The heating element is contained in a metal receptacle.

897,194. LAMP-SHADE HOLDER. John Cruikshank, Shamokin, Pa. The relatively movable conical plates are provided with a plurality of gripping members interposed between the plates.

897,203. ELECTRIC FURNACE. Johannes Härdén, London, England, assignor to the Gröndal Kjellin Company, Limited, London, England. A primary coil is positioned on an iron frame in inductive relation to an annular fusion chamber.

897,211. PROTECTIVE DEVICE FOR ELECTRICAL SYSTEMS. Karl Kuhlmann, Berlin, Pankow, Germany, assignor to General Electric Company. The conductors of a polyphase electrical system are provided with a resistance and safety device connecting each conductor with each other conductor of the system, and a low reactance path to ground from the junction of each safety device and its corresponding resistance.

897,212. LIGHTNING ARRESTER. Karl Kuhlmann, Berlin, Pankow, Germany, assignor to General Electric Company. A multi-gap, variable-resistance arrester.

897,215. ELECTROMAGNETIC SWITCH. William MacMillan, New York, N. Y. The switch is automatically locked or unlocked by means in the controlling circuit.

897,226. MEANS FOR GENERATING AND DISTRIBUTING ALTERNATING CURRENTS. Edward B. Raymond, Schenectady, N. Y., assignor to General Electric Company. The alternating-current generator has two relatively movable members, each provided with a multiphase winding. A resistance in the circuit of the exciter is used for varying the compounding action of the generator.

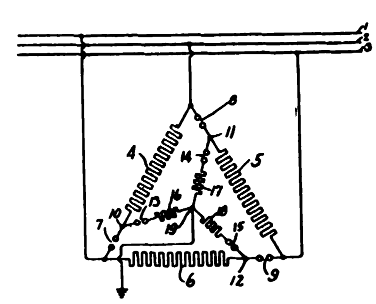
897,232. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Means are provided at the subscriber's station to control the flow of current in the line.

897,233. TELEPHONE-EXCHANGE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. The signal is displayed when the line circuit is closed at the substation.

897,234. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Means are provided at the subscriber's station to determine the current flowing in the line.

897,235. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. The signal-receiving electromagnet associated with the line has an energizing winding of low energizing capacity normally in circuit.

897,236. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. A switch is provided at the substation for controlling the flow of current over the line through the substation.



897,211.—PROTECTIVE DEVICE FOR ELECTRICAL SYSTEMS.

897,237. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. A central station provided with a link circuit.

897,238. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. The system is provided with a repeating coil for inductively uniting the line to the terminal.

897,239. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. The polarized repeating coil relay has windings inductively uniting the line to the terminal.

897,240. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. The repeating coil relay is controlled solely by the subscriber, having windings inductively uniting the line to the terminal.

897,241. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. The talking circuit is substantially devoid of resistance and impedance.

897,242. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Means are provided for interrupting the normal connection during the connection of the ringing source.

897,243. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Current sources of different potentials are used.

897,257. DYNAMOELECTRIC MACHINE. Max R. Hanna, Schenectady, N. Y., assignor to General Electric Company. The machine has two armature windings provided with commutators and adapted to be connected relatively in the supply and load circuits.

ELECTRICAL REVIEW

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ADVERTISING
CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

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CONTENTS

MOTOR LOADS IN HOTELS.

To the central station which numbers one or more modern hotels among its customers the chance for the development of power business is worth following closely, for there is no field where the advantages of the electric motor are more conspicuous. The great problem in operating a hotel is to keep the labor cost down, since in many houses there are often from one to one and a half employés per guest. The wages of many hotel attendants are small, but rarely anywhere near enough to be more economical than a machine capable of doing the same work. The organization of the larger city hotels has been carried to a point of great refinement, but it is a question if the size of the staff can not be very materially reduced by the installation of motor-driven machinery to a wider extent than has generally been the case in the past.

Upon the cleanliness and speed of the service the patronage of a first-class hotel largely depends. Labor-saving devices are therefore at a premium in the management of the most progressive hostelries. In the kitchen and laundry the electric motor affords the cleanest of all powers. It economizes floor space, enables the best lighting conditions to be enjoyed in the culinary department, allows the location of any machine at the most convenient point, and thus facilitates the quickest handling of both raw materials and cooked-food products. It is a great convenience to be able to put a motor-operated machine well out of the reach of the ranges, ovens, broilers, cold-storage chests and other equipment frequently visited by employés, and here the motor drive contributes directly to the acceleration of the service to and from the dining rooms. The severity of the surrounding conditions causes little embarrassment in a motor installation, and the time spent in repairs by the generally overworked maintenance staff of a modern hotel is seldom chargeable in any considerable proportion to the electric motor.

The number of individual applications of motors that can be made to advantage in a large hotel with resources enough to purchase the most efficient labor-saving equipment is too great to specify in a simple list, but in almost every department the convenience of the motor drive justifies its adoption. Passenger and freight elevators, semiautomatic hoists and dumbwaiters, dish conveyers, ash hoists and coal lifts form a class of equipment by itself especially adapted to motor driving. A strong point in favor of the electric elevator is the fact that it takes power only in proportion to the load, while the hydraulic machine consumes practically full power regardless of the weight in the car. The choice between electric and hydraulic elevators is, however, a problem in itself, but for the smaller hoists there is no other power as advantageous as electricity, both in respect of the speed of service and economy of operation. The electrically driven dumbwaiter has reached an advanced stage of development in the later hotel work, especially in its automatic features.

In the electrical operation of bread-mixing machinery, apple parers, bread-moulding machines, ice-cream freezers, fruit cleaners, pie trimmers, coffee grinders, meat and food choppers. silver polishers, knife grinders, cutlery brighteners, pitcher and silver buffers and scrapers, ice crushers, dish-washing machines and other smaller apparatus, there is an excellent chance to save labor through the use of the electric motor. Over steam the efficiency is undisputed, but the chief gain to the hotel management is, as indicated above, in the cost of attendance. When a single chopper driven by an one-horse-power motor will handle from 500 to 750 pounds of meat in an hour; when a two-horse-power washer will clean 3,000 dishes in sixty minutes, and a knife polisher brighten 250 knives in half an hour, the possible savings in hand labor become attractive. The cost of the machine is a small matter when its capital charges and operating expenses are balanced against the wages item with and without the machine under the conditions usually prevailing in hotel service. In the field of general motor application, driving small fans, pumps, refrigerating apparatus, and notably in keeping the odors of the kitchen away from the cafés, corridors, etc., in assisting fireplace ventilation, or in extracting smoky air from the banquet rooms, in operating sewing machines in the linen division, and in numerous other uses, the electric drive can be made so serviceable that the central station man who fails to emphasize these features in seeking to enlarge his power load in the hotel field lets slip an excellent opportunity to secure business of the most desirable kind.

THE RELATIVE HYGIENIC VALUES OF ELECTRIC INCANDESCENT LAMPS AND GAS.

Among the advantages claimed by the electric lighting companies for the incandescent lamp as compared with gas are its higher luminous efficiency and the fact that it does not give off useless, if not objectionable, gases. It is contended, and apparently with good reason, that since the incandescent lamp gives off only about half as much heat as an equivalent incandescent gas lamp, the latter will heat the air in a room to a higher temperature, which is a disadvantage when it is desired to keep the room cool, and since the gas lamp depends upon the combustion of gas for producing incandescence, and this combustion uses up oxygen, while there is no combustion in the incandescent lamp and no utilization of oxygen, the latter source of light should leave the air of a room in better condition for use by those persons therein. Theoretically, no fault can be found in these arguments, so that it only remains to demonstrate how far they apply to actual conditions. If living rooms were airtight there would be no doubt of what actual tests would show; but fortunately for the health of the race all buildings are more or less pervious to air, so that a certain amount of ventilation takes place without any special provision having been made for it. The air in a room is constantly changing at a rate depending upon many factors—the number of windows and doors, the character of the walls and ceiling, the state of the weather, and the location of the room with respect to other parts of the building, or to other buildings. In buildings of light structure the ventilation will generally take care of itself unless there be an unusual number of persons in a room at a time. But in the heavier buildings, such as are constructed of steel and brick, or stone, and which are usually heated by steam or hot water, ventilation must be provided. It, therefore, becomes an interesting question as to the effect of the source of light upon the air of a room and the additional ventilation necessitated by it.

Until about a year ago no figures obtained from actual tests had been published. Last summer, however, Mr. Vivian B. Lewes, in a lecture before the Royal Naval College, of Greenwich, England, touched upon this point and made the statement that the very features of the gas lamp which the electrician considered as faults were benefits, since the greater amount of heat set free, as compared with the incandescent electric lamp, and the volume of hot gases produced acted as ventilating agents and kept the air of the room purer and in a better condition for the use of the occupants. Mr. Lewes's contention, however, was spoiled by the manner of presentation, which was too obviously that of one determined at all hazards to show that gas was in every respect superior to electricity. Hence little weight was given to his statements and in the instances in which the electrical journals noticed them they were ridiculed.

More recently the question has been investigated somewhat carefully by Dr. Samuel Rideal, a recognized authority in sanitary matters in England. His results were presented to the Royal Sanitary Institute, and are given in abstract in the *Engineering News* for July 30. The investigation was carried out on three lines: into the direct effect of the light; into the effect of the products of combustion, respiration, perspiration, etc., and into the nature, amount and distribution of these products. A lack of information on the ventilation of rooms and the results of physiological examinations of persons while at their normal tasks made the investigation more troublesome than had been anticipated. About fifteen persons took part in the experiments, all normal individuals.

The experiments were carried out in a basement room of a London office building. This room had been formed by throwing two rooms, each fourteen feet by sixteen feet, into one. It had one front wall containing four windows. Later this room was cut into two similar rooms, each with two windows, by means of a wooden partition and screens. To minimize disturbances due to persons entering the rooms, air locks were constructed out of baize doors placed in the corridors at the entrance of each room. The rooms were cleaned and whitened before beginning the tests, and the ventilation was brought partially under control by means of an adjustable grating. From the results of the tests, however, there seems to have been ample ventilation due to leakage around doors, windows, etc. At first the rooms were unheated, but when the weather turned cooler electric heaters were put in, this type being selected to avoid, as far as possible, bringing in any other agent which would affect the air in the rooms.

Before dividing the large room into two the gas and the electric lamps were used on alternate evenings. Afterward gas was used in one room while the electric lamps were used in the other, the two systems being used alternately so as to avoid any change which might result from the continuous use of one system in one room. Each room was fitted with a central fixture containing two electric and two gas lamps. Both types of lamp were rated at twenty-five candle-power, the gas lamps being of the inverted-mantle type taking 1.28 cubic feet of gas an hour, and the electric lamps consuming ninety-four watts each. The arrangements of the two types gave a more intense illumination on the table beneath the lamps, where the experimenters worked, when the gas lamps were in use, but a better general illumination when the electric lamps were employed. To these differences were attributed the slight difference in the optical effects noticed during the experiments. The heat liberated in an hour by the gas lamps was computed, from the calorific value of the gas, to be 1,382 British thermal units; that liberated by the electric lamps was something less than half this, being 658 British thermal units.

At first the ventilation was watched by determining the quality of the air before and after each evening's work, but the changes found were so slight and so variable that no satisfactory conclusions could be drawn. Then the plan of introducing a large quantity of carbon dioxide was resorted to. This was thoroughly mixed with the air of the rooms, and the rate at which the air returned to normal was taken as a measure of the ventilation. This method showed apparently that there was a slightly better ventilation when the lighting was done by gas than by electricity, a result attributed to the greater amount of heat produced and the hot products of combustion. But it was found that the heat given off by the occupants of the room and their movements had much more to do with the ventilation than either of the systems of illumination. Nor did changes in outside conditions, except the temperature, seem to have any effect; if anything the ventilation was somewhat better with a moderate wind blowing, or when the weather was fairly quiet, than when a strong wind prevailed. The only influence noticed was the difference in temperature between the air in the room and that outside; the greater this difference the more rapidly was the air of the room changed. This result is rather remarkable because the tests were carried out in a building with massive walls and the ventilation was restricted, and, moreover, it was computed that about twenty-eight per cent of all the heat developed in the room was carried away by the air, the remaining seventy-two per cent being carried off by radiation and conduction through the walls.

Other tests were made to study the effects of other influences: the humidity of the air was varied from very dry to very moist without appreciable effect on the occupants; the organic matter exhaled by those in the room was collected in potassium permanganate and it was found that less was collected in this way when gas was used for lighting, the burning gas evidently destroying a certain amount of these volatile substances; the traces of sulphur dioxide formed by the burning coal gas seemed to have a germicidal action on the bacteria existing in the room; coal gas was allowed to escape into one room at the rate of 8.8 cubic feet an hour for over four hours, but no serious symptoms were noticed in any of the three men who remained in it.

The *Engineering News*, in an editorial commenting upon this work, says it remains to be seen how those interested in electric lighting will receive this blunting of one of their favorite weapons of attack, and then proceeds to show that the blunting is not as serious as at first seems. The tests were made in cold weather, which, it is evident from the tests, is more favorable to gas. Similar tests during the summer might show different results.

It is to be noted that the differences found between the two systems of lighting were slight and neither one was as important a factor in determining the conditions in the room as the occupants themselves. Such conditions are not favorable to accurate differentiation between the effects of the two lighting systems. The tests were conducted in a steel-framed structure which dissipated seventy-two per cent of the heat by conduction and radiation and the results are not applicable to buildings of other types. Moreover, the two systems of illumination were used alternately so as to avoid differences resulting from the use of the two rooms without change. If the object of the investigation was to detect differences between the two systems of illumination it would seem logical not to alternate in this way and to let the differences accumulate. It is not customary to vary one's system of lighting as was done here. Another point to be remembered is that the tests were conducted with incandescent gas lamps and the results do not apply to open burners.

Dr. Rideal's results are interesting, but not entirely convincing, and further tests will have to be made before it can be said that the superiority of gas has been demonstrated. It would be well if some of those interested in electric lighting should undertake similar investigations under somewhat different conditions. We should be much surprised if some of these tests, should they be made, do not show quite different results. As we remarked before, the electrical advocates' theory is sound and it only remains to show how far it applies in practice.

DANGEROUS HAND LAMPS.

A recent report, prepared by Mr. G. S. Ram, inspector of factories for the British Board of Trade, calls attention particularly to what seems at first a slight defect in electrical hand lamps, but which the inspector says has already caused three fatal accidents. These are electrical hand lamps attached to a flexible cord, with a wire guard for protecting the bulb. The guard is very frequently attached to a metal base, clamped upon the lamp sockets. The cord itself is usually, for convenience, passed through a hole running through the insulated handle. The trouble with this device is that occasionally the metal plate supporting the guard becomes alive, due to some injury to the insulation of the wire. The guard is, of course, in metallic connection with the socket, and is alive whenever the latter is. And, although the user of the lamp would avoid touching the socket, he is not apt to anticipate danger in touching the guard. Sometimes, indeed, the socket is attached to a brass ferrule, which seems to form part of the handle, and which the uninitiated would not consider part of the socket, although it is metallically connected thereto. It was just these faults which gave rise to the three deaths referred to above.

This defective construction should never be allowed because of the risk when such a device is used on alternating currents. The fault is easily corrected by supporting the wire guard on an insulating plate or shell, thus avoiding any metallic connection whatever in the pocket. There are a number of such arrangements available, one of which should always be adopted. The reason is so apparent it would hardly seem necessary to call attention to it, if the defective arrangement had not actually been the cause of death. It may be added that it is just as important to avoid an arrangement which is likely to bring the hand of the user of the lamp in contact with the connecting wire, when the arrangement of the handle is liable to injure the insulation of the wire. We are apt to forget that even though the actual potential at the lamp is low, it is possible by a combination of defects for a high potential to exist between the lamp and the ground if the system of distribution employ alternating currents.

ILLUMINATION AND OUR EYESIGHT.

In an interesting editorial discussion our London contemporary, *Engineering*, takes up the possible effect upon our eyesight of the brilliant illumination which is now so much in popular favor. The introduction of powerful electric incandescent lamps, fitted with metallic filaments, has increased the complaints from those who see in the intense brilliancy of the newer forms of lamp a lurking danger. It is conceded that with the improvement in our newer forms of incandescent lamps we have been receiving more and more ultra-violet rays. In many cases where the light source is surrounded by glassware more or less opaque to the ultra-violet rays, this effect has been masked, and has lessened what, in some quarters, is considered a danger. It is well known, however, that experimenters working with metallic filaments at a point of high incandescence have been affected by severe irritation of the eye and eyelids, and this effect has been set down to the prevalence and activity of the ultra-violet rays. Coincidentally, the effect has been noticed where the filaments have been encased in quartz glass tubes, the quartz glass being, of course, more transparent to the ultra-violet rays than is the glass from which the ordinary lamp bulbs are made. Both the crystal lens and the retina of the eye are said to be affected by ultra-violet rays, and it is also announced that a good many of our protective spectacles are of little value. Dr. Fr. Schanz and Dr. C. Stockhausen regard the ultra-violet rays as a source of danger, and point to the experience of several operators as conclusive testimony to this effect. On the other hand, Dr. Voege, of the physical government laboratory, of Hamburg, after conducting numerous photographic experiments to determine the abundance of the ultra-violet rays in our modern illuminants, as compared with sunlight, states that the danger is exaggerated. The chief results of Dr. Voege's experiments would seem to indicate that the ultra-violet rays are more plentiful in the sunlight than they are in various forms of incandescent illuminants, with a few exceptions. His experiments, however, are all photographic, and the eye certainly, as far as we can determine, is not sensitive in the same order as is the sensitized plate.

Direct photographs of the spectra of various lamps and of the sunlight taken through the slit of a spectrograph gave a much longer ultra-violet spectrum in the case of sunlight than any lamp, and the interposition of a screen of window glass did not much alter the result. Even the sunlight reflected from the slabs of sandstone stairway was richer in ultra-violet light than the electric light. Dr. Voege concludes that the eye receives less ultra-violet light from the lamps than from the direct sunlight, but makes suggestions concerning the shielding of the eyes from the direct light of the former.

What the real danger is still remains to be discovered. Fortunately, we are not inclined to gaze directly upon the glowing filament, and in most modern illumination good taste demands that the direct light from the filament be diffused by means of some form of semi-opaque glassware. The experiments which have been announced by the workers just mentioned, and their results, will be watched for with keen interest by every one having to do with the subject of illumination.

The whole subject of the effect, whether for good or evil, of the invisible radiation, is worthy of continued study. The early practitioners with the X-ray found to their cost that careless handling caused disastrous results both to the operators and to the patients subjected to the photographic influences of the Roentgen ray. Nowadays the danger has been eliminated, due to the scientific use of filtering screens and the shortening of the time necessary for a complete and satisfactory exposure. There are also many well-authenticated cases of burns from the invisible radiation from radium emanations, and the penetrating power of these rays, too, was discovered accidentally. These accidents and such work as is being conducted by Drs. Schanz, Stockhausen and Voege indicate that wherever the invisible radiation is involved, or where there is good reason to suspect that it is present, care should be taken to guard against damage in so far as our present methods of protection will insure possible safeguards.

In still another direction comment is raised, and a warning is sounded that the etheric impulses propagated through the use of wireless telegraph systems will have a deleterious effect upon living organisms. Of course a good deal of this will doubtless prove to be visionary, but that certain effects are produced upon certain forms of anatomy appears to be assuredly a fact. It is to be hoped that further investigation will make us so familiar with cause and effect that we can detect, arrest and utilize to the service of man these elusive and at present hidden forces.

CORROSION OF IRON FROM THE ELECTROCHEMICAL STANDPOINT.[1]—I.

BY C. F. BURGESS.

Depreciation is a subject which is to-day occupying the attention of financiers, economists and accountants. It is one which presents various phases, none of which is more important than those of obsolescence and physical decay. For one of these the engineer may be held responsible; the other he should work to prevent. Obsolescence comes as a direct result of new discoveries in science and their adaptation to man's use. Physical decay apparently follows the working out of nature's process, yet it has been proved possible for the scientist and engineer largely to reduce the rapidity with which such decay progresses.

In the use of iron as the most important structural material, attention has been given hitherto more to design and erection than to preservation, but as the amount of erected iron increases, the importance of preserving it likewise increases. The older our existing iron structures become, the greater is the need of retarding their decay.

The phenomenon of physical decay of iron and its alloys has long been known, but is little understood. To control it a deeper knowledge of the underlying causes is necessary. When we recognize the fact that iron structures depreciate annually in value through physical decay at a rate varying from perhaps one per cent to twenty or more per cent we have a means of stating the importance of this in money units. When viewed from the standpoint of safety to life, as well as that of preservation of property, the matter takes on a far greater significance.

The importance of this subject from economic, socialistic, governmental and humanitarian standpoints should be sufficient to enlist interest in the work, quite aside from the fascination which it exerts in itself. As Sir Robert Austen has said, "The study of metals possesses an irresistible charm for us quite apart from its vast national importance. Metals have been sadly misunderstood; in the belief that animate beings are more interesting experimenters have neglected metals, while no form of matter in which life can be recognized is thought to be too humble to receive encouragement. Bacteria with repulsive attributes and criminal instincts are petted and watched with solicitude and comprehensive schemes are worked out for their development and culture."

Corrosion of iron may be considered as the generic term covering a number of diseases peculiar to iron and iron alloys. So little is understood as to the causes of even the most common of these diseases that to prescribe for them requires considerable assurance on the part of the experimenter. There is an insistent demand at the present time for further experimental study of corrosion and for the gathering of accurate records on corrosion phenomena.

Some of our leading authorities hold that primarily iron corrosion is an electrolytic phenomenon. Such a view was advanced by W. R. Whitney (Journal American Chemical Society, 1903, page 394) and this was corroborated and notably extended by W. H. Walker (Journal American Chemical Society, 1906, page 1251). A. S. Cushman, through some interesting experiments described to our society last year, also sought to ascribe corrosion to electrolytic action.

The acceptance of such a belief would place upon the electrochemist the first responsibility of making a thorough study of iron corrosion, and it is certainly true that such research would offer him a most attractive field for work.

In viewing corrosion of iron as an electrochemical action, it may be desirable to divide into classes various kinds of corrosion encountered in practice. The first class to be considered is:

CORROSION OF UNDERGROUND STRUCTURES.

It is well known that under normal conditions, iron pipes buried in the earth for distribution of gas and water will corrode so slowly that the life may well exceed a century. The owners of such pipes were greatly disturbed not many years ago to find that a disease had been contracted by their pipes, presumably through association with electric railways. They attempted, and are still attempting, to demonstrate to the courts that the railway companies are responsible for damage caused to their pipes by the leakage of currents from the railway returns.

It has been shown beyond doubt that current flowing from iron to earth subjects the iron to electrolytic corrosion, but beyond discovering methods for mitigating the destruction, the electrochemist has not succeeded in freeing from electrolytic trouble pipes located near a single-trolley railway.

This phenomenon has attracted such attention that to many people the term "electrolysis" is synonymous with destruction of underground pipes. In spite of extensive study which has been given to this matter it is interesting to note various curious beliefs which are held even by some of the experts. Thus we have the disputed point as to whether current flowing from iron to earth will cause a quantitative corrosion as required by Faraday's laws; some hold that the earth conducts to a certain degree metallically, and therefore a small current density may not cause any corrosion whatever; while others assert, and probably more correctly, that Faraday's laws hold exactly for large and small currents alike. Testimony has been given to the effect that the flow of current through the earth results in the deposition of a coat of iron upon pebbles in the earth, a phenomenon certainly of interest to those who have experienced the difficulty of depositing iron under most favorable conditions upon a conducting cathode. The statement is repeatedly made that current flowing from the rails to the pipes does not produce electrolysis, but that current flowing in the reverse direction is dangerous. This, of course, is only another case of "whose bull is gored."

In the study of this type of corrosion the electrochemist is called upon to clear up erroneous beliefs by quantitative measurements. So far remedies applied have been qualitative rather than quantitative, and before accurate work can be done in treating this trouble a large amount of data must be available; such as the specific electrolytic conductivity of various earths, clays, gravels, etc. The minimum electromotive force for flow of current must be more carefully studied to determine whether an electromotive force, no matter how small, will cause electrolysis, or whether polarization is to be counted upon.

Some authorities assert that if the direction of the flow of current can be reversed occasionally the electrolytic corrosion of both electrodes may be prevented, the argument being that current flowing from the iron will carry iron in a solution and that some iron will be redeposited when the direction of the current is reversed. This remedy has been attempted in the operation of certain electric railways by reversal of the polarity of the generators once a day or every hour, or even more frequently, and the observations made during such practice led to the conclusion that the more frequently the reversals are made the less is the danger from electrolysis. In fact, when we carry this practice to its extreme

[1] From the presidential address before the American Electrochemical Society, Albany, N. Y., April 30.

limit and have a reversal several times a second we arrive at alternating-current transmission, the advent of which is generally assumed will be an absolute cure of electrolytic troubles, although some experts assert that an alternating-current system of distribution will not remedy present difficulties. The writer's experience in depositing iron from a solution even under the most favorable laboratory conditions has led him to believe that the chance conditions to be met with in the earth are not unlikely to make it possible to deposit iron from the earth on to the metallic electrode. Consequently relief from an occasional reversal of the current does not appear practical of attainment. This statement may not apply, perhaps, when the frequency of reversals is so rapid as to make the current come under the classification of alternating current.

GALVANIC ACTION.

Iron in contact with a metallically conductive material electronegative to itself, and both making contact with an electrolyte, constitute an active electrochemical system in which the iron is subject to corrosion. The rate of corrosion depends upon the electromotive force, upon the conductivity of the electrolytic and metallic conductors, and upon the polarization. If the electrolyte is such that the hydrogen is liberated on the electronegative surface it may produce polarization sufficient to stop the flow of current. If a depolarizing material be present the polarization will be decreased and the increased current thereby produced results in increased rate of corrosion. (Walker *et al*—Journal American Chemical Society, 1906, page 1251.)

As examples of an electrochemical system of this type, the following well-known cases may be named: An iron ship in a harbor with a copper-sheathed ship are considered undesirable companions, since if metallic contact be made between the two, the iron suffers by being made the anode of a huge electrochemical system of which the copper ship is the cathode and the sea water the electrolyte. It is not good practice to attach a bronze propeller on a steel shaft of sea-going ships, for unless suitable protective steps are taken the neighboring steel will be damaged.

The more electronegative the material the more marked is the electrolytic action, and some forms of conductive carbon have properties such as to make the electrolytic action particularly pronounced. Various investigators have pointed out that carbon cinder embedded in an iron surface, or carbon making contact with iron in any way, engenders corrosion by galvanic action. This action takes place whether the piece of iron is of large or small size, and the kind of action produced by particles of microscopic size is identical with that produced by the large particles. The uncombined carbon which chemical analysis shows to exist in certain kinds of iron may therefore increase the corrodibility of such iron. The measurement of the single potential of iron sulphide shows this to be electronegative to iron and its presence in iron will give rise to active couples. It can hardly be doubted that such surface exposing spots of iron sulphide is one upon which electrolytic action will take place if an electrolyte be present.

Almost any microphotograph of iron and its alloys shows non-uniformity of composition of surface exposed to corrosion, and we are justified in the belief that the micrographic constituents should be studied in dealing with iron corrosion from the electrochemical standpoint. We do not know in what electrochemical order the ferrite, pearlite, cementite and other constituents of iron alloys may arrange themselves. Data as to the single potential of these various constituents are needed if we would express quantitatively the tendency of a certain combination to corrosion. At the present time our only knowledge of these potentials is of a qualitative kind and also very fragmentary. The available published data come from the records of the work done by the metallographists in their microscopic study of iron. Highly polished iron surfaces have been treated with various corroding acids and reagents, the purpose being to corrode the different constituents at different rates under the microscope. A study of the literature on metallography for the purpose of classifying these observations might constitute interesting and valuable work.

It is perhaps doubtful if the exact measurement of any one constituent could be made, at least with the present method of measurement, since in measuring the electrical potential of an iron or iron alloy, a value is obtained which may be the electromotive force given by the most positive constituent, or it may be that produced by the polarization phenomenon, or it may be some intermediate or composite value. W. H. Walker and associates (Journal American Chemical Society, September, 1907) have devised an ingenious method for determining the different potentials established by different portions of an iron surface, and they have shown "that in certain instances areas having marked difference in potential exist in far greater number upon the surface of a piece of iron prone to corrosion than upon iron which is resistant to corrosion." Whether this method would lend itself to the measurement of microscopic portions of an iron surface is problematical. An active electrochemical system can usually be detected wherever corrosion is observed, but whether corrosion can exist where no electrolytic action is possible is a matter which appears far more difficult to determine.

Assuming a similarity in chemical composition and metallographic constitution in different samples of iron or iron alloys the question may be asked, "Can the single potential differ in different specimens or different parts of the same specimens?"

INFLUENCE OF STRAIN ON CORRODIBILITY.

Does strain in iron increase tendency to corrosion? This is a question which has been the subject of interesting discussion and upon which there is radical difference of opinion. Data obtained by different investigators are quite contrary, and it is natural then that contradictory conclusions have been drawn.

In referring to those radically different conclusions of different experimenters the writer disavows any desire to enter into a controversy. But it appears that unless errors which are allowed to creep into methods of measurement are recognized and then guarded against, the data obtained can be of little value and these errors can perhaps be detected by comparison of the methods employed by different observers.

As a matter of scientific interest we may refer to that well-known riddle which runs as follows: Two steel clock springs are identical as to weight and quality of material, and differ only in that one of the springs is coiled and the other uncoiled. These are immersed in an acid solution and completely dissolved. What has become of the energy which was stored up in the coiled spring? The answer which most easily suggests itself is that this energy must have been liberated during the chemical process of solution and manifested itself as heat. Upon this supposition in dissolving the coiled spring more heat would be liberated than in dissolving the uncoiled spring. Further, the coiled spring would be more chemically active, and if so this chemical activity should be manifest as increased electrical contact potential existing between the metal and the solvent.

There are many instances coming under practical observation which seem to bear out the idea that a metal under strain is more subject to a dissolving or corroding action than is unstrained metal, this relation being particularly true in iron and its alloys. Mr. James Andrews in 1894 (Proceedings of the Institution of Civil Engineers) described some experiments by which he attempted to demonstrate that strained iron has a higher potential in a corroding solution than has unstrained. He concluded, however, from the results of his measurements, that the reverse condition holds, and that unstrained metal is more rapidly acted upon by the solution than the strained metal. Mr. Carl Hambuechen in 1900 (Bulletin of the University of Wisconsin, Engineers' Series) pursued an investigation which was, in a measure, a duplicate of that made by Mr. Andrews, with the exception that Hambuechen sought to eliminate some error in the former work by modifications and refinements in the method of measurement. He produced experimental data showing that the iron behaved as it should according to theory, and in fact he was able to secure, in some cases, a remarkable similarity of stress-electromotive-force diagrams with the stress-strain diagrams obtained simultaneously on the same sample. He says, "The application of stress to metal causes an increase in chemical activity, this increase being especially marked after the elastic limit has been reached."

In 1906 T. W. Richards and G. E. Behr, Jr., contributed a paper to the Carnegie Institution of Washington, publication No. 61, entitled "The Electromotive Force of Iron Under Varying Conditions and the Effect of Occluded Hydrogen." This paper asserts the presence of regrettable errors in Hambuechen's work, and among the conclusions it is stated that "measurements of the free-energy change in iron during a pull upon wire great enough to cause rupture gave results showing that this change must be very small." The authors apparently conclude from their work that the changes in electromotive force actually produced are too small and the data too scanty and irregular to warrant conclusions of value being drawn. This view apparently places Hambuechen's data under the charge of accidentally falling into a systematic order, which order would not have been shown had the alleged errors been avoided.

In 1907 Messrs. W. H. Walker and Colby Dill discussed "The Effect of Stress Upon the Electromotive Force of Soft Iron" before the American Electrochemical Society. In their summary the statement is made that "the magnitude of the potential suffered by soft iron when tested in a tension machine below the elastic limit is exceedingly small. . . . The change, when great enough to be measured, was negative; the strained metal had a slightly lower potential than the same metal unstrained. . . . . . Somewhere above the elastic limit the potential rises suddenly several hundredths of a volt."

It may perhaps be not unprofitable to enter into a consideration of the cause of the marked differences of the results obtained by different observers and the diametrically opposite conclusions which were drawn therefrom. Of the various authorities mentioned, Hambuechen has apparently secured results which uphold that plausible theory that iron upon which mechanical work has been done retains some of the energy in a potentialized form capable of being measured by electromotive-force readings. The other authorities discredit these results. It is probable that none of the results referred to have been obtained under conditions which are free from all sources of error. Hambuechen's work was done under the supervision of the writer, who therefore feels justified in discussing some criticism of his methods and conclusions. Mr. Hambuechen pointed out in his bulletin that chances for error existed in Andrews's work by reason of the fact that the surfaces whose potential was being measured were not protected from action of the air. He devised a cup-shaped arrangement which surrounded the sample of iron in the testing machine and carefully protected all of the parts of the iron from the air and the electrolyte except such portion of the surface as was kept immersed in the electrolyte and whose potential was being measured. He recognized that the amount of potential changes was exceedingly small and that the potential established by a metal in contact with an electrolyte is easily upset by the flow of exceedingly small amounts of current. The use of an ordinary galvanometer used in connection with the compensation method was believed to allow the flow of sufficient current to materially polarize the small surface under measurement. He therefore used a capillary electrometer, which acts as a condenser of small capacity and does not allow the steady flow of current through it. This electrometer had a sensitiveness of 0.0007 of a volt, and in addition to this sensitiveness it was unaffected by vibration and magnetic disturbances and could be mounted in close proximity to the testing machine.

Messrs. Richards and Behr employed a D'Arsonval galvanometer sensitive to 0.001 volt, and they apparently did believe it necessary to guard fully against polarization phenomena. Walker and Dill likewise took this view as to the precautions deemed necessary, for they employed a D'Arsonval galvanometer of fairly high resistance but provided with a shunt "to protect the galvanometer from too heavy currents during the preliminary adjustment of the resistances."

In both papers referred to, that by Richards and Behr and by Walker and Dill, objection is made to Hambuechen's results on account of his use of ferric chloride as the electrolyte against which the potential of the iron was determined. The former writers say that "this unfortunate choice" (of ferric chloride) "completely invalidates all the results. The reason is very simple. Ferric chloride is always hydrolized to a considerable extent —that is, it contains acid. . . . . . There exists in the electrolyte a continually changing concentration of ferric, ferrous and hydrogen ions and reliable work is out of the question. The effect of these influences combined would cause the electromotive force to change steadily, quite independently of any stress and strain effects." Data are given showing that in two cases the electromotive force of iron rose 0.192 and 0.123 volt in about seventeen hours, and they say that this rise would have been ascribed by Hambuechen to strain.

While it is perhaps true that a solution better than ferric chloride might be chosen, the criticism of Hambuechen's work for this reason is perhaps too severe, since he did recognize the fact that the electromotive force was subject to change, regardless of any strain effect. The change becomes so slow after a half-hour that a stress-strain diagram could be run through in a sufficiently short time that the natural change would have little effect in masking the changes produced by strains. In fact, in producing autographic record of the stress-strain diagrams the testing machine was run continuously and the electromotive-force measurements had to be taken with some rapidity. The writer believes that these observations of varying electromotive force are more probably the results of potentialized energy in the iron than the effects of hydrolysis of the ferric chloride solution, as emphasized by Richards and Behr.

The feature which at first sight might discredit more than any other the accuracy of Hambuechen's results is that he found changes in electromotive force which were materially greater than those calculated on the assumption that all of the energy applied to an iron rod in pulling it apart is thereby potentialized.

Barus has studied the disposition of energy applied in rupturing a piece of iron. ("The Energy Potentialized in Permanent Changes of Molecular Configuration," United States Geological Survey Bulletin, No. 94, 1892.) And quoting from him we read: "To summarize, it appears that as much as one-half of the work done in stretching up to the limit of rupture may be stored up permanently. Calculation of the increase of electromotive force by the potentializing of energy in iron involves the application of the formula

$$E = \frac{W \times c}{96540 \times g}$$

where

E is increase of electromotive force in volts.

W is energy stored, expressed in watt-seconds.

c is the chemical equivalent.

g is weight in grammes of the iron in which the energy is stored.

From measurements of stress and deformation Hambuechen calculated that the possible increase in electromotive force on a particular sample was 0.0126 volt (on the erroneous assumption that all of the applied energy was potentialized). He found in some of his measurements values two or three times as high as were apparently theoretically possible, to explain which he assumed an excessive storing of energy in the outer layer of iron as compared with that at the centre. Richards and Behr were justified in considering this an erroneous assumption. They have apparently overlooked the possibility, however, of a non-uniform distribution of such energy as may be potentialized by strain, for in their calculations of electromotive force they have assumed the energy to be equally stored in all particles of the sample of iron.

Ewing and Rosenhain, in a paper on "The Crystalline Structure of Metals" (Philadelphia Transactions, Royal Society, Vol. cxciii), have given results of microscopic study on the effect of strain on metals. It is well established in their work that the influence of strain is not uniformly distributed throughout the mass. It appears that the shape of the grains is altered, but that the crystals making up the grains are not deformed. "The conception that metals adapt themselves to the new shapes imposed upon them when they undergo plastic deformation by means of slips along cleavage or gliding planes within each crystalline grain leads naturally to the supposition that the crystalline elements themselves undergo no deformation in the process."

Energy is expended in overcoming the adherence or attractive force between crystals, and if there is a storage of this energy it might well be considered as being stored in the portion of metal adjacent to these surfaces. As this metal, containing potentialized energy, is exposed to the electrolyte, the electromotive force of this portion will be greater than that of the remaining portions. To calculate this electromotive force according to the formula given requires a knowledge of the actual weight of that portion of the metal in which the energy is stored, which obviously would be less than that obtained by weighing the entire mass. This weight is, of course, impossible to determine by known methods of measurement.

The electromotive force of the most electropositive particles is then greater than the average electromotive force calculated. The question then arises as to which value—the maximum, the minimum or average value, or some value of overvoltage of hydrogen—is obtained by experimental measurement of contact potential. Richards and Behr have described their determination of the single potential of small globules of iron around which were wrapped platinum wires to make contact. Their voltages are given as being the values for iron even though it is in contact with the more electronegative platinum. Likewise we have in a zinc amalgam the electromotive force of the zinc almost unaffected by the electronegative mercury. From analogy we might expect, therefore, that the potential would be that set up by the most electropositive particles on its surface. And if this line of reasoning is correct, we can easily explain why Hambuechen's measured values of electromotive force were higher than those calculated, and we may perhaps wonder why the differences were not even greater than found.

It should be recognized, in comparing the results of different investigators, that the materials designated as iron may, in fact, be different grades of iron. Richards and Behr confined their attention to highly purified iron, while Hambuechen used the term more loosely as designating the commercial grades of the metal. He found that the increase of potential by strain is more marked in steel than in pure iron, and a microphotograph of steel reveals the presence of various constituents. In all probability there is a difference in the storage of energy in the various constituents, and consequently the possibility of higher electromotive forces.

It may be emphasized again, and in this connection, that the microscope is a useful device in studying the phenomena pertaining to the corrodibility of iron.

(To be concluded.)

Semiannual Meeting of the National Association of Cotton Manufacturers.

The semiannual meeting of the National Association of Cotton Manufacturers will be held at Saratoga Springs, N. Y., September 29 and 30. The sessions will be held in the ballroom of the United States Hotel at 10 A. M., 2.30 P. M. and 8.15 P. M. on Tuesday, and at 8.15 P. M. on Wednesday. The fore part of Wednesday will be devoted to an excursion to the works of the General Electric Company at Schenectady, as guests of that company.

A programme has been arranged with fewer papers than usual in order to provide ample time for discussion. Among the papers to be presented are several which will bear directly upon the use of electricity in the textile industry.

The Textile Exhibitors' Association will hold its annual meeting at Saratoga Springs on September 29, and at this meeting officers will be elected for the ensuing year. Plans will also be made for a textile exhibit in the spring of 1909.

The officers of the National Association of Cotton Manufacturers are as follows:

President — Charles T. Plunkett, Adams, Mass.

Vice-presidents—George Otis Draper, Hopedale, Mass.; Franklin W. Hobbs, Boston, Mass.

Secretary and treasurer—C. J. H. Woodbury, Boston, Mass.

Auditor—C. E. Roberts, Boston, Mass.

Directors—Robert Beatty, Philadelphia, Pa.; Frederick A. Flather, Boston, Mass.; George P. Grant, Jr., Fitchburg, Mass.; Edwin Farnham Greene, Boston, Mass.; David S. Johnston, Cohoes, N. Y.; John W. Knowles, New Bedford, Mass.; William H. Loftus, Newark, N. J.; Henry F. Mansfield, Utica, N. Y.; Joseph Merriam, Middletown, Ct.

A Twelvemonth's Achievement of the Tungsten Lamp.

By S. E. Doane, Chief Engineer, National Electric Lamp Association.

THE past twelve months has marked the greatest progress in the history of artificial lighting. No epoch equal to it has ever been known. The advent of the incandescent lamp itself was possibly a greater scientific achievement, but no one period of time since has marked so great a change or benefit to the general public.

The carbon lamp created a field for itself. The tungsten lamp found the field created.

The carbon lamp was put into service with many frailties, whereas the latest unit was given to the world as a product of splendidly equipped laboratories and workshops where the testing and perfecting had all been done. The customer was made to suffer from the mistakes of the manufacturers of the early carbon lamp. This has not been the case with the tungsten. The new lamp from the first has outstripped its guaranteed performance and nowhere has there been a single failure of this lamp to fulfil all expectations.

The Nernst and Gem lamps were perfected several years too late, to have been fully appreciated. It is also a pity that the achievement of the tantalum lamp should have been so quickly superseded by the greater achievement of the tungsten.

The last twelve months have seen general recognition of the fact that the enclosed arc lamp is being superseded for interior lighting, while the Nernst lamp is entering upon this stage of its history.

The carbon lamp is still holding its own in quantity of production. Its rate of increase of production has been materially decreased and at no distant day the replacement of carbon lamps by tungsten will offset the new installations where the carbon lamp should legitimately be used.

It was inevitable that the first shock of the tungsten lamp introduction should occasion much anxiety on the part of the central station managers, but there is now to be noticed the most gratifying optimism on the part of the central stations. Many now report that the tungsten lamp has actually served to increase their revenues. From this time on, it is my belief, that these conditions will continue to prevail.

The central station has seen its worst days so far as decrease of revenue through the tungsten lamp is concerned. It was inevitable that stores and other places of a public or quasi-public character should have been the first to have employed this lamp, due to the fact that the first development of this lamp was in the units of larger candle-power, to which the fixtures in residences were not adapted. Central stations have suffered in revenue where public or quasi-public employment has maintained the volume of light which was sufficient, according to the old standard, with a decrease in current revenue to the station. This condition of replacement was continued for some months, but the progress of the country's recovery from its financial stagnation will now turn the tide.

Although replacement of carbon type lamps with tungsten in such places will continue, nevertheless, the opening of new fields and the general increase in the standard of illumination in such places will offset the decrease in current revenue from the places where illumination is already sufficient and also where the tungsten lamp replaced the carbon.

The next great field for the introduction of the tungsten lamp will be in domestic lighting. Light in public or quasi-public places is a necessity and is regarded as such, but, as with every other necessity, economies of the situation have to be largely considered. The tungsten lamp would have been adopted even at a higher price on account of the improved quality of the light. No up-to-date store can afford to be illuminated by anything else. The quality of light from an arc lamp can be made extremely good, but its flickering character, its comparative clumsiness of installation, its failure to conform well to artistic and architectural requirements, are such that the tungsten lamp has found it an easy competitor.

In the case of domestic lighting, electric light as employed to-day is not a necessity, but is a luxury. The domestic users of electric light are those who are willing to pay something for luxury. The tallow candle and the kerosene lamp are to-day cheaper sources of light, yet the general improvement in the standard of domestic livelihood demands electric light and it is my belief that the advent of this tungsten lamp brings the day of universal electric lighting nearer than any one event in the history of the electric lighting industry. The tungsten lamp is already recognized by the architect and decorator of this country as offering them an opportunity for larger and more artistic color schemes and decoration than have before been possible. Interior decorators with whom I have talked tell me that there is already a noticeable change and that the interiors of public buildings are being tinted to take advantage of the new opportunities. These conditions will likewise shortly prevail in domestic incandescent lighting.

There is another most important consideration in connection with the introduction of tungsten lights in the homes, and this is that the average individual who must divide up his income, living in the best quarters that his income will permit, and undertaking only such amusements as his income will allow, has been obliged to limit his expenditures for light on the same basis. The tungsten lamp will make light cheaper for him as well as giving him a quality of light by which he can better enjoy the furnishings of his home. The effect of this is going to be that the domestic user will use light for longer hours and inasmuch as the tungsten lamp, for the same illumination, will take much less current, the result is going to be that the peak load due to domestic lighting will be greatly changed. It is fair to call attention to this under the subject given me for this article inasmuch as the twelve months passed have already marked the beginning of this change. Residences will be more generally illuminated and instead of lamps being installed with many switches for the sake of economy in operation, the contractors will, in the future, arrange for rooms more generally and continuously lighted throughout the period between twilight and bedtime. This will result in increasing the demand factor and also the load-factor for our central stations with a result that they will be able to decrease rates, which, in itself, will again stimulate the introduction of the tungsten lamp.

Many practical problems have been met and solved in the last year. We now no longer hear of the great fragility of the tungsten lamp. Much of this has been due to increased knowledge in the laboratories by which the filaments have been made stronger. At the same time, the customer himself has learned how to handle this lamp. Breakage in shipment to-day is less than one-half of one per cent. While it is to be regretted that the lamp is as fragile as it is, a general recognition of this fragility, together with an improvement in the strength of filaments, has almost removed the question of breakage from a consideration of adoption of this lamp. Scarcely twelve months ago there was not a single well-equipped, well-established tungsten lamp factory in the United States; to-day there are several with a combined capacity of 75,000 lamps a day, and at present a combined daily output of 25,000 lamps. Prompt deliveries are being made by all tungsten manufacturers.

The next twelve months will see a rapid introduction of train-lighting lamps and other battery users for this lamp. The maker of the storage battery has begun to profit much from the demand for tungsten lamps of low voltage at various candle-powers.

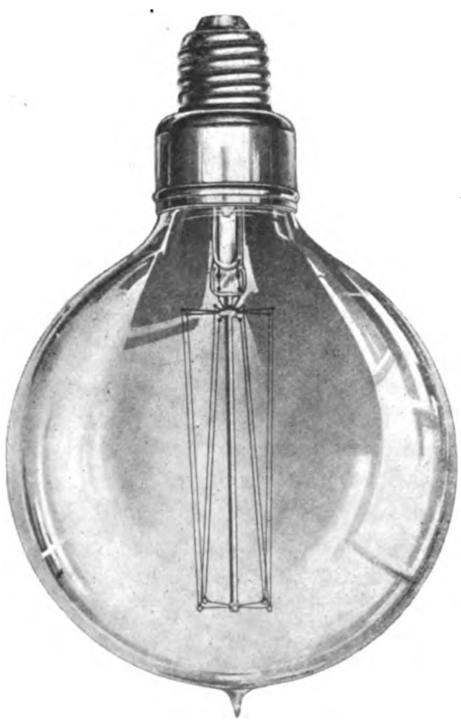
Great as has been the progress in the manufacture and production of this lamp in the past twelve months, an even greater progress awaits it in the twelve months to come. The industry is to be congratulated that the shock of the first introduction of this lamp has been so well met.

There will be other progress in the future. The problem of selective radiation, which the tungsten lamp has so well opened up, will be solved to a greater or less extent in the near future and a comprehensive and serious effort on a considerable scale has been inaugurated for the thorough scientific study of this and other problems underlying our industry. We look for much progress from such work.

Tungsten Lamp Economy.

By Francis W. Willcox.

RARELY does the evolution of an art culminate in such a simple device as the incandescent lamp, and in the case of the tungsten lamp the future appears to hold no prospect of undermining its supremacy as a lighting unit, but on the contrary promises to make its position stronger by increased efficiency.



Sixty-Watt Meridian Tungsten Lamp.

The arguments in favor of the electric incandescent lamp have long made it the standard to which all other illuminants have aspired, but the question of cost enabled its competitors to maintain a strong position in the field. The tungsten lamp distances in average efficiency its strongest competitor, gas, and, ideal in every other respect, places the best illuminant within the reach of all.

MANUFACTURING FACILITIES.

During the year that American-made tungstens have been on the market appreciation of their qualities has been shown by an enormous increase in their sales. Anticipating the demand, the manufacturers have kept pace with their orders after the first few months, and in the immediate future 75,000 per day will be the capacity of American factories, one manufacturer alone advertising facilities for nearly half this number. The economy, brilliancy and general satisfaction given by the tungsten lamp make every one of them a salesman, and the 1,000,000 American-made lamps now giving satisfactory service are dominating factors in the demand for their increased adoption.

RECENT IMPROVEMENTS.

Improvements in the tungsten lamp have been numerous during the year. Specially designed packing cases have reduced breakage in shipment to an almost negligible quantity—out of 100,000 lamps shipped by the company with which the writer is connected less than one and one-half per cent were lost, and damage from careless handling has naturally been eliminated by a realization of the caution required in installing. While the pendent position is recommended, tungsten lamps as now made give excellent results when burned at any angle.

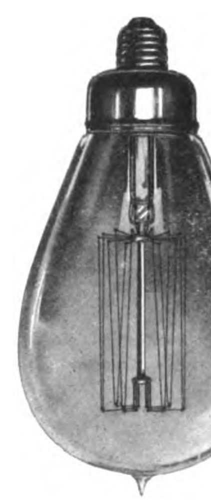
The twenty-five-watt tungsten for standard lighting circuits is still a thing of the future. Until it is perfected, however, the twenty-five-watt tantalum lamp, which has proved commercially satisfactory on alternating-current circuits, is making an excellent substitute.

THE 250-WATT TUNGSTEN.

At the other end of the scale the new 250-watt tungsten is making a phenomenal record. This lamp of 200 candle-power replaces gas arcs or electric arcs, lamp for lamp, and with considerable saving in operating expense entirely apart from increased safety, convenience and the other inherent advantages of the incandescent lamp.

The cost per candle-power naturally becomes less as the size of the unit increases, while the saving per unit of illumination remains the same (2.25 watts saving per candle-power when compared to a 3.5-watts-per-candle carbon lamp).

As compared to carbon lamps for equal illumination the forty-watt tungsten saves enough at ten cents per kilowatt-



General Electric 250-Watt Tungsten Incandescent Lamp.

hour to pay for itself three times over, but the 250-watt lamp saves enough to pay for itself eight times over. Furthermore, the 250-watt filament is much thicker and stronger than in the smaller sizes. It is a happy coincidence that this lamp, which is the most active factor in replacing the strongest competitors of the incandescent lamp, should be the sturdiest, and therefore least subject to, perhaps the most frequently mentioned argument against its use—the bugbear of fragility.

OPERATING COSTS.

The basis of all comparison is the actual saving in watts per candle-power of light, but the cost of the lamp and its life are necessary factors in making a correct commercial investigation of the tungsten lamp's merits.

The accompanying table has been compiled from such general data, and may be found surprising in many of its items. Its most interesting feature, however, is found in the last line of the table, which shows that for the same number of candle-hours of light the total cost of power and lamps for carbon lamps is more than double that with tungsten lamps.

TABLE OF DATA AND COSTS FOR SERVICE WITH VARIOUS LAMPS.

	Carbon.			Gem.		Tantalum.	Tungsten.			
	16 C.P., 3.1 W.P.C.	16 C.P., 3.5 W.P.C.	32 C.P., 3.1 W.P.C.	20 C.P., 2.5 W.P.C.	40 C.P., 2.5 W.P.C.	20 C.P., 2 W.P.C.	32 C.P., 1.25 W.P.C.	48 C.P., 1.25 W.P.C.	80 C.P., 1.25 W.P.C.	200 C.P., 1.25 W.P.C.
Total watts	50	56	100	50	100	40	40	60	100	250
Hours life to 80 per cent rated candle-power	500	1,000	500	500	500	800	800	800	800	800
Cost of lamp	17¢	17¢	25.5¢	21.25¢	29.75¢	51¢	$1.23	$1.49	$1.70	$3.40
Kilowatt-hours during life	25	56	50	25	50	32	32	48	80	200
Cost of renewals per kilowatt-hour	0.68¢	0.30¢	0.51¢	0.85¢	0.595¢	1.6¢	3.84¢	3¢	2.11¢	1.7¢
Cost per 100 hours' service for power at 10 cents per kilowatt-hour	50¢	56¢	$1.00	50¢	$1.00	40¢	40¢	60¢	$1.00	$2.50
Total cost of power and lamps per 100 hours' service at 10 cents per kilowatt-hour	53.4¢	57.7¢	$1.05	54.3¢	$1.07	46.4¢	55.3¢	78.5¢	$1.21	$2.925
Candle hours during life	7,350	14,700	14,720	9,200	18,400	14,720	23,680	35,520	60,000	150,000
Cost of power per 100 candle-hours at 10 cents per kilowatt-hour	3.4¢	3.8¢	3.4¢	2.7¢	2.7¢	2.17¢	1.36¢	1.36¢	1.36¢	1.36¢
Cost of renewals per 100 candle-hours	0.23¢	0.12¢	0.17¢	0.23¢	0.16¢	0.35¢	0.50¢	0.41¢	0.28¢	0.226¢
Total cost of power and lamps per 100 candle-hours at 10 cents per kilowatt-hour	3.63¢	3.92¢	3.57¢	2.93¢	2.86¢	2.52¢	1.86¢	1.77¢	1.64¢	1.586¢

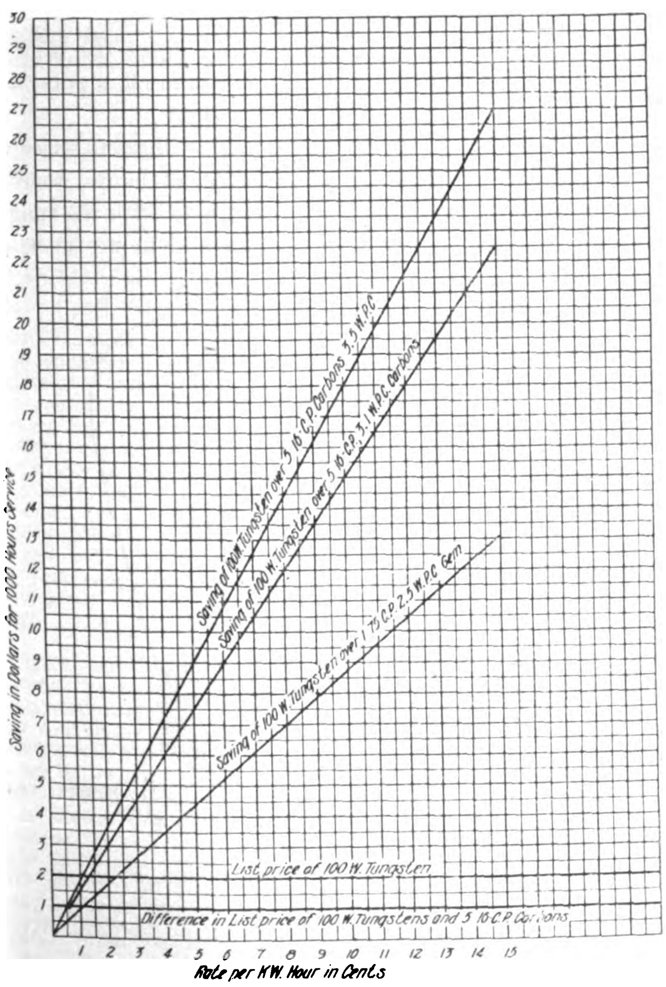


FIG. 1.—DIAGRAM SHOWING SAVING OF 100-WATT TUNGSTEN LAMP, AT EQUIVALENT CANDLE-POWER, OVER GEM AND CARBON LAMPS, AT DIFFERENT RATES PER KILOWATT-HOUR.

SOME STRIKING COMPARISONS.

Two diagrams are given herewith which illustrate the advantage of high-efficiency lamps, the eighty-candle-power, 100-watt tungsten being taken as the unit of comparison.

Fig. 1 shows the saving for equal illumination secured by the 100-watt tungsten over carbon lamps at various rates per kilowatt-hour. The curves are based on a life for the tungsten lamp of 1,000 hours and it will be seen at what an extremely low rate the tungsten lamp will pay for itself in saving of energy. Horizontal lines at the bottom of the diagram give the list price of the 100-watt tungsten and also the difference in list price between the tungsten and sufficient carbon lamps to give equivalent candle-power. The points at which the diagonal lines cross these horizontal lines give, respectively, the rates necessary for the tungsten lamp to save its entire cost and its extra cost over carbon lamps.

Fig. 2 is a comparison of the cost for 100 candle-hours' service of the 100-watt tungsten lamp, the 100-watt carbon lamp, the 100-watt Gem lamp and the forty-watt tantalum lamp at different rates per kilowatt-hour.

TUNGSTEN BATTERY LAMPS.

A very wide field has been found for the tungsten lamp in low-voltage and miniature types, where the high efficiency of the tungsten filament gives ideal results. In these lamps the low voltages permit the use of shorter and stronger filaments, and render the lamp able to withstand shocks and jars to much better advantage. In fact, they are being used extensively in automobile service, where

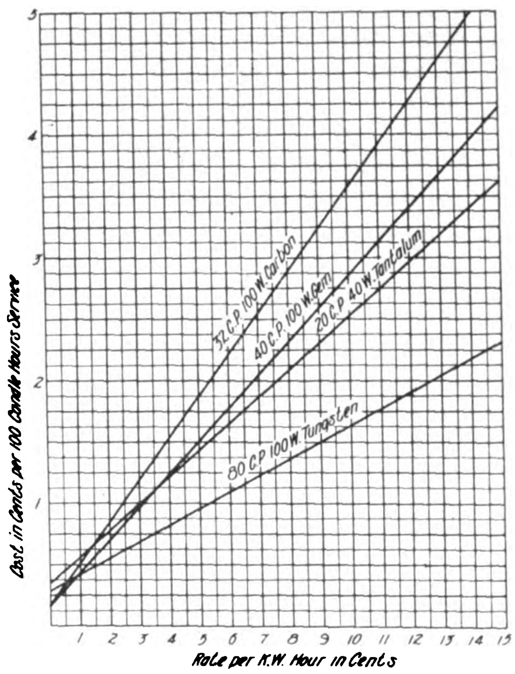


FIG. 2.—COMPARATIVE CURRENT COSTS FOR 100 CANDLE-HOURS OF SERVICE WITH TUNGSTEN, TANTALUM, GEM AND CARBON LAMPS.

the reduction of requisite battery capacity is of great value.

The efficiencies of the low-voltage and miniature lamps run from one to one and one-quarter watts per candle, with lives corresponding to those of carbon lamps of the same candle-powers and voltages. Besides giving three times the light of carbon lamps, the superior brilliancy and whiter color makes them much more desirable for many purposes.

In surgery the small tubular tungsten lamps give a more brilliant light and are cooler than carbon lamps.

In automobile service small lamps for side lights, for tail lights, instrument illumination, etc., can be operated satisfactorily from the ignition storage battery, and where auxiliary lighting batteries are used much cost and weight are saved by installing tungstens.

The numerous advantages of electric lamps in automobiles, including cleanliness, safety, convenience in lighting, reliability, etc., have made the tungsten battery lamps, which can replace oil lights without an excessive battery equipment, very attractive to automobile users. Adapters have been devised for changing oil burners into electric fixtures, and a simple wiring scheme completes the outfit.

Novelty lamps for dry-battery service are made with the tungsten filament for a great variety of purposes, and can be used in flashlights, pocket-lamps, portables, night-lamps, and a variety of specialties manufactured by the trade.

The accompanying illustrations show samples of some different types of tungsten miniature and battery lamps. They can be obtained in round and pear-shaped bulbs and in special shapes and candle-powers, and in a great variety of voltages, mounted on either miniature or candelabra bases.

While American-made miniature tungstens have been on the market but a few months, many new uses are being constantly found for them, the great reduction in battery capacity making them suitable for purposes for which electric lamps were formerly impracticable.

TUNGSTEN STREET SERIES LAMPS.

Little has been written regarding the tungsten lamp for street series circuits, and the following comparisons have been compiled to bring out the remarkable saving obtained by this new factor in the street-lighting field.

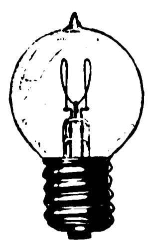
The value of the incandescent lamp in suburban districts is now generally conceded. The arc lamp has its place in densely populated districts (where the walls of the houses are close to the curb and by reflection eliminate dark shadows) and in locations where the required quantity of illumination warrants the units being placed near together.

In the less densely populated portions of our cities, however, the adoption of the arc lamp on an economical basis necessitates such great distances between the poles that evenly distributed and efficient illumination is impossible.

The tungsten series lamp is remarkable in many respects, and the success it has had from the first is a thing that has not often been duplicated in the electrical field. Long life results have been obtained, the average minimum being 1,200 hours, including all renewals, breakages, etc., and the average maximum over 2,000 hours, the general average being above 1,500 hours. These figures are not the result of a few installations, but of many thousand lamps.

Another remarkable quality of the lamp is that it maintains its candle-power practically constant, there being no blackening, which not only is a good feature while the lamp is burning, but gives it a much better appearance when the lamp is not lighted. This quality also allows the lamp to be used until it fails, and, together with its long life, reduces the labor cost of trimming to a minimum, a point which should not be lost sight of.

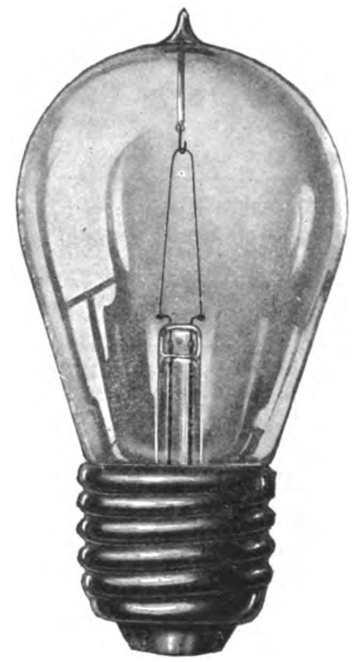
NOVELTY TYPE, STYLE G-3½, ONE-HALF TO ONE AND ONE-HALF CANDLE-POWER, ONE AND ONE-HALF TO THREE AND ONE-HALF VOLTS.



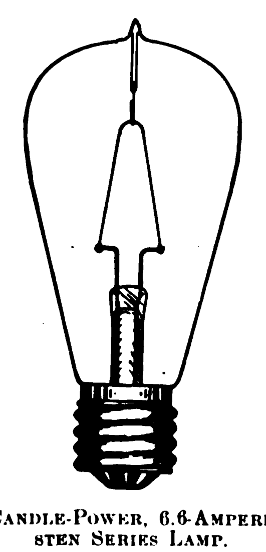
GENERAL BATTERY LAMP, ROUND STYLE, ONE TO FOUR CANDLE-POWER, FOUR TO SIX VOLTS.

GENERAL BATTERY LAMP, ROUND STYLE, FOUR TO TEN CANDLE-POWER, FOUR TO EIGHT VOLTS.

GENERAL BATTERY LAMP, STYLE P-8, FOUR TO TEN CANDLE-POWER, FOUR TO EIGHT VOLTS.

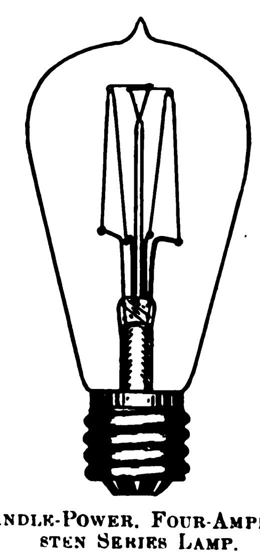


TUNGSTEN BATTERY LAMP WITH STANDARD EDISON BASE, FOUR TO TWENTY VOLTS.



FORTY CANDLE-POWER, 6.6-AMPERE, TUNGSTEN SERIES LAMP.

In comparing the tungsten series with carbon and Gem series lamps, there are two distinct advantages with the tungsten lamp, if actual costs alone are to be considered. The first is the saving in kilowatt-hours during a period of, say, a year's time, which is worth so many dollars according to the rate per kilowatt-hour for current. The other is the saving in capacity of station apparatus, or in other words, the station apparatus has a capacity



SIXTY CANDLE-POWER, FOUR-AMPERE, TUNGSTEN SERIES LAMP.

of three times the number of carbon lamps previously used. The former is a very large item where the generating costs, line losses, etc., are high, and the latter where the constant-current transformers are nearly fully loaded and it is desired to put on extra lamps in excess of their capacity.

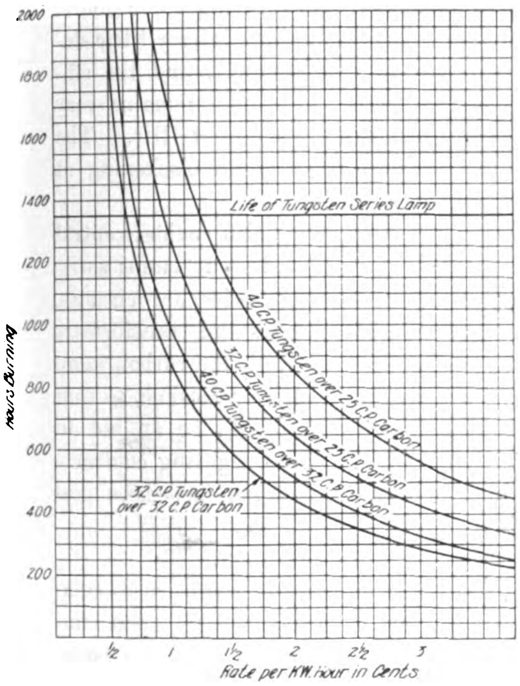


Fig. 3.—Life Necessary to Compensate for Increased First Cost of Tungsten Over Carbon Series Lamps, at Different Rates per Kilowatt-Hour.

THE SAVING IN POWER.

Following are illustrations of the saving in kilowatt-hours of the tungsten over the carbon and Gem series lamps:

A thirty-two-candle-power carbon lamp consumes in watts	112
A thirty-two-candle-power tungsten lamp consuming forty watts gives a saving in watts of	72
For 4,000 hours' service per year this gives a kilowatt-hour saving of	288
Value of saving at two cents per kilowatt-hour	$5.76
Net additional cost per year of tungsten renewals (three renewals tungsten, four renewals carbon)	$1.85
Net saving per year for tungsten over carbon	$3.91

A thirty-two-candle-power Gem lamp consumes in watts	86.4
A thirty-two-candle-power tungsten lamp consuming forty watts gives a saving in watts of	46.4
For 4,000 hours' service per year this gives a kilowatt-hour saving of	185.6
Value of saving at two cents per kilowatt-hour	$3.71
Net additional cost per year of tungsten renewals (three renewals tungsten, four renewals Gem)	$1.62
Net saving per year for tungsten over Gem	$2.09

THE SAVING IN APPARATUS CAPACITY.

As an illustration of the value of the saving in apparatus capacity the following possible gain in income will serve as an example.

With apparatus capacity sufficient for 100 thirty-two-candle-power carbon lamps (3.5 watts per candle), a station could supply 280 thirty-two-candle-power tungsten lamps. Assuming $30 per lamp per year revenue, the possible gain in income from additional tungsten lamps would be as follows:

COMPARATIVE INCOME.

Income from investment in apparatus for 100 carbon lamps at $30	$3,000.00
Possible income from same investment in station apparatus for 280 tungsten lamps at $30	8,400.00
Possible gain in income	$5,400.00

COMPARATIVE EXPENSE.

Tungsten lamp renewals at $1.27½, net, each, three per year for 280 lamps	$1,071.00
Fixed charges per year on additional line equipment for 180 additional lamps	150.00
	$1,221.00
Less expense of carbon renewals at 49.3 cents net, each, four per year for 100 lamps	197.20
Net additional expense	$1,023.80

NET GAINS FOR TUNGSTEN.

Hence net gain in income on each 100-light (carbon) capacity of apparatus is $5,400 less $1,023.80	$4,376.20
This gives a possible income per lamp station capacity now earning but $30 per year of	73.76
Or possible income per kilowatt-hour after the extra cost of tungsten renewals has been deducted ($73.76 ÷ 112 watts × 4,000 hours)	16.4
The present income per kilowatt-hour with carbon lamps is—$30 ÷ 112 watts × 4,000 hours.	6.7
The income per kilowatt-hour, if an equal number of forty-candle-power tungsten lamps are used in place of thirty-two-candle-power carbon lamps, after the extra cost of tungsten renewals has been deducted is— $\frac{\$30.00 - (3 \times 1.27\frac{1}{2} - 1.97)}{50 \text{ watts} \times 4{,}000 \text{ hours}} =$	14

Fig. 3 and Fig. 4 show the number of hours at various rates per kilowatt-hour a tungsten series lamp must burn to exactly pay its increased cost. Should the lamp last any longer than this, there is a thing that heretofore had been impossible. Twenty-five-candle-power carbon lamps have been used, but this has not satisfactorily met the situation. At rates of from $20 to $35 per year for 4,000 hours' (all night, every night) service for

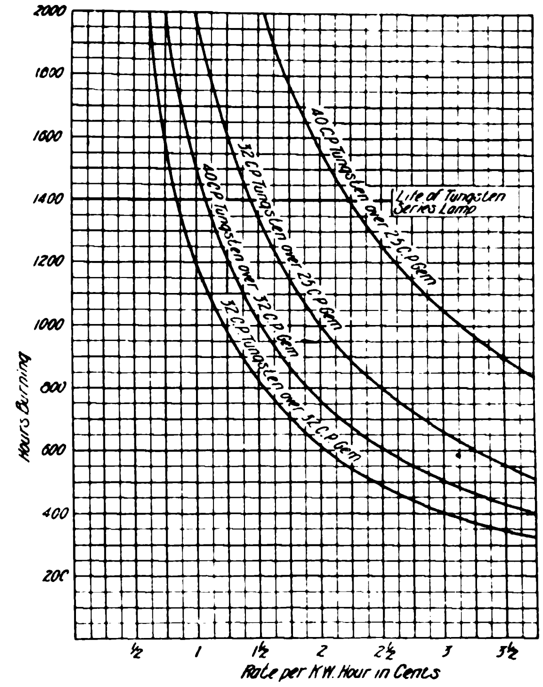


Fig. 4.—Life Necessary to Compensate for Increased First Cost of Tungsten Over Gem Series Lamps, at Different Rates per Kilowatt-Hour.

gas-mantle lamps, only a very low rate per kilowatt-hour is obtainable with carbon lamps to meet this cost.

Although the mantle is rated at sixty candle-power, tests recently made in three New England cities on the gas-mantle street lamp while operating under actual service conditions show, as the following figures indicate, a wide variation in candle-power:

City.	Maximum C-P.	Minimum C-P.	Average C-P.
(1)	55.0	21.5	36.7
(2)	25.0	6.5	16.8
(3)	55.1	16.3	27.8

RATES OBTAINABLE WITH FORTY AND SIXTY CANDLE-POWER LAMPS.

Income per year	$20	$22	$24	$26	$28	$30	$32	$34	$36
Rate per kilowatt-hour with forty-candle-power tungsten series lamps	8.8c.	9.8c.	10.8c.	11.8c.	12.8c.	13.8c.	14.8c.	15.8c.	16.8c.
Rate per kilowatt-hour with sixty-candle-power tungsten series lamps	5.4c.	6.0c.	6.7c.	7.7c.	8.0c.	8.7c.	9.4c.	10.0c.	10.7c.

an actual net saving during every moment of its use.

There is no doubt that the tungsten lamp enables central stations to compete with the gas and gasolene mantle lamps at very profitable rates per kilowatt-hour,

Hence a forty-candle-power tungsten lamp which maintains candle-power practically constant throughout life will give better average illumination than the mantle lamps in any of the above cases.

The accompanying table shows the rates

that can be obtained with forty and sixty-candle-power tungsten lamps covering power and labor, the cost of tungsten renewals (three per year) having been deducted.

Very few cities supply a mantle lamp for less than $25 per annum, and, as the above table indicates, both the forty and sixty-candle-power tungsten lamps can easily compete with it profitably.

Another way of illustrating the above will be found in the following figures showing the cost of supplying a mantle lamp and the income for current obtainable to exactly meet it.

Consumption of gas per hour of mantle lamp	3½ cu. ft.
Cost of gas at $1 per thousand for 4,000 hours' service per year...	$14.00
Renewals, repairs and labor at three cents per night per year (figures given in a recent city contract)	10.95
Total cost per year gas mantle.	$24.95

The possible rate per kilowatt-hour obtainable with the forty-candle-power tungsten series lamp to exactly meet the above cost is as follows:

Income per year per forty-candle-power tungsten lamp	$24.95
Three renewals at $1.27½ per lamp per year	3.83
Income per lamp per year to cover cost of power, labor and repairs	$21.12
A forty-candle-power tungsten lamp consumes in watts	50
For 4,000 hours' yearly service it consumes in kilowatt-hours	200
Hence rate obtainable per kilowatt-hour for power, labor and repairs is $21.12 ÷ 200, or over.	10.5 cents
Similarly the rate per kilowatt-hour obtainable for the sixty-candle-power (seventy-five-watt) tungsten series lamp, to cover cost of power, labor and repairs is $21.12 ÷ 300, or over	7 cents

The cost of producing a candle-hour of light with the tungsten series lamp is considerably less than the carbon lamp, as is shown relatively in Fig. 6. These values are determined on the differential basis

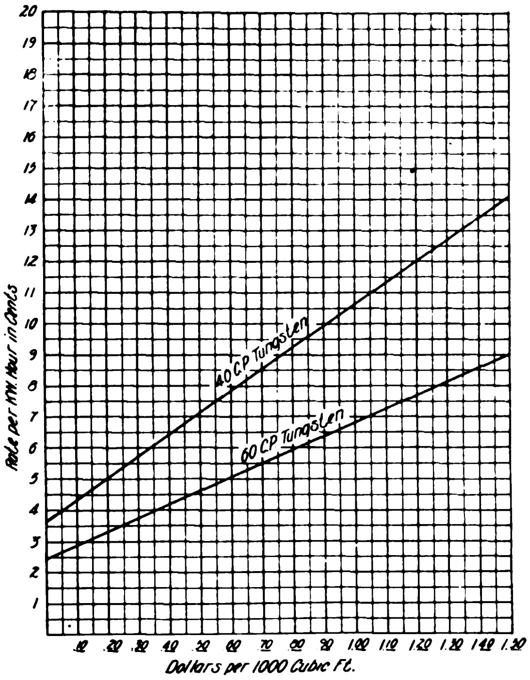


Fig. 5.—The Rate per Kilowatt-Hour Obtainable for Forty and Sixty-Candle-Power Tungsten Series Lamps to Meet the Cost of the Welsbach Mantle at Various Rates for Gas for 4,000 Hours' Yearly Service.

for various hours' use of lamp per year, and cover:

First—Generating cost proportional to output covering fuel and station labor costs at a value (at the lamp) of one cent per kilowatt-hour.

Second—Fixed charge on investment in generating apparatus taken at twelve per cent on $125 investment per kilowatt of capacity, giving a value per kilowatt of apparatus of $15 per year.

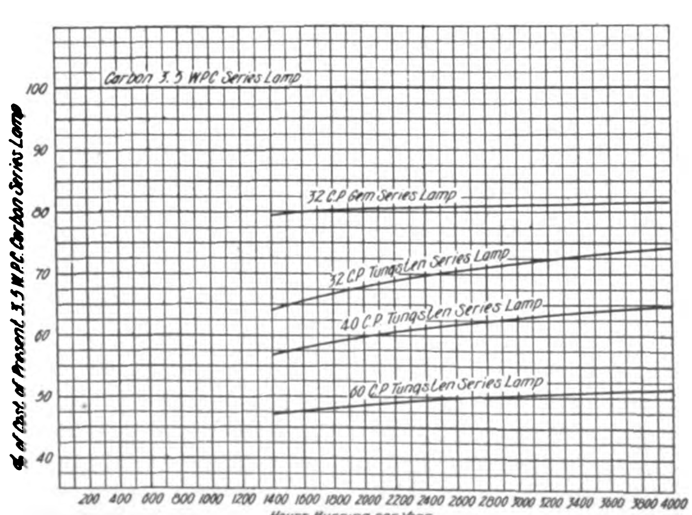


Fig. 6.—Relative Cost of Producing a Candle-Hour of Light—Tungsten Versus Gem and Carbon Series Lamps.

The curves in Fig. 5 show the above graphically at various rates for gas.

Third—Renewal costs of lamps as estimated from the following prices:

Carbon lamp	$0.54
Gem lamp	.65
Thirty-two-candle-power tungsten lamp	1.50
Forty-candle-power tungsten lamp	1.50
Sixty-candle-power tungsten lamp	1.50

The candle-power and efficiency curves of the tungsten lamp during 2,000 hours' burning shows that there is very little depreciation in candle-power, and the efficiency in watts per candle remains very nearly constant throughout life. The lamps show practically no blackening at the end of the test.

The tungsten lamp also enables central stations to put incandescent lamps satisfactorily on existing series arc circuits, so that separate circuits and transformers are not necessary. With the carbon lamp this has not been entirely feasible, so that the tungsten lamp should be an aid in getting suburban street lighting contracts which heretofore may not have been possible.

CONCLUSION.

The tungsten lamp is unique in its combination of advantages—the great improvement in efficiency it secures being followed by gains instead of losses in other desirable characteristics.

The increase in efficiency is accompanied by lengthened life with a better maintenance of candle-power than in carbon lamps. The quality of the light, furthermore, is more brilliant, and instead of showing objectionable peculiarities is unsurpassed in its resemblance to sunlight.

The high efficiency of tungsten lamps does not make them susceptible to slight changes in voltage, but, on the contrary, the positive temperature coefficients of metallic filaments render them less liable to the effects of poorly regulated circuits.

With such a list of good points added to its remarkable economy, there can be no doubt that the tungsten lamp is here to stay.

Its improvement in quality in one year of American activity has been so great that predictions of future improvements, however enthusiastic, could hardly be called exaggerations, and remembering the early days of the carbon lamp the present characteristics of the tungsten seem remarkably free from faults.

Electric Traction in the Bernese Alps.

An appropriation of $200,000 has been made by the Bernese Alps Railway Company for the installation of electric traction between Spiez and Frutigen, on the northern approach to the Loetschberg tunnel. It is intended to use fifteen-cycle single-phase current at 15,000 volts line pressure. The current will be obtained from the Kander & Hagneck hydraulic plant at Spiez. The maximum gradient in the tunnel is 2.7 per cent.

Cooper Hewitt Lamp Progress.

SINCE its introduction into the field of illumination, the Cooper Hewitt mercury vapor lamp has undergone continual development, and, year to year, there have been evolved new types which have been the natural evolution of close application and keen scientific investigation in the effort to supplement the original high efficiency with ease of manipulation and invariability of service. The theory of operation and the characteristics of the mercury vapor lamp are well understood, and the present article will deal specifically with the mechanical construction of the lamps which are available to-day for commercial service.

One of the improvements with which the lamp is at present equipped is a self-contained adjuster, which affords an economical and uniform current regulation, placed in an easily accessible position in the cylindrical casing which forms an integral part of the lamp fixture.

To avoid the method of tilting the lamps by hand to start the arc, which is quite practicable where the lamps can be easily reached, but is hardly feasible when the lamps are placed in inaccessible positions, an automatically tilting lamp, type H, has been produced. This lamp is illustrated in Fig. 1. When the line switch is closed an electromagnet is energized and a movable iron plunger tilts the lamp. When the arc is established the solenoid is automatically cut out.

This method is adaptable particularly where short lamps are used, and is supplemented for universal service by an automatic shifter starting method. The shifter is so-called because it shifts the current from its own circuit to that of the lamp. This starting method, briefly, consists in the introduction of the arc through the medium of a high-potential kick. This method of starting has been developed to such a point that the starting of the arc and the satisfactory operation of the lamp are invariable.

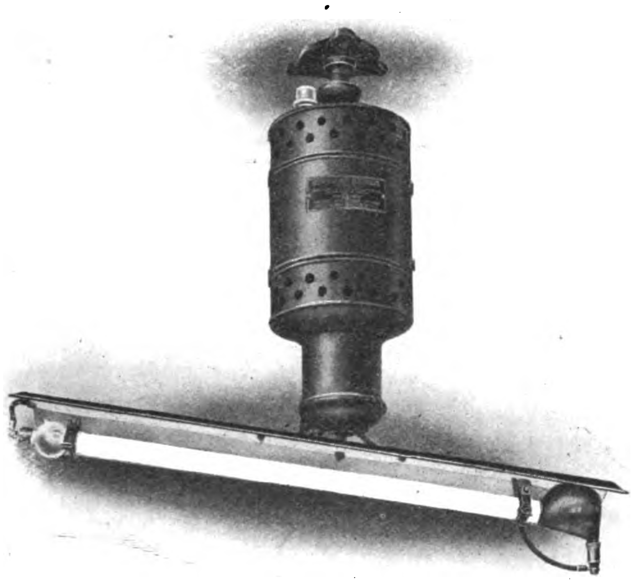


Fig. 1.—Cooper Hewitt Type "H" Automatic-Tilting Mercury Vapor Lamp.

Three new types of lamps, all equipped with the starting method just indicated, are designated as type P, type U and type F. The type P lamp is shown in Fig. 2. This lamp is designed to operate on 100 to 120-volt circuits, and has a mean hemispherical intensity of 800 candle-power on 110 volts, the current consumption being three and one-half amperes.

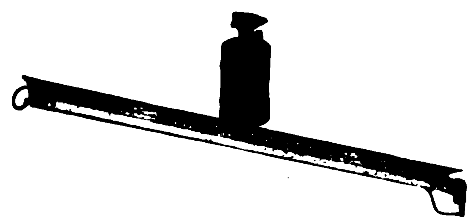


Fig. 2.—Cooper Hewitt Type "P" Mercury Vapor Lamp.

The type U lamp, shown in Fig. 3, is calculated for the double voltage of the type P lamp. The construction of this lamp is similar to that of type P, with the exception of the difference in the physical form of the U-shaped vacuum tube. The lamp consumes two amperes on 220 volts, and has a luminous intensity of 900 mean hemispherical candle-power.

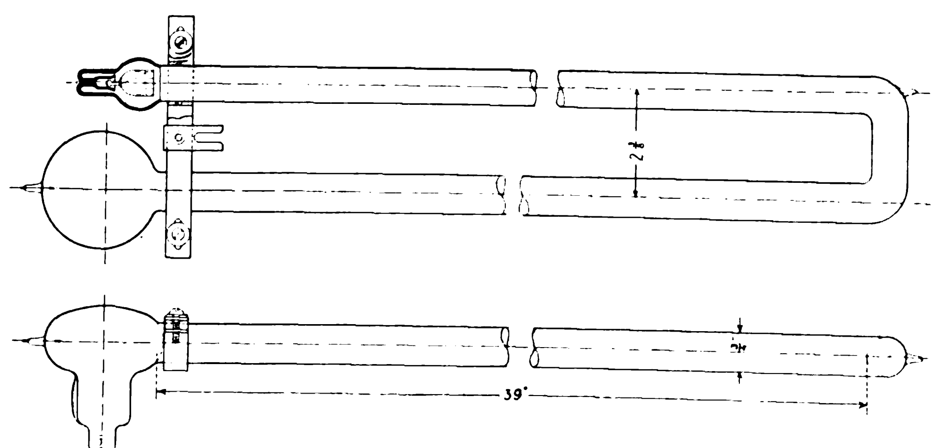


Fig. 3.—Representation of Type "U" Cooper Hewitt Mercury Vapor Lamp.

Upon the principle of the mercury rectifier, the mercury vapor lamp is adaptable to use with alternating currents. Any difficulty which was experienced with the alternating-current mercury vapor lamp, due to trouble in starting, has been overcome by the use of the new shifter method. The alternating-current lamp, the type F, (Fig. 4) is similar in appearance and construction to the type P lamp, but, like a rectifier, has two positive (iron) electrodes connected to a transformer, the middle point of which leads over an adjuster and two inductance coils to the negative (mercury) electrode. The inductance serves in this case both for the starting of the lamp and the damping of the current pulsations on the negative running arc. The auxiliary apparatus is similar to that used with the type P lamp, but a transformer is added, and this is generally made an integral part of the outfit, but in exceptional cases can be supplied as a separate installation. This lamp is designed in six types, for various voltages, and consumes, on the mean voltage for each respective type, 400 watts with a mean hemispherical illumination intensity of 800 candle-power and a primary power-factor of eighty-three per cent.

A summary of the present installations of the Cooper Hewitt mercury vapor lamp indicates that it is being used successfully for the illumination of almost every conceivable character of interior industrial illumination. It has been found particularly adaptable to the illumination of large areas where a high quality of lighting is necessary for the carrying on of

Fig. 4.—Cooper Hewitt Type "F" Mercury Vapor Lamp.

processes requiring close inspection. One of the most recent successful invasions of this lamp is in silk-mill illumination. As far as the process of making silk is concerned, it is not so much a question in the mill of matching colors as it is of securing a uniform product and detecting at once any variation in the physical character of the silk threads. The testimony of silk makers who have used this form of illumination is to the effect that the peculiar quality of the mercury vapor lamp renders it very easy to detect any flaws which may develop in the textile during the process of manufacture.

Electricity Supply in Marseilles, France — The Brillanne-Villaneuve Hydroelectric Station.

The Brillanne-Villaneuve hydroelectric station, which partly supplies Marseilles with electrical energy, is described by J. A. Montpellier in *L'Electricien* (Paris), August 22, for the benefit of electricians who will visit that city during the coming International Congress of Applied Electricity. The station is situated near the community of Brillanne, on the banks of the River Durance, from which water is taken at the rate of sixty cubic metres per second to a head reservoir through a canal starting eight kilometres above the station. From the head reservoir the water flows into five large sheet-steel pipes, eighty metres long and 2.70 metres in diameter, each one of which feeds one of the groups of generators. A sixth pipe, 1.2 metres in diameter, feeds the turbine driving the exciters. The turbines are of the two-wheel Francis type, each installed in a separate water chamber, but all having one common discharge channel. They can generate 3,500 effective horse-power each under a head of twenty-two metres at an angular velocity of 250 revolutions per minute. Each turbine is directly coupled to an alternator. The exciters are driven by Francis turbines of 250 horse-power. The station is to contain five generator units, of which four are at present in operation. The dynamos are three-phase alternators of 3,000 kilowatts, furnishing a current of 7,500 volts and twenty-five periods a second. The exciter is a 200-kilowatt, direct-current machine giving 110 to 125 volts. On account of the high tension adopted on the transmission line, 52,000 volts at the station, the transformers are installed in a separate building, which occupies a space of 1,100 square metres, while the generating station occupies 1,000 square metres. Each alternator is connected by a paper insulated, lead-covered cable with three conductors to a group of three single-phase transformers, of a capacity of 900 kilowatts each and a ratio of transformation of one to four. By a triangle connection in the primary circuit and a star connection in the secondary they raise the tension between phases from 7,500 to 52,000 volts. The transformers had to be constructed with particular care and required special precautions for cooling. Their windings are immersed in oil and the oil is cooled by the circulation of cold water through a coiled pipe. Automatic devices indicate any abnormal rise of temperature in the oil at the station. The current from each group of transformers can be led to either one of two series of bus-bars, from which the 52,000-volt, three-phase transmission lines branch off and leave the building from special bays in which Wirt lightning arresters are installed. All the high-tension circuits are controlled by special three-pole circuit-breakers, which are operated by small direct-current motors by means of cogs and levers, a double break taking place in oil and each phase being in a separate brick compartment. A 10,000-kilowatt current at 52,000 volts can be thus interrupted without deteriorating the contacts. The small motors operating the circuit-breakers can be controlled at will from the switchboard, and the circuit-breakers also open automatically when the current rises to a dangerous intensity. All the controlling, regulating and measuring instruments are placed on the main switchboard of the station. The safety of the attendants is insured by the fact that all of these apparatus, without exception, operate under 110 to 125 volts, direct current being used for the motors actuating the circuit-breakers, and the alternating current being reduced by tension and intensity transformers. Three high-tension transmission lines leave the station, going, respectively, to Allauch, Arles and Marseilles. The line supplying Marseilles is over 100 kilometres long and the tension of 52,000 volts is the highest so far adopted in Europe. The plant has been in operation for over four months, so far without incident. All the machinery and apparatus have been supplied by the French Thomson-Houston Company.

The Empire State Gas and Electric Association.

The annual meeting of the Empire State Gas and Electric Association will be held in the Engineering Societies Building, New York city, on October 7. Among the subjects to be discussed are the following: "Public Policy Work of the Association;" "Standards for Gas Service and Standards for Electric Service, Taking as a Basis the Recent Rules of the Railroad Commission of Wisconsin;" "Taxation of Gas and Electric Companies in New York State, with a Report from the Taxation Committee;" "Insurance of Gas and Electric Stations;" "Review of the Decisions of the Public Service Commissions;" "Electric Meter Testing, with Report from the Meter Committee;" "Accounting, with Report from the Accounting Committee;" amendments to the constitution and by-laws, with a new schedule of annual dues; affiliation with the American Gas Institute and the National Electric Light Association.

The secretary of the association is Charles H. B. Chapin, 154 Nassau street, New York city.

The New Westinghouse Nernst Lamp.

By Otto Foell.

IN the 1907 "Electric Lighting and Illuminating Engineering Number" I presented to the readers of the ELECTRICAL REVIEW the commercial status of the Nernst lamp. In the interim we have witnessed great activity on the part of lamp manufacturers to improve the efficiency of the incandescent units.

The Nernst lamp has kept pace with the demand for increase in economy. Great progress has been made during the past year in the application of the Nernst glower principle, and to-day I am prepared to outline some new features of Nernst lamp practice which, with the mechanical improvements embodied in the designs, make the new Westinghouse Nernst lamps the most efficient and economical lighting system, as by their use the total cost of light (current plus upkeep) is reduced to the lowest point ever reached by incandescent lighting units.

FIG. 1.—MULTIPLE-GLOWER WESTINGHOUSE NERNST FIXTURE LAMP WITH SQUARE CANOPY AND CHAIN.

The principle of the Nernst lamp is well understood by this time.

The incandescent body or glower is a non-conductor for electricity when cold but becomes a good conductor when heated and remains a current conductor by reason of the energy dissipated in the filament.

The lamp body contains the parts for starting the glower and for current control, the former being an electric heater with automatic cutout, the latter a small iron wire resistance mounted in a glass container, exhausted and then filled with an inert gas.

When first introduced, four standard sizes of lamps were manufactured for operation on alternating current: a six-glower lamp, a three-glower lamp, a two-glower lamp and a single-glower lamp, varying in mean lower hemispherical efficiency from 1.64 watts per candle-power to 2.54 watts per candle-power, this efficiency data based on lamps equipped with alabaster or diffusing glassware.

A little later the four-glower lamps were brought out to meet a want for a unit between the three and six-glower sizes.

The bunching of glowers in parallel on one burner or holder created an incandescent unit which gave the lamp a wide field of usefulness.

About a year ago the 110-watt Nernst was introduced. This unit marked one great step toward realizing a higher glower efficiency. Its general success led to the present perfection of a complete line of lamps.

Coincident with the marketing of the 110-watt unit, the advent of the direct-current Nernst lamp was announced. These direct-current units are now used in large numbers and among the prominent installations I desire to mention the great store of Marshall Field & Company, in Chicago, where 12,000 units are employed.

It should be remembered that the glower, being a conductor with negative temperature coefficient, requires for current control a highly sensitive ballast resistance, and upon the ability of this resistance to perform its function properly depends to some extent the glower life performance.

Users of the standard Nernst lamp are probably aware of the fact that immediately upon lighting the amount of light emitted is far in excess of the rated candle-power of the lamp. This is caused by an excess current flowing through the glower, the current gradually decreasing until the lamp attains normal operating temperature.

In the new Westinghouse Nernst lamp a great improvement in electrical performance has been attained. That is, the individual life performance of the glower has been improved, ballast troubles have been reduced and the heater has been made of such proportions and such lasting qualities that a lamp once installed will need very little attention. The combination of these properties naturally results in a lower maintenance cost.

The features just mentioned, even without improved efficiency, would make the Nernst lamp a very attractive commercial lighting proposition. We, however, did not stop in merely improving the electrical performance and reducing the maintenance cost, but succeeded in materially increasing the efficiency of the lamps. Hand in hand with these improvements there was an improvement in the mechanical arrangement of the different lamp parts, so that the Westinghouse Nernst lamp of to-day represents a unit of high efficiency, good electrical performance and low maintenance cost.

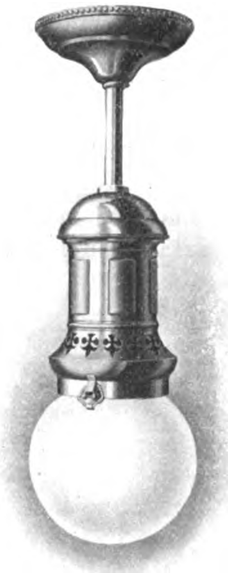


FIG. 2.—MULTIPLE-GLOWER WESTINGHOUSE NERNST FIXTURE LAMP WITH ROUND CANOPY.

Before I go into a detailed description of the different Westinghouse Nernst units available for commercial use, I shall deal generally with the principles of current control in the lamp and their influence on the performance of the glower.

Since the current through a glower is controlled by the ballast, it naturally follows that improvements in glower performance must begin in a better ballast performance. This may be accomplished by placing the ballast in a medium where its characteristic is not influenced by its surroundings.

In the standard Nernst lamps the ballasts are bunched. Their heat is emitted and radiated into an enclosed housing, tending to decrease the current capacity of the ballast. To offset this effect the ballast was designed to take a current, when cold, far in excess of its normal operating current. Moreover, the question of supporting the resistance wire was not very well understood and material was used in the construction of the ballast which tended to further decrease its current-carrying capacity.

In the Westinghouse Nernst lamps now available, this objectionable characteristic has been eliminated by so increasing the radiating surface of the ballast that the ballast characteristic is not influenced by its surroundings. The mechanical device consists of a number of phosphor-bronze pieces placed in a cooling cylinder and so formed that the contact surfaces firmly enclose the ballast. The heat liberated in the ballast is transmitted to the bronze pieces by contact, and from there it is radiated and conducted into the surrounding air.

The effect of this improvement in glower current control is readily noted immediately after lighting the Westinghouse Nernst units.

Hand in hand with improved current control came the improvement of the glower proper.

The glower of to-day is a radical departure from the glower used in the older lamps, both mechanically and in the composition of its constituent parts. Mechanically we have to-day a greatly improved terminal construction which reduces the terminal loss due to the Peltier effect approximately two-thirds. The result is a longer lighting length between terminals for a specific voltage. Moreover, a larger percentage of radioactive material is used in the glower, the properties of which have been recently established. Their addition to the glower mixture greatly increased the glower efficiency without materially increasing its operating temperature.

The characteristics of the new glower are about the same as those of the old glower, with the exception that its candle-power performance during life is more constant, which means Nernst lamps with only slight candle-power depreciation.

However, one feature not to be overlooked is the individual life performance of the new glower. Owing to their treatment during manufacture, glowers of old construction were more or less unreliable. While the average life performance of the glowers was all that was claimed for them, yet there were early failures. The new terminal successfully overcame this defect in the glower and failures during early life should be few and far between.

The ballast employed in the Westinghouse Nernst lamp is of rugged design. The iron resistance wire is enclosed in a bulb of increased diameter, so that an anchoring of the resistance wire other than on the terminals is unnecessary. These anchors, being metallic supports, have little heat capacity compared with the former porcelain disc anchor, and consequently give the ballast very quick action; that is, voltage variations of the circuits are immediately taken care of, thereby protecting the glower in the most sensitive way against possible overloads. On the other hand, the ballast itself is very well adapted to withstand voltage fluctuations without damaging it, a noteworthy and desirable feature.

Fig. 3.—Screw Burner for Westinghouse Nernst Lamp.

A mechanical detail to which I desire to call attention is that all ballasts are equipped with a bayonet socket, making their replacement an easy matter.

Fig. 4.—Single-Burner Westinghouse Nernst Lamp.

DESCRIPTION OF LAMPS.

The mechanical construction of the multiple-glower lamp presents a harmonious design, embodying simplicity and compactness. Unsightly exposed terminals are done away with and in their stead the insulating hook is provided with an opening through which the service wires enter the top of the lamp housing and terminate in two enclosed binding posts.

This construction makes it possible to use the lamp in connection with fixture work by substituting a special fixture nipple for the standard insulating hook. Fixture lamps are illustrated in Figs. 1 and 2.

Extending from the terminal construction is a tubing to which, by means of screws and washers, is fastened the middle part of the housing, containing the ballast coolers. Sliding up and down inside the tubing is a brass rod serving to support the lower part of the lamp body, including the ballast plate, contact plate for holder and globe-holder ring.

The sliding inner post is provided with a steel stop engaging in a slit of the tubing, serving to lock the two parts of the housing together by means of a hooking catch, which may be operated by the lever provided in the middle part of the housing.

This construction affords an easy access to the ballasts, as the latter are arranged to drop with the lamp body when it is lowered.

The cutouts are below the ballast porcelain and electrical connection between the terminals, and the ballast plate is made by means of a brass rod and brass tubing, the latter sliding up and down with the lower part of the lamp, insuring electrical connection at all times.

The alternating-current Westinghouse Nernst lamps are provided with two cutouts, one located in each side of the service line. The direct-current, multiple-glower Westinghouse Nernst lamps have one cutout only, opening the heater circuit at the positive side of the supply circuit.

The part of the lamp body containing electrical connections is fastened to the lower lamp housing by means of an accessible nut. This housing is arranged in such a way that it leaves insulated openings for the insertion of the holder.

The petticoat of the lamps, which serves at the same time as a globe-holding device, is composed of two main parts, an inside and an outside shell, which are of different diameters and arranged like two concentric rings, one inside the other, thus providing an opening for ventilation. The air for ventilating is drawn into the inside of the lamp housing through this opening and through the ornamental openings in the petticoat and leaves the lamp, after passing through the ballast coolers, through the outlets provided in the top part of the lamp housing.

The device for holding the globe to the lamp housing is similar in construction to the globe holder used in the arc lamp. It consists of a phosphor-bronze band which is fastened to the globe by means of screws. From this band two lips protrude which engage with properly shaped wire rings on the lamp body. The latter are pivoted eccentrically in movable stampings, which when moved simultaneously toward the lamp housing draw up the globe and hold it firmly in place. When lowering the globe, one lip of the globe band is easily disengaged, the globe swings freely on the other, thus giving ready access to the holder and facilitating rapid maintenance.

The holder of the Westinghouse multiple-glower units presents a radical change in design. The old two-piece porcelain holder is replaced by a one-piece holder base, to which are attached contact prongs as shown in Fig. 7. Two prongs are brought through the holder base and are secured in such a manner that they lie in a plane parallel to the glowers and at right angles to them. The use of two or more heater tubes is superseded by a wafer heater, a heater consisting of a small platinum-wound rod, which in turn is coated with refractory cement and bent into the form of a wafer, from which the heater obtains its name. The wafer is mounted securely to a flat porcelain. This porcelain is provided with contact sleeves,

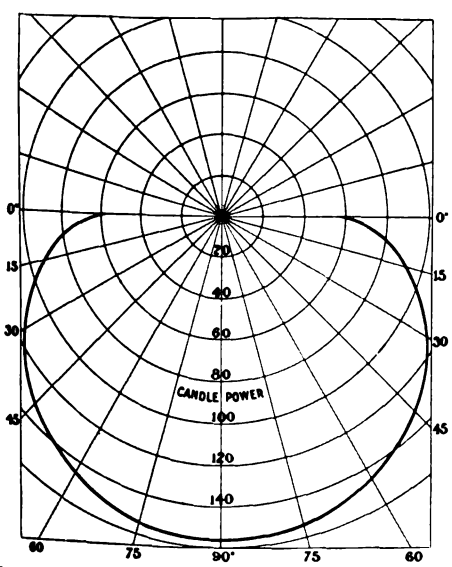


Fig. 6.—Distribution Curve of 132-Watt Type Westinghouse Nernst Lamp.

which engage with the heater prongs on the holder, holding it firmly by friction and at the same time making electrical connection. This design simplifies maintenance to a great extent as it allows the removal of the heater without disturbing the glowers, a feature which was not possible with the old-type holders. It is evident that such a holder means decreased

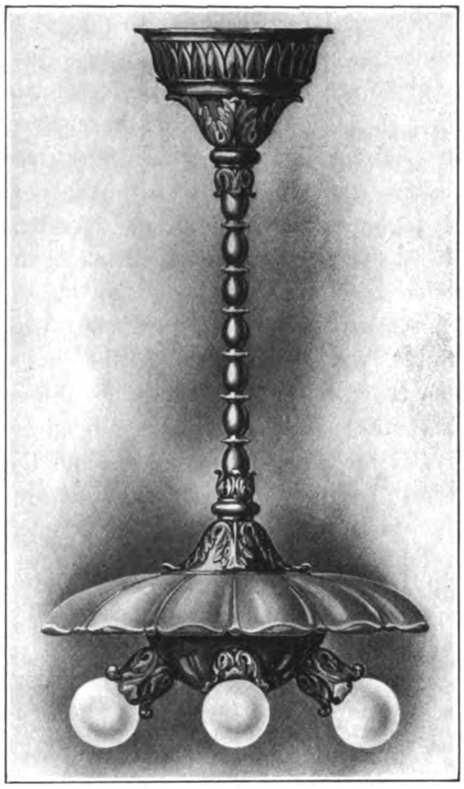


Fig. 5.—Fixture for Single-Glower Westinghouse Nernst Lamp.

cost of maintenance, a saving being made in both labor and material.

The various sizes of single-glower lamps are of the Edison base type, very similar in construction to the new popular 110-watt unit, but present a radical change in the method of maintenance, which is simple in the extreme.

In the bottom of the lamp housing is found a screw receptacle in place of the prongs formerly used in connection with the "push-type" holder.

The present holder consists of a glower and wafer mounted on a small porcelain with a screw base and provided with three contacts, the centre one of which is a pin. This renewal is popularly termed the "screw burner." See Fig. 3.

By an assortment of diameters and lengths of the contact pin, it is impossible to insert any other than the proper holder in the lamp body, thereby insuring the consumer against troubles incident to confusion from lamps of various voltages and current capacities.

The holder can be supplied with or without glassware of various sizes and density. This type of renewal will supply the popular demand for a high-efficiency incandescent lamp so rugged in its design that systems can be maintained by any one, and the renewals safely shipped by freight, mail or express. Fig. 4 shows the general appearance of the lamp.

The value of any lighting system does not depend, however, on its efficiency alone, but due consideration must be given to the cost of its maintenance. All other factors, such as life, being equal, a system having an efficiency for the same candle-power delivered may be preferable on account of its low maintenance cost, which may be so low that the increased cost of current consumed is more than offset by its lower maintenance cost.

The new Westinghouse Nernst lamp, which combines the highest efficiency (and with a daylight quality of light) with lowest maintenance, I believe, has no equal to-day in artificial lighting.

EFFICIENCY AND MAINTENANCE.

The efficiency of any lighting system is best expressed by the horizontal intensity of illumination produced by its light sources when suspended at a specified height above the test plane. That is, only light sent out by a lamp in a downward direction or its mean lower hemispherical candle-power can be considered. Therefore all figures for efficiency given below express the economy of the Westinghouse Nernst lamps in watts per mean hemispherical candle-power.

All holders for the new Westinghouse Nernst unit are designed along the same principles as have been consistently advocated by the Nernst Lamp Company since the advent of the Nernst lamp, namely, to give a downward distribution, with as

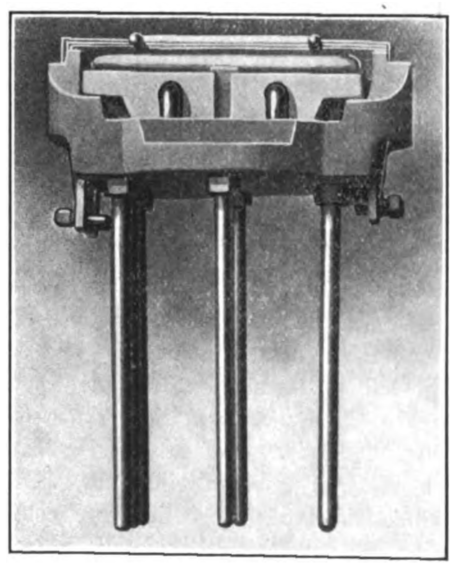


Fig. 7.—Westinghouse Nernst Multiple-Glower Wafer Heater Holder.

little light in the upper hemisphere as possible.

Consequently the glowers are arranged horizontally below the heater, thereby throwing almost the entire flux of light downward from the glower in the useful plane.

Fig. 6 gives the light distribution from a 132-watt direct-current type Westinghouse Nernst lamp equipped with clear glassware. This curve represents the average result of a number of holders and should be considered typical for this unit. The mean lower hemispherical candle-power is equal to 114.8 the corresponding efficiency being 1.2 watts per candle-power.

In comparing these figures with the data published for the old type two-glower lamp, it will be noted that the efficiency is increased from 2.05 watts per candle-power to 1.2 per candle-power, or a gain in light of forty-one and one-half per cent for equal energy consumed.

The efficiency per mean lower hemispherical candle-power of this unit is 1.07 watts, which is equal to 516 mean lower hemispherical candle-power. It will be noted that this unit is not only the largest incandescent unit on the market, but in every respect it delivers the most light for the energy consumed.

The distribution is ideal, especially for large interiors with high ceilings. A five-glower, 660-watt Nernst unit will also be placed on the market this year, having a still greater efficiency.

The figures for efficiency are somewhat modified when lamps are used with diffusing glassware. The latter case is the rule rather than the exception. I have given the efficiency figures for clear glassware to show what is possible with the new Westinghouse Nernst units and to establish a basis of comparison with other incandescent lamps.

A series of tests has been made to determine the visible spectrum of the glower when the light is passing through different opalescent globes. The combined efforts of the glass manufacturers and the Nernst Lamp Company laboratory resulted in an alabaster globe being adopted as standard, which gives a well-diffused light with the least loss in efficiency.

The light absorption in the special Nernst globe is about fourteen per cent. The character of the distribution curves is not changed materially, that is, the light emitted from a Westinghouse Nernst unit is decreased in the different vertical angles about fourteen per cent when equipped with diffusing glass as compared with clear globes.

In conclusion I want to say that the invention of the Nernst glower stimulated activity in all directions and to-day we have a number of incandescent lamps, of various efficiencies. While all the latter lamps are vacuum lamps and depend on a good vacuum for life performance, the distinct advantage of the Nernst glower lies in the fact that it is operative in the open air. It can be readily understood that such a principle must be the basis of all future developments in high-efficiency lamps.

The screw burner principle makes it possible to obtain very artistic and desirable combinations, also permitting the operation of the burners in any position.

To meet the demand for artistic fixtures the Nernst Lamp Company has developed a line of Westinghouse Nernst fixtures, which are available for alternating current or direct current, 110 or 220 volts. Fig. 5 illustrates one of the standard fixtures now ready for the market. It may be used with sixty-six, eighty-eight, 110 or 132-watt units.

The Illuminating Engineer as an Architectural Critic.

By Bassett Jones, Jr.

"NOTIONS of some sort," says Symonds, "underlie all judgments." By notions he means the organization of personality peculiar to each individual. This organization of the personal self determines the form of the active judging attitude we take toward experience. No two minds will perceive objects in the same way, unless the stock of "funded" truths which each possesses is each for each alike. New ideas can never be accepted as true unless the present organized facts of knowledge can be readjusted to make place for the new thought. This fact is at once the safeguard and the danger of society. We can live together in peace only in so far as the presuppositions of our beliefs are common, while, on the other hand, unless there is some diversity of attitude there can be no development and no advancement.

There will be, then, certain basic common attitudes—the attitudes we adopt toward justice, liberty, and morality for instance—which will form the substratum of the basis upon which the larger groups of society are founded. Above these fundamentals society will be found to break up into smaller and smaller sub-groups until the essentially personal attitude of the individual is reached. The active judging attitude of each group will determine the perspective in which reality is seen and will determine the aspects of reality that go to make up the world of knowledge common to the group. The validity of judgments is determined by whether or no the activity subsequent to and founded upon the judgment brings experience that fits into the world of knowledge, or the presuppositions which determine the judgment, and not upon whether or no this experience fits into some other scheme of knowledge foreign to the judgment. When such experience does fit, we say that the judgment is a true judgment. Truth is a meaning that attaches to the result of a valid judgment *per se*.

It then follows that attitudes can not be judged with relation to some form of funded knowledge that does not give rise to them, except and only in so far as the basis of the judgment is common to both attitudes, namely, the attitude judged and the attitude giving rise to the judgment.

Society is grouped, then, according to the attitudes toward experience common to the individuals forming the group. Thus scientists possess in common one attitude toward experience, engineers possess another, artists possess a third, mathematicians possess a fourth. Each deals largely with the same experience, yet each isolates and selects certain aspects of this common experience and judges it according to his own light. All these various aspects are equally real, and the judgments dealing with each aspect, in so far as they result in co-ordinated knowledge, are equally true. The engineer can not say of the artist that his judgments are bad, because their results do not "gee" with the engineer's presuppositions, nor can the scientist claim all truth as particularly his because the truths of other men's worlds are not the truths of his world.

I think that ignorance of or failure to realize the importance of these facts is at the basis of much of the inadequate and mistaken criticisms that have been made both by architects and engineers, one of the other. In some cases there sems to be on both sides a failure to recognize the meaning and intent of activity. The architect "has it in" for the engineer, so to speak, because the engineer does not appreciate the importance of meeting the conditions that the design imposes, while, on the other hand, the engineer "cusses out" the architect for interfering with the working out of his pet formula for efficiency. The cause of this state of affairs is due largely to an unfortunate over-specialization in education. But the education of the architect is necessarily somewhat broader than that of the engineer and his "fund of knowledge" is usually of sufficient scope to enable him to understand the means whereby the engineer arrives at his conclusion, whereas to the engineer there is usually something so inexact and "unreal" about art that he is prone to assume offhand that the æsthetic qualities of the design are of relatively little utility; or if the engineer does possess any artistic appreciation of the value of beauty he often tries to formulate his æsthetic judgments in the same way that his professional judgments are developed. In other words, he tries to reduce the facts of the æsthetic world to a system of scientific truths. The result is quite as logical as an attempt to organize the facts of the scientific world by the method of the æsthetic judgment. Of course we do not mean by this that the development and meaning of art and the æsthetic consciousness can not be made the subjects of rigorous analysis. But there is every difference possible between describing the processes of art in definite laws, and evaluating the results of the operations of these laws. To attempt to define one in terms of the other is to violate a fundamental canon of logic.

The necessary broadness of the architect's training sometimes places him in a position where he can judge the relative importance of the various factors in the construction of a building, whereas often the engineer is only able to realize the importance of what he himself desires to do. This has resulted in a disposition on the part of the architect to criticize where sometimes his criticism is unjust. A further result of this situation is that the co-operation of the engineer has been forced upon the architect rather than that the assistance of the engineer has been accepted as an unquestioned necessity.

Any behavior on the part of the engineer that tends to widen rather than heal this breach is unfortunate, and I propose to devote the remainder of this paper to pointing out certain mistakes in criticism which have been made by those who stand as representing the profession of illuminating engineers.

The situation, as I see it, is this: The illuminating engineer is seeking the opportunity to apply scientific principles to artificial illumination. He claims, and his claim is doubtless just, that since the old empirical methods of heating, sanitation and structural design have been reduced to general wide principles applicable to all cases, the same methods should be employed in designing lighting arrangements. He must remember, however, that in almost every case the heating and the structural engineer do not attempt to dictate to the architect how his building should be designed in order that their apparatus may be as economical and as inexpensive as possible. On the contrary, these experts take the plans as they come and lay out their work to fit the building as designed, except in rare cases where the design is such that the conditions can not be met without exorbitant expense; in which case there is usually found some solution satisfactory to both parties. The heating expert does not demand that iron-pipe coils shall be used in every case simply because iron pipe is the most efficient radiating surface known, nor does he demand that radiators shall be located only thus and so, and that they shall never be concealed because concealing them hides their true nature and lowers their efficiency between twenty-five and thirty per cent. Furthermore, he agrees with the architect that radiators and registers are at the best unsightly and should be made as inconspicuous as is possible, or else their design should be such that they will, as far as posible, tone in with the environment and become in appearance at least a part of the architectural treatment.

The structural engineer does not insist that false steel work shall never be used solely for architectural effects, or purely for supporting decorations, nor does he attempt to criticize the architect for doing all he can to hide his essentially mechanical structure. Neither does he say to the architect that he, the architect, does not know his business because he does not make his design illustrate the method of construction. On the contrary he admits that such things form no part of his business, and if he thinks of it at all, he probably admits that the architect knows what he wants and knows how to obtain it. The illuminating engineer, on the other hand, has taken upon himself, officially at least, the duties of a general architectural critic. In which he may be justified if he feels that way, and considers himself fitted to undertake the task. It seems, however, that he would exhibit better judgment if he presented himself as a critic under the proper auspices. It is a little hard to expect a man to co-operate with you if you slap his face at every opportunity. Furthermore, it seems to be the duty of the critic to appreciate and evaluate the object of his criticism from the viewpoint of the social group to which the individual belongs who created it. It is as senseless to criticize a lighting fixture solely on the basis of its qualities as a light-giving source, as it would be to criticize a building solely as a means of furnishing shelter. The lighting fixture has to give light, it is true, and also it is primarily a *lighting* fixture; but that is not all it is by any means. From the designer's viewpoint it must possess his conception of beauty and he is often quite at a loss to find some way of giving even some semblance of beauty to the very mechanical requirements that the scientist has imposed upon him.

There seems to be a prevalent idea that true criticism is destructive and not constructive. This assumption, however, fails to properly account for the attitude from which the criticism is made. Criticism must be founded upon some basis of knowledge, and it seems impossible that criticism is not a matter of comparison between what is and the ideal construction of what ought to be. To know what is wrong it seems that the critic must, *ipso facto*, know what is right, and if one assumes the duty of critic he must be prepared either to present his reasons or to be completely misunderstood. Nor is criticism a mere cataloguing of faults, for the critic, *qua* critic, assumes a position which he thinks is higher and more thoroughgoing than the position of that which he criticizes. If he is an architectural critic he assumes that he knows more about the meaning and intent of architecture than the architect himself. But the knowledge on which his critical judgment is formed must be architectural knowledge, and not mere knowledge of the history and development of the forms of construction used in architecture. If he thinks that architecture is principally a matter of construction, then he is wofully in error. As a matter of fact, in architecture the emphasis is always on the form rather than on its construction.

One may agree substantially with a theory of æsthetics based upon the development and meaning of the objective aspect of art. But when this theory is used as a basis for criticism of the solely subjective quality of beauty it is time to call a halt. No amount of study as to how things have come to be as they are can tell us altogether why we consider them beautiful or not. The *how* of things is probably far more dependent on the *why* than we are at first blush disposed to imagine.

The engineer is fully within his rights in criticizing objects from his viewpoint; but he should not criticize them for meeting some other requirements at the same time. He should appreciate the fact that the relative importance of requirements placed upon the object from viewpoints other than his may require and make necessary some modification of his own demands.

If the illuminating engineer criticized lighting fixtures only, and only as fulfilling or not fulfilling engineering requirements, the architect would have no complaint to make. But the engineer as engineer has been emphatic in his opinion as to the artistic value of many lighting installations, and, not satisfied with this, he has extended his criticisms to architectural treatment in general.

We find his printed opinion that certain works of some of our most famous architects are monstrosities, and others are in bad taste; that the modern architect is a mere copyist and compiler. We are told that the famous Hall of Mirrors in the Palace of Versailles is archaic in comparison with many a café along "The Great White Way"—that, since diamonds are always in good form (!) therefore, the faceted or prismatic glass pendent is equally beautiful and appropriate, no matter what particular period the furnishings or decorations may be in. Oh, shade of John Stuart Mill; Oh, memories of Canterbury! We hear that fixture designers often make the mistake of considering themselves artists, and that since the lamps and their accessories weigh be a few pounds, it is senseless to support them by a structure that in itself weighs many times more.

I do not mean to say that there may not be very good reasons for these, and many similar statements, for the percentage of men engaged in the architectural profession who are little fitted to cope with their responsibilities is probably not very different from the relative number of engineers in a similar position.

Concluding these remarks, is it any wonder that instead of accepting the illuminating engineer at his real worth, the architect says that he does not know what he is talking about? The attitude that the illuminating engineer seems to have taken has undoubtedly retarded the development of the profession and it will continue to do so for some time to come.

The Position of Electric Lighting in England.

By Albert H. Bridge.

PERHAPS at no previous period of the electric lighting industry have engineers been in the midst of such changes and uncertainties as they are at the present time, yet notwithstanding this circumstance there is a very decided ring of optimism in the remarks of those who attempt to foretell the future.

It has been recognized that gas engineers have already passed through experiences very similar to those of the electric lighting engineer and manager to-day—indeed, are still so passing. A very striking speech to this effect was delivered only a few days ago at the meeting of perhaps the largest gas supply authorities in England, and because the writer believes it to be of interest to electrical readers he quotes it below. It will be observed that with only a very slight variation in one or two particulars it represents the position of electrical lighting as accurately as it does that of gas illumination:

"The diminished sale was fully accounted for by climatic conditions, while the substitution of new lamps for old, of methods of burning which were increasingly economical from year to year, had added to the volume of light while enormously reducing the quantity of gas needed to produce it. One comparatively small railway station had reduced its consumption in this way by 3,000,000 cubic feet, and a city warehouse by very nearly the same amount, and these were only types of thousands throughout the company's district. They welcomed every improvement in this direction, but the immediate effect was to curtail the company's business. The simple inverted incandescent burners gave a light eight times better than good flat-flame burners, or in other words the same light could now be obtained from 1,000 cubic feet which would have required 8,000 a few years ago. With gas used at high pressure the increase was not eight times, but twenty times."

One of our illuminating experts, Leon Gaster, has gone so far as to suggest the idea that the severity of the competition between gas and electricity might be eased, or put an end to altogether, by the adoption of some mutual limitation of spheres of work. There is something Utopian in the idea; no one can say that any prospect of such an arrangement has appeared on the horizon, and few things seem to the writer less within the realm of probability. In the midst of metal filament-lamp prophesies and hopes, however, it were unwise to attempt to indicate what the effects of the most recent electrical advance may be even upon gas authorities in the course of a few years. British gas interests have developed a fighting spirit of enterprise which they did not possess in presence of a weaker rival and electrical interests are gradually becoming more enterprising too, but their desire is to hold the hand until they see which way the metal-filament cat jumps in their stations.

At St. Pancras the electricity department recently stated that the one thing that stood in the way of the small consumer was the cost of wiring and fitting. Some students of the situation urge the sanctioning of cheaper and more simplified wiring systems, a greater freedom from onerous restrictions, and some even go so far as to advocate free wiring of all consumers' premises by the undertakers. In England, where gas authorities have been so long at work, enabling them to secure so firm a hold upon the small consumer, it is, of course, imperative that it must be made as easy and cheap to change over as reasonable safety will permit. The extreme competition among electrical contracting firms is doing much to keep down the price, and to raise the indignation of organized contractors, and it may be bringing down the quality of the work installed.

Many of our electric lighting authorities have but touched the fringe of the business so far as the private lighting small consumer is concerned. A number of them have conducted experiments to watch the value of supply to small property. One of the latest steps in this direction is announced from Swansea, where some workmen's dwellings which are being built on the hollow-concrete-block plan are being wired, giving the tenants the option of slot meters, calibrated for six pence per unit. Some other authorities, who have incurred outlays of a somewhat similar kind, are being hauled over the coals by critics because the incoming tenants in the small property so wired have not thought it worth while to avail themselves of the supply at the price per unit charged, in spite of the fact that the wires and lamps are in position awaiting their use.

How far publicity campaigns can be relied upon for bringing in new consumers of the smaller class is a very questionable matter. Indeed, aggressive campaigns of this kind are not welcomed in England, either by lighting authorities or by lighting consumers. There is a more promising scope for them just at present in the power field, but even there the Britisher is a delicate subject who requires skilful, diplomatic handling. He is not to be netted by any kind of literature that tells him that he is an ignoramus or a fool, or that in sticking to old methods he is doing foolishly. A fool he may be, and may know it, too, but he is the more likely to continue foolishly if he be told that he is so by the man who is seeking to profit by his turning over a new leaf.

The coming of the metal-filament lamp, however, gives one of the best chances for publicity pamphleteering, for it is by some such means that the pounds, shillings and pence side of this lamp is going to be fully and speedily appreciated by the present small consumer of gas. Some central station men have shown no overweening anxiety to boom metal lamps, for obvious reasons, but none of them would favor a continuance of that policy for long. If the new lamps are going to reduce the cost of electric lighting to the small consumer so that he can adopt it without an increase in his quarterly bill, it can not fail to bring about an enormous amount of additional mains-laying and house-service work, for few English lighting authorities have more than touched the fringe of the business that he represents. Very large numbers of streets in which mains are not yet laid comprise, for the greater part, small-class property where gas-pipes and fittings are installed, where a gas stove is in vogue for cooking purposes, and where, if electricity were adopted for lighting, the gas stove would still be required, as electric heating and cooking are regarded as a luxury.

With this class of consumer it is almost solely a matter of pounds, shillings and pence; convenience, cleanliness, greater healthiness and all that are in many cases matters that, short-sightedly, of course, they do not care a brass farthing about. As to the standard of illumination being raised, they have the incandescent gas mantle and there is no good in blinking the fact that it seems to answer their purpose, so that it must be more the argument of cost than any other that will appeal to them.

Only a comparatively small proportion of these people are the owners of the houses in which they live and they will not run to the cost of installing electric light into premises which, either perforce or by choice, they may vacate in a very short time. So the landlord is frequently the person to bring persuasive pressure upon. But apart from the cost of installation, which is a very considerable obstacle, there is that quarterly account which is a far more impressive difficulty.

The foregoing comments relate to property which has stood for from twenty to forty years or more. To-day builders of a great deal of new property are wise enough to wire straight away, so that the tenant is not concerned with the cost of installation; the gas stove is hired from the gas company. The electrical contractor gets a hint that new buildings are to be erected, and he is on the scent if the premises are to be reasonably near to the supply mains; if the builder or architect happen to be undecided as to illuminating arrangements he is compelled to give full thought to electricity by the attentions received from the aforesaid contractor. No doubt many a new electricity consumer is being secured in this way.

It is becoming patent that it is imperatively necessary that there must be the utmost simplification of charges and supply arrangements to help in the forward movement, as W. M. Mordey, the president of the Institution of Electrical Engineers, has lately remarked. At Marylebone some very plain advice has been given concerning the necessity for exercising great care at the present time lest indiscreet changes in the matter of charges for energy should disturb relations with existing consumers. The fact is that while engineers are awaiting the effect of the use of the new lamps they can not afford to lose a single customer. Systems which are dependent mainly—or to any very large extent—upon lighting, are reckoning upon a decreased rate of increase in units sold, and some will be satisfied if there is not an actual decrease in output, but the full effect will not be felt all at once, and by the time it is making any very deep impression the existence of the "wire" lamps and their economy will have become more common knowledge among potential smaller consumers, while we may also hope that the initial cost of the lamps will fall so as to give a compensating impetus.

The lamp makers are proceeding with their arrangements for the manufacture of the new lamps on a large scale in England, but until the completion of factory equipment for this purpose large numbers are being imported from the Continent. The lamp makers are, of course, displaying considerable energy in pushing the sale, and the testimonials that they have received and are publishing from consumers, are eloquent concerning the economy in their bills for energy. In one case a consumer states that in his premises he is doing for £16 per quarter what formerly cost him £56; and numerous others produce returns showing an actual economy of fifty per cent in their payments, with a superior illuminating effect. There may be exceptional cases, such as one the writer learned of recently, where the lighting cost comes out at a higher figure, but other circumstances than the lamp itself must have been to blame, although complaints as to breakage are pretty frequent. Their extra liability to breakage in transit, perhaps due to inefficient packing, is also occasionally referred to, but these can have little force against the tide that is beginning to flow in metal lamp favor.

One of the outstanding features of British electric lighting business at the present time is the slackness of orders for new generating plant. Very few new public supply systems have been set up during the last year or two, for reasons that need not here be stated, and the engineers of some of the existing installations are nervously holding their hands in the matter of extensions to plant. It was recently stated at Hull that before making particular advance of this description the corporation awaited experience in regard to the effect of the new lamps. It is safe to say that many other engineers are seeking guidance in the same way. Mr. Talbot, in his presidential address to the Municipal Electrical Association a few months ago, remarked that the electrical plant supply would feel the effect, and he is proving to be correct. But the municipal authorities and companies who sell electricity are also feeling the effect upon their finances. Already the price of electricity has been forced down to too low a figure for reasonable profit to be earned upon its sale, and reduced consumption has in some places led to suggestions for raising the charges to the consumer who uses the new lamps. This course meets with little approval. Some authorities will be helped this year to bear the loss of revenue by the reduced cost of their coal bills, which last year were exceptionally heavy, and when comparisons have to be made this factor will require attention. The attitude of the investor who has put his money into electric lighting companies seems to be one best described as suspicious hesitation. The new lamps can not be an immediate dividend-earner, so they do not lend strength to market prices of shares; they may raise values in years to come, but it is only the shareholder who means to hold on who cares much about the future. It had been thought that after so many blows received in recent years electric lighting investments were due to take an upward turn, but it seems that it is this nervousness regarding the metal lamps that stays the movement. So that the financial position of electric lighting business in England just now, whether municipal or private, is not all that one could desire. Municipalities in some towns have become weary of carrying an electric lighting undertaking round their necks, and are inclined to receive affectionately the financier who makes an offer from a company. One of the most amusing and instructive commentaries that could be passed upon municipal electrical enterprise, and its changing moods and fancies because of changing councillors, is recorded at Bath. Here many years ago a company obtained powers and supplied the town, but it was everlastingly heckled and persecuted by the corporation until at last it sold to the latter body. It has had its run, with the city rates carrying the burden, and has just entered into contracts with private parties, who will buy the undertaking and work it through a company!

Reverting to the question of simplification of charging systems, it is clear that the maximum-demand system is going more and more out of favor. It is out of favor with the consumer because what he wants is something that he can understand without an effort, and a flat rate, however inequitable it may be thought in some cases, seems to give him less room for harboring a suspicion that he is being "done." It is out of favor with the engineer because so much depends upon his being able to satisfy his consumer. Some engineers are advocating the "contract-demand" system, one of whose points would be the equalization of quarterly bills—which might or might not avoid complaints. But space does not permit of a disquisition on charging in this article—it is sufficient to indicate that the whole subject is in process of development.

One of the satisfactory effects of the lamps so far has been the increased attention that has been devoted to isolated installations for smaller country houses, hotels, and so forth, on account of the lessened cost of plants consequent upon the increased illuminating power from a given energy consumption.

A matter in connection with interior illumination that has received more attention on your side of the Atlantic than on this is the part that may be played by illuminating engineers in the improvement of existing installations by effecting a better distribution of a consumer's lamps, and so on. Undoubtedly there is a good deal of useful work to be done in this direction, reducing waste and increasing satisfaction with electricity as a lighting agent, but there are wanting indications of a burning anxiety on the part of owners to engage a specialist of this class.

Progress is now being made very satisfactorily with electricity for street lighting and open spaces generally. The effects of the improvements introduced by the inventor and the lamp maker are very plainly apparent in this department. The innumerable types of flame arc lamps, the Nernst and tungsten lamps, are aiding the electrical engineer in making an advance, and an examination of the most recently compiled statistics shows that these are all having a pretty extensive trial in different cities. We do not go in for many thousands of arc lamps in a town yet, as you do, but a number of small places count their Nernst and flame lamps by some hundreds, while the metal-filament lamps are being very extensively employed for experimental purposes, and if they pass through the ordeal well, public electric lighting in England will advance far more rapidly than it has done. Engineers are, of course, feeling their way in the matter at present. At Colchester, for instance, Nernst lamps are being replaced by Osrams as street lamp renewals become necessary. At Brighton some hundreds of street lamps have been changed over to metal filaments.

By far the finest object lesson that the public has ever had in this country in illumination systems is that to be seen at the Franco-British Exhibition in London. Both gas and electricity are well represented in the lighting of different parts of the grounds—the court of honor has a fine electrical display by arc lamps, and the electric illuminating effects generally are making a good impression upon the public mind. Then inside the machinery hall model houses fitted up respectively by the gas and electric lighting authorities are to be found, and the visitor has an admirable opportunity of comparing the merits of the two systems.

The Illuminating Engineer.

By Albert J. Marshall, Chief Engineer, Bureau of Illuminating Engineering.

THE illuminating engineer and the principles which he is advancing are receiving, at this time, more of the careful thought and attention of architects, engineers, central station and gas men than ever before. This recognition has been brought about through the fact that the competent illuminating engineer has been able to demonstrate that it is within his ability to predetermine with much accuracy the resultant illumination from any artificial lighting installation, and at the same time produce an effect as a whole pleasing to the eye. Many of those people whose business it is to specify the use of artificial light, in its various forms, are now beginning to appreciate the fact that through the medium of good illuminating engineering principles, desirable results may be obtained, obviating almost entirely the probability of failure not uncommon where the old hit or miss, or trust-to-Providence principles are in vogue.

It is only recently that the average person whose business it was to specify the use of artificial light gave little or no thought to the value or need of such services as the competent illuminating engineer could offer. But those people who did make use of such services obtained such results that it practically compelled reluctant coworkers to acknowledge that the illuminating engineer *did* have something of value to offer and that his services or ideas in many classes of work were practically indispensable.

There were many, and there remain quite a few, people who felt that it was, and is, unnecessary to consult with a recognized authority on illuminating engineering to make use of artificial light. The large percentage of this class are persons who have been "handling" lighting problems in a hit or miss or trust-to-Providence manner for a number of years, and they have become so accustomed to using light in this manner that they have come to consider it something which requires no special skill or marked ability to intelligently make use of same. These people, feeling that light is not tangible, regard it much in the same manner as Little Eva did her existence—it just happened, and is not subject to control. To this class of people the retaining fees of the illuminating engineer are considered an unwarranted expense.

Another class of people who have been rather skeptical, but who, it has been found are rather easier to convince, are those who, in making use of artificial light, have realized that it was possible, in some manner of other, to approximate what a light source, when installed under various conditions, would do. This class often made use of certain rough formulas (based, however, on scientific data) in their work, which sometimes they were willing to discard when newer and better formulas were brought to their attention. One difficulty, however, with this class of people is that after they accept a formula they apply it without variation to all manner of installations coming under a general classification. Almost all formulas used by the illuminating engineer to-day are subject to variation, depending on conditions, and that variation is to be determined by the general experience and ability of the engineer. Therefore, any one using such formulas without taking into consideration necessary variations find that the results vary greatly, which, of course, is not good engineering. However, the people who do make use of such formulas as have been given to the public quite recently by competent illuminating engineers, are much surer of success than their coworkers, who still rely on the old hit or miss principles.

There is still another class of people who make use of artificial light, and who, apparently, use neither of the methods employed by the two. I refer to that class of people who in using artificial light subordinate almost everything to æsthetic ideas. It is reasonably safe to state that in many instances where light is used the utilitarian as well as the æsthetic should be given consideration. One seldom sees a lighting system where it would not be possible without sacrificing beauty to utilize some of the light to produce useful and desirable illumination. In other words, one seldom sees a lighting installation, unless it is purely decorative, wherein the utilitarian should be entirely subordinated to the esthetic, or *vice versa.*

This naturally leads up to the point of who must decide when the question arises whether the utilitarian or æsthetic should receive the greatest consideration; and who, might I ask, is better qualified to answer such a question than a competent illuminating engineer.

It is but recently that a few scientific men began to realize that artificial light was being used in a most wasteful manner. Realizing this condition of affairs, they began to look about for a remedy and it was principally through the application of scientific principles that the remedy was first discovered. It was the technical man, chiefly the electrical enginer, who began to make experiments in order to determine what might be done in order to eliminate this waste of artificial light; and he, naturally, because of his education and training, made use of scientific principles in attaining the desired end.

In fact, the engineer at that time gave little or no thought to anything other than the purely scientific features of the case. This I think, we can readily understand, was natural when we consider the vast improvements that the engineer saw could be made through this medium. The engineer, essentially of technical and scientific mind, up to this time had had no cause or reason to make a study of æsthetic principles, inasmuch as he had never had occasion to apply such principles to his work. As it was the engineer who first appreciated what could be accomplished by the proper use of artificial light, new systems and methods of use suggested by him were strongly impregnated with his views, his ideas. These new methods and ideas that the illuminating engineer was offering and putting into actual use were applied at first, principally, to so-called commercial lighting installations, wherein the utilitarian side was of prime importance. After a number of such installations were made it was noted that improvements on the side of economy were showing up to such advantage that the same principles were then tried out in classes of service wherein the utilitarian was *not* of such great importance. In some instances these principles were made use of by people who did not have the training or natural taste to fully appreciate the æsthetic, the result being that while the installation from an economical point of view was almost entirely satisfactory there was something to be desired in the effect as a whole.

About this time users of artificial light in work wherein other than the purely utilitarian was of first consideration, came to the fore with the general statement that the scientific mind was unable to fully appreciate the beauty and harmony that work of this nature demanded; that it was all right for the illuminating engineer to handle lighting problems where the utilitarian was the main consideration, but when it came to specifying lighting systems for such places as churches, theatres and public buildings the illuminating engineer should recognize his inability and permit those with a highly trained artistic sense to take charge.

The outcome of this controversy was that men who could and did appreciate the ultimate sphere which the competent illuminating engineer would eventually reach, began to study this new science and art from all points of view, so that they would fully appreciate not only the utilitarian and æsthetic, but the psychological as well. There being no schools or colleges where one could go to learn the principles and applications of this new art and science, it was necessary for these men to supplement their already wide experience with keen observation and close application to the study of all theories presented to assimilate the really desirable knowledge necessary for this new work. He must be able to appreciate what is meant by simplicity, beauty and harmony; to be able to see through the eyes of the architect and to so work as to assist the architect in accomplishing the most desirable end; to understand the eye, for if the eye is not given due consideration work done will be for naught.

The illuminating engineer of to-day, and I speak of that type of engineer who is competent to discuss intelligently illuminating engineering principles in all its many phases, because he has made a study of the work, is here to stay because he is necessary to success in the use of artificial light. This type of engineer is not merely a man of figures, but one who can and does cause beauty to be reflected from his ideas.

The illuminating engineer, generally speaking, has got to look to the architect for the bulk of his work and, realizing this, it is necessary to convince the architect that he is capable of carrying out any and all work which the architect may place in his hands. It has been an up-hill fight to convince the average architect that the services of a competent illuminating engineer are desirable, and often indispensable in many classes of work, and it is most gratifying to note that there are to-day architects of recognized ability who have given the illuminating engineer a chance to demonstrate his value and the results which were thus obtained warrant other architects taking up the ideas which the illuminating engineer can suggest.

I do not know of a single instance where the architect, when he consulted with a competent illuminating engineer, had reason to regret it. Unquestionably the day is rapidly approaching when the illuminating engineer will be firmly established and those who appreciate his value will gain over their reluctant brethren.

The Carbon Flaming Arc.

By Thomas Spencer, Chief Engineer, Helios Manufacturing Company.

ALTHOUGH the term luminous arc has been applied to a much larger field than formerly, including, as it now does, lamps in which the electrodes are of other substances than carbon, and in which the light is given from the flame rather than from an incandescent crater, the term flaming arc seems to be applied only to the earlier form in which the electrodes are carbon impregnated with the salts of alkaline earths.

This form, which is the subject of this article, has now been a commercial possibility for something like five years and has been upon the American market for a little more than two years. Abroad it has made great progress and lamps of this character can be seen burning in great numbers in all of the large cities, but here the introduction has been comparatively slow. It is true that a few can be seen on the streets of our principal cities, used mostly for advertising purposes, but still the number of lamps used is very small compared with what you would expect for a source of illumination whose efficiency is so much higher than any other.

The principal reason for this, in my mind, is the short life of the carbons.

The complete replacement of the open arc with us, by the enclosed, has so accustomed our people to an arc lamp which has a long life that one which requires frequent trimming is not attractive, no matter what its other good qualities are.

Abroad this does not apply as the enclosed type of lamp has not obtained the footing it has with us.

There is another reason perhaps which has contributed to lessen the rapidity of their introduction and that is that the lamps which were first brought to this country were of a type known as the clockwork pattern. This form is looked upon here as much too delicate to long stand the hard service to which arc lamps are subjected, but no doubt the short life of the electrodes is considered the greater drawback.

In some of the early lamps, the light-giving salts were mixed through the body of the carbon and in large quantities. This was found to give a great amount of light, but unfortunately when the lamp was turned off it would not light again on account of the insulating slag that was formed upon the ends of the carbons. To overcome this an attempt was made to break off this slag by means of a mechanical device worked by a magnet, but this was not very successful.

Then an old form of lamp in which were two carbons pointing downward at an angle to each other was tried, the supposition being that the slag would drop off as fast as it was formed, leaving the points of the carbons clean. Although this was a great improvement over the carbons placed one above the other, the difficulty still continued and it was not until after the German carbon makers had taken up the manufacture of this type of carbon and had discarded the form in which the light-giving salts were mixed throughout the body of the carbon and had substituted one with a core containing the light-giving salts that this trouble began to disappear. It was soon found, though, that this type required the carbon to be the smallest possible diameter to secure steady burning, and this small diameter, of course, as it will easily be seen, reduced the time of burning of a pair of carbons of a given length, so, to obtain even a practical life, the carbons had to be made of an unusual length and, of course, with a corresponding increase in the length of the lamp.

Another difficulty which the small diameter of the carbons introduced was the large variation in resistance which they caused in series with the arc which very much interfered with the regulation of the lamp.

To remedy this, copper plating of the carbons was first tried, but this did not seem to meet the conditions. The solution was finally found in the introduction, either in the core or in a special opening running the whole length of the carbon, of a metallic wire which in some cases was zinc and in others brass, depending upon the makers. In spite of all of these improvements the objection still remained of a long, delicate carbon. To remedy this a great many inventors have tried their hand at what are known as magazine lamps; *i. e.*, lamps in which a number of carbons are placed in a magazine, only one carbon burning at a time. As soon as it is consumed another takes its place automatically from the magazine, and this continues until all the carbons in the magazine are consumed. Quite a number of lamps of this character are in operation abroad, but on account of their necessarily complicated structure it is evident they are bound to be troublesome in operation.

Another set of inventors have tried burning a number of pairs of carbons in parallel, the arc shifting from one pair to the other as they burn away. While this is much simpler than the magazine form it involves considerable difficulty in the control of the arc by the blow magnets, which control is absolutely necessary to produce steady burning.

If, instead of a number of carbons, only two pairs are used, this trouble is overcome and, in my opinion, the most practical solution of the life question is obtained, as with two pairs of carbons of reasonable length a life of between twenty-five and thirty hours can be obtained with a lamp whose length is only a few inches longer than the average enclosed lamp.

Our friends across the sea, from whom we received our ideas of the flaming arc lamp, realized that their solution of the problem, as far as the lamp was concerned, was rather a complicated one, but they think there is no way of accomplishing the results other than by the so-called clock-work mechanism.

It is quite true that several types have been developed which do not use the clock-work form, the feeding of the lamp being accomplished by letting one carbon rest upon a support at its burning end, the carbon feeding down as it burns away by gravity, carrying with it the other carbon to which it is attached mechanically. This form of lamp has taken a great many shapes, according to the ideas of the inventors. In a number of cases special forms of carbons are used, while in others the simple round carbon is retained. This lamp has a number of good features, the principal one being that it can be operated in series without a shunt coil and, of course, this principle leads to great simplicity in construction. Unfortunately experience has proven that the burning of the carbons is much less regular and reliable than when the carbons are burned free with no support. This is even the case with those lamps using the special forms of carbons, and the use of any special carbon is a serious objection in itself. From what I have said it would therefore seem that there is some middle ground in the construction of a flaming arc lamp between the clock-work lamps of the Germans and the so-called gravity-feed lamp which we have just described which will be the final form which this type of lamp will assume.

Considering the improvements made, which I have pointed out, it would seem that there should be a large field in this country for this form of illumination, as there is no question that the volume of light obtained for the energy expended is the highest obtainable. The golden yellow color, the form usually used, has proven extremely pleasant to those who are compelled to work under such an illuminant and, besides this, the color is particularly suitable for illuminating such places as are dull from dirt and soot, as more light is reflected from such surfaces with this color than with ordinary white light.

I feel that when these points are fully appreciated by the American people that the flaming arc lamp will be much more generally used, even more than it is abroad.

A New Field for the Electric Sign.

By Benjamin Wall.

WHILE it is pretty well understood that many progressive business men of to-day do not consider an establishment complete without a suitable electric sign burning either a name or a business into the mind of the public every night the store is open, it is not so well known that there are numerous electric signs now being used in lower Manhattan as "business-getters" that burn all day from the opening until the closing of the store.

The streets of New York are somewhat narrow, but the same statement applies to a number of other cities of importance in this country. Narrow streets with tall buildings and the resultant darkened area give the central station sign man an excellent argument when advocating the use of the electric sign for daylight advertising.

A Nassau street clothing-store proprietor uses an electric sign containing 125 eight-candle-power lamps, the sign being placed flat against the building, and although the show window beneath is brilliantly illuminated the sign burning in the daylight attracts the greatest attention and has added considerably to the business of this house since its installation.

A well-known retail drug store in lower Manhattan has for some time maintained a panel sign in front of its window. This sign is lighted from 8 A. M. until the store closes at night and is a prominent feature of the advertising display made by this firm.

In the shoe store of Frazin & Oppenheim in New York city may be seen another electric sign burning all day over an archway leading from the main store to their annex.

Another case of daylight use of the electric sign may be observed in Brooklyn. The Abraham & Straus department store has an entrance leading from the subway directly into its store, and it has installed an electric sign with the firm's name in electric letters over the doorway. This sign does double duty, as it burns all day during business hours and at night, even when the store is closed.

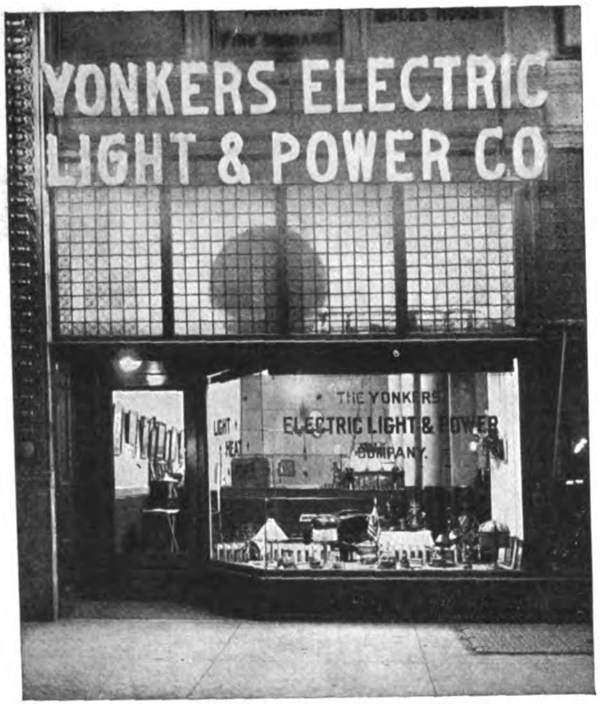
A Daylight Electric Sign.

The outside stock exchange, known as the "Curb," which holds its meetings in the open air on Broad street, south of Exchange place, in New York city, has been a cause of complaint on account of noise to the occupants of office buildings nearby. To end this trouble S. Mendel, the "dean" of the "Curb," decided to use an electric call sign. Each brokerage firm was given a number, and a blackboard, equipped with incandescent lamps under the firm's number, may be seen from both sides of Broad street. If the representative of Mendel & Company is wanted at the telephone, their number is flashed on the electric sign, and until the call is answered the number remains displayed on the electric call board.

Anent the general use of electric signs, the illustration of the first electric sign in New York city, shown herewith, is interesting. This sign was installed some twenty years ago at the spot where the so-called "Flatiron" Building now stands, at Broadway, Fifth avenue and Twenty-third street.

Part of this sign was flashed and there is an interesting little story connected with the flasher that was in use here, it being stated that instead of commutators, gears and motor now in universal use for flashing electric signs, the flasher for the first sign was operated by hand-power. Knife switches were installed for each circuit of lights and a young man employed to pull the switches until one line of letters was flashed, then he closed the switches, thus lighting the entire sign. This was done from dark until midnight every fair night and must have been a very irksome task for the "human flasher."

So confident was the Garden City Estates Company that an electric sign would prove beneficial to its business that it insisted on a clause being inserted in its lease giving it the privilege of installing an electric sign in front of the windows of its suite of offices on both sides of the building on the north end and willingly paid a higher rental for the privilege.



How One Electric Light and Power Company Takes Its Own Medicine.

Central stations throughout the country are using the electric sign more than ever, thus setting an example to the merchants of their cities, and even the gas companies are taking up the electric sign to advertise their product.

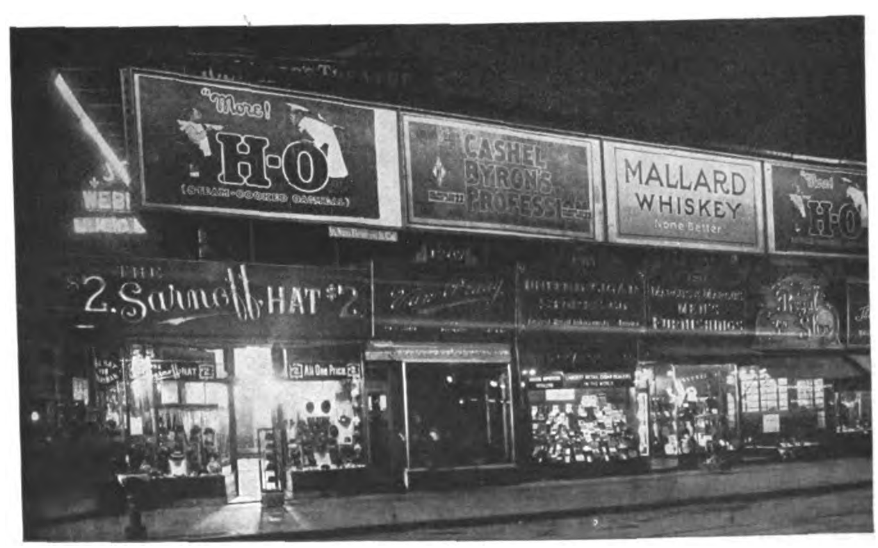
On One Hundred and Twenty-fifth street the Consolidated Gas Company has installed a large vertical electric sign reading "Cook with Gas." The Municipal Gas Company, of Albany, N. Y., has a similar electric sign in front of its office building. The Public Service Corporation of New Jersey has recently placed in front of its Passaic office building a vertical electric sign reading "Use a Gas Range." All main line trains of the Erie Railroad pass within two hundred feet of this building and the sign is read at night by thousands of passengers.

The Utica Gas and Electric Company has one of the best advertising signs in the country. On the smokestack of its power station in Utica it has installed an electric sign of the skeleton-letter type reading "Utica Gas and Electric Company." It can be read at night for several miles and is an excellent daylight sign on account of its great size.

The New York Edison Company has the honor of using the largest vertical electric sign in the world. It is built in four sections and is 100 feet high, with letters twenty-four inches high studded with electric lights. This sign, with the large electric roof signs on all four sides of the Duane street office building, gives that section of Manhattan the appearance of being on fire at night.

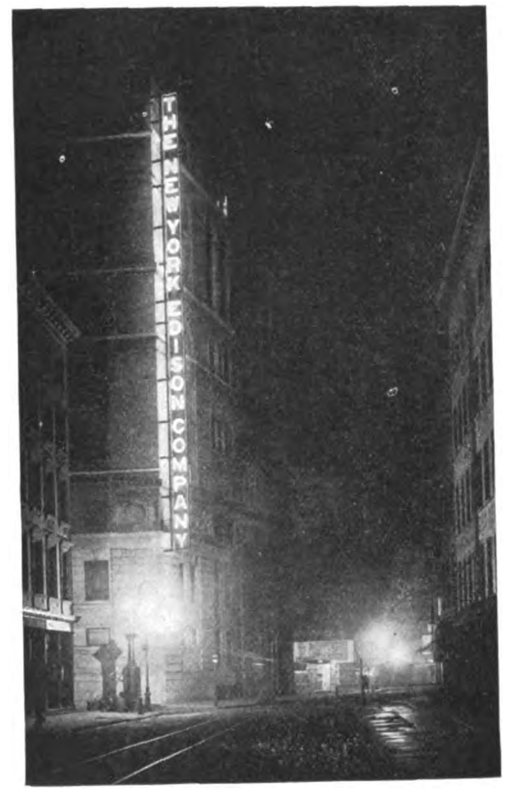
The First Electric Sign in New York City.

The Yonkers Electric Light and Power Company has installed a large electric roof sign as well as a flat box skeleton-letter sign in front of its office building. The roof sign can be seen both day and night from almost any point of the Highlands across the Hudson and from all Hudson River steamboats.



A Well-Illuminated Bill-Board.

One of the notable electric signs on the river front is that of the Heinz Pickle Company. The letters "Heinz" are fourteen feet tall and the numerals "57" are each twenty feet high by fifteen feet wide.



The Tallest Electric Sign in the World.

This sign can easily be read by day or night from Hoboken and Jersey City and from all the ferryboats plying on the Hudson River, and, like the Colgate sign in Jersey City, is a landmark of the sky line of lower Manhattan.

In Greater New York a recent ordinance has compelled the reduction in the size of sidewalk electric signs to six feet at right angles from the building. The

United Cigar Stores Company had a number of eletric signs in front of its stores that exceeded this limit and the writer visited several of these stores with the cigar company's electrician to see what could be done to so modify the signs as to bring them within the requirements of the new ordinance. It may be worth while to relate here the gist of a conversation which occurred between one of the cigar store company's managers and their electrician on one of these visits. The manager stated that he hoped his sign could be fixed speedily, adding "since that sign has been up I have done fifty dollars a week more business in this store." This was with a sign that represented an investment of about $75 for the sign and necessary service wiring.

The New York *Herald* has recently placed a V-shaped electric sign in front of its One Hundred and Twenty-fifth street branch office. The New York *Evening Post* one on the roof of its beautiful new office building in Vesey street. The New York *World, Staats Zeitung, Press, Times, American* and Brooklyn *Daily Eagle* and Brooklyn *Citizen* have all installed electric signs on their main and branch offices, and there is no question that they feel it is a profitable method of advertising.

A view of a section of bill-board reflector lighting is shown herewith. These reflectors are at the northwest corner of Broadway and Twenty-eighth street, New York city—well known as the site of Weber & Fields' theatre. The bill-boards are ten feet high and the reflectors five feet from the bill-board. For a cheap and satisfactory method of advertising by day and night nothing has yet been devised that will take the place of the electrically illuminated bill-board. Placing the lamps one foot apart (using either four-candle-power or eight-candle-power lamps) will give all the light required with reflectors at a distance of five feet to properly illuminate a ten-foot bill-board. The lamps used in this illustration are eight candle-power.

The first recorded instance of the use of tungsten lamps in sign lighting is that of the New York Edison Company, which is just installing a sign reading "Tungsten Lamps" on its branch office in West Thirty-second street, equipped with twelve-volt, twenty-five-watt tungstens, operating ten in series.

In closing, the writer considers the following account of an incident related by a manager of a central station sign department of possible interest. The customer occupied the basement of a three-story building. He ordered a panel sign from the central station, the sign to be erected over his door. To do this safely it was necessary to use guy wires which ran across the windows of the floor above. The tenant on this floor objected to this and the central station man was threatened with a cancellation of the sign contract. He was so well satisfied that the sign would benefit the customer who had ordered it that he suggested and was able to convince his customer that even if he had to rent the other floor it would be better to do so than to give up the sign. The customer was able to secure a lease of the floor above and to-day occupies the entire building, where only two years before he was able to handle all business that came his way in the basement. He has the electric sign and would not part with it under any circumstances.

Luminous Arc Lamps.

By G. N. Chamberlain.

THE luminous arc, sometimes termed magnetite arc, metallic-flame arc, has for some time been admitted by the most conservative or sceptical to be out of the experimental class. Although through the early stages of development, the system was received with scepticism by many of the leading illuminating engineers and arc-lamp manufacturers, it has long since been acknowledged as the most reliable and efficient illuminant available for outdoor services. At the annual convention, held in Chicago, May, 1908, the National Electric Light Association accepted the report of its committee of representative illuminating and central station engineers, which placed the luminous arc in a class by itself and far ahead of all the other out-door illuminants investigated.

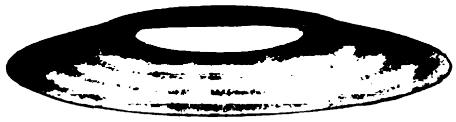


Fig. 1.—Concentric Ring Reflector.

The many points of superiority claimed for the system have been expounded in detail, both by the representatives and publications of the manufacturers, and the interesting phenomena of the luminous arc itself have been discussed at length by the technical press. A repetition of such details is therefore unnecessary as the data can be secured through the channels mentioned. Several years' commercial operation has resulted in the introduction of refinements into the series luminous system. Fig. 1 illustrates a concentric ring reflector designed for use with the series luminous arc. The superior distribution of light resulting from the use of this type of reflector in connection with the carbon arc has led to its application to the series luminous lamp. The use of the reflector, while maintaining the same lighting distance previously attained, assures an evenly diffused light and absence of shadows in the immediate vicinity of the lamp.

Fig. 2 illustrates a well-known form of copper upper electrode. The diameter of the copper has been increased from five-eighths inch to three-quarters inch and entirely enclosed with the exception of the burning ends, with one-sixteenth-inch iron casing. The use of the extra amount of copper and the prevention of the rapid oxidation of the same by the iron sheath have increased the life of the electrode to about 6,000 hours, or approximately fifty per cent. While no radical changes have been made in the design or manufacture of the lower electrode, a more uniform product and a gradual increase in life and efficiency are being obtained.

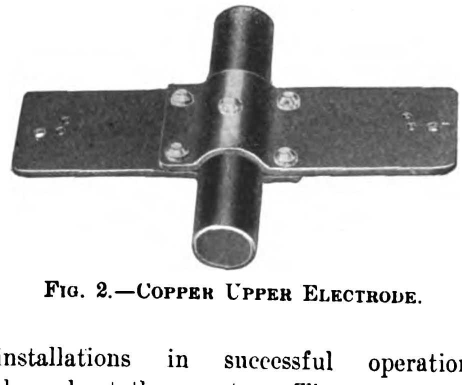


Fig. 2.—Copper Upper Electrode.

Fig. 3 represents a street lighted by luminous arcs and is one of the many installations in successful operation throughout the country. The system has not only been adopted by the smaller towns and average-sized cities, but has been accepted by the larger representative cities of the country.

The following extract from a daily paper of recent date is representative of the expression of universal approval with which the system is received:

"On Saturday evening the new electric street lamps were turned on after having received a good test and found entirely satisfactory by the superintendent and the electric light committee.

"The system that furnishes the light is the newest on the market, and its simplicity of construction and operation is apparent even to the layman.

"This new type of lamp is particularly suited to street lighting. It has a small power consumption, four amperes, at seventy-five to eighty volts, being about one-third less than the old lamps. Everybody has noticed the uniform lighting of our streets and commented thereon. There are hardly any shadows in the streets between the lights. Combined with this new lamp is the efficient transformation of alternating current into direct current by means of a mercury arc rectifier.

"Ordinary carbon electrodes are rejected in this system. To explain the operation of the lamp would be to give the reader a lot of technicalities, which are unnecessary in view of the fact that the lights work exactly as represented by the installing company, and that the people are very well pleased.

"The superintendent says that these lamps will need trimming but twenty times a year, and that the department expects to run at least 3,500 hours a year.

"Council had a number of systems to choose from, but all the members were unanimous in picking the luminous and not one has any complaint whatever to make. All over town the people are commenting on the uniformly bright lights and are expressing themselves in high terms of praise on the electric light department's acquisition."

So marked has been the success attained by the introduction of the series luminous arc, that it has naturally lead to other applications. Conditions often exist where it is prohibitive or at least undesirable to install a high-potential series circuit, but where otherwise the luminous arc would most efficiently and satisfactorily fulfil the requirements. To meet such a demand there exists a lamp suitable for maintaining a luminous arc on direct-current circuits of nominal 110 volts or multiples thereof.

Fig. 4 illustrates a type of lamp available for multiple or series-multiple operation. For single operation on 110 or 220-volt circuits the lamps are connected directly across the line, the difference between the two lamps being that of windings and adjustment.

Besides being operated singly on 220-volt circuits, two lamps may be connected in multiple-series and such connection is necessary where higher voltages only are attainable. The arc proper has all of the characteristics and advantages of the series luminous arc and the lamp is representative of the most modern arc lamp engineering practice.

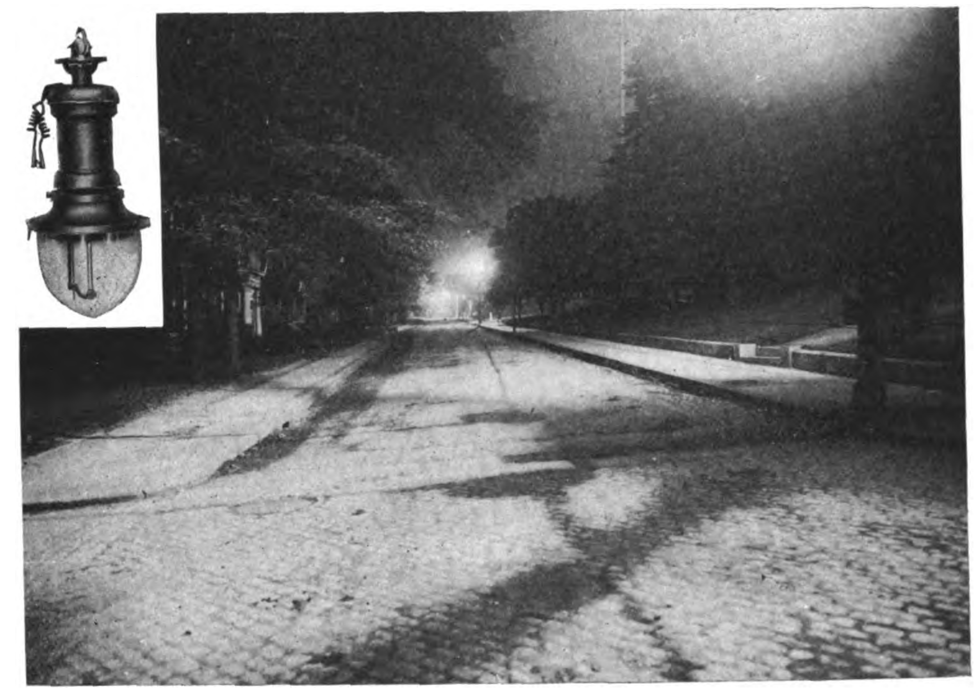


Fig. 3.—Street Lighted by Luminous Arcs. The Lamp Shown is for Series Operation.

The casing is symmetrical in construction, of pleasing appearance and so arranged as to admit of the use of the twenty-six-inch concentric diffuser, the advantages of which have long been acknowledged in connection with the distribution of light from the enclosed carbon arcs.

Fig. 4.—Luminous Arc Lamp for Multiple Operation.

This type of lamp is especially recommended for the lighting of foundries, freight yards, machine shops, train sheds, freight houses, drill halls and riding academies, or, in general, for the lighting of large areas where the fumes would not be noticeable.

The luminous arc is also found to be ideal for city street and interurban headlights. This application of the luminous arc is the result of the constantly increasing demand for a more efficient and reliable headlight than could be obtained with the enclosed carbon arc. The track illumination is very satisfactory, the headlight not only illuminating the track for a distance of 1,200 to 1,800 feet ahead of the car, but the beam is exceptionally broad. The peculiar characteristics of the luminous arc are such that by reversing the current, thereby making the copper electrode negative, the light is reduced to such an extent as to make it suitable for city service. This is readily accomplished by a reversing switch installed in the car vestibule near the motorman.

The maintenance of the enclosed arc headlight for cars has always been comparatively high on account of excessive globe breakage and resulting rapid consumption of carbons. A life of 2,000 to 3,000 hours for the positive electrode, fifty to seventy-five hours for the negative electrode, together with the absence of all enclosing globes, is readily appreciated as shown by the number of present users of the luminous arc headlights.

Another type of luminous headlight has been designed for mining locomotives, which is also available for use in localities where a heavy cast frame of small dimensions is required for protection.

The Helion Lamp.

By Professor H. C. Parker and W. G. Clark.

WHILE the difficulties encountered in the experimental investigations involved in the development of the Helion lamp have been very great, such progress has been made that we feel that commercial perfection is rapidly being approached. Early in 1907 we exhibited the first Helion filaments upon which a satisfactory life was secured. These were extremely sensitive to the slightest trace of gas in the lamp bulb, and it was difficult to exhaust the bulbs to the necessarily high vacuum. When the lamps were burned with only a slight trace of gas in the bulbs, in the course of time a cathode discharge was set up between two points of the filament near the terminals, and this invariably resulted in burning out the filament near one of the leading-in wires. This gas which caused the trouble was contained in the cement, and was very difficult to remove entirely. After experimenting with a great many cements a process of elimination finally provided one best suited to the purpose. The vacuum apparatus was also developed to the point which the characteristics of the filament demanded.

It was realized, however, that the difficulties entailed in making such a process commercial were enormous, and a series of experiments was started on the filament itself in order to reduce its sensitiveness to the presence of gas and enable the filament to be burned in a vacuum at a slightly higher pressure than that at which the cathode rays were liable to start.

A great deal of work has been done to make filaments of a uniform composition, and to standardize methods under which they were produced, so that it could be announced definitely that invariable results could be obtained. It is now a fact that a filament has been secured which is less sensitive to the presence of gas, and this is well substantiated by the demonstration of the burning of this filament with an efficiency of two and one-half to four watts per candle in the open air without any enclosing glassware whatever. Where the heat is retained by reducing the convection currents, the efficiency, of course, increases very rapidly.

The new filament differs in some characteristics from the original Helion filament, and a tabulation is now being made of many of the interesting physical properties which are being discovered.

So much success has been attained in the production of filaments of a much higher resistance than the original filaments, that we are now able to absorb either 110 or 220 volts in a single loop of moderate length and comparatively great cross-section. This filament may be maintained at bright incandescence in the air for many hours without deterioration, at a temperature approximating 1,800 degrees centigrade. When atmospheric dust is kept away from the filament there is apparently no surface change, but when particles of dust in the atmosphere come in contact with the hot filament they are fused and stick to it, so that in the course of time the filament takes on a growth, the rate at which the accumulation develops being entirely dependent upon the amount of dust which comes in contact with the filament.

A peculiar feature of the filament is that after burning a number of hours in the air there is noticed a slight progressional change in luminosity. This begins at one terminal and gradually continues around the entire length. It has been discovered that this is due to the burning out of the carbon core on which the filament is formed. As this core burns out the tube remaining is composed of pure Helion and, as the only portion of core exposed is the end within this tube, the rate of oxidation is very slow. When the carbon core is entirely burned out, the conductivity of the filament is decreased by an amount equal to the original conductivity of the carbon core. This effect can be prevented by sealing the terminals of the filament to prevent oxidation. When this is done the filament will burn in air for a great length of time.

The specific resistance of the filament is nearly fifty times that of the carbon filament, and several hundred times that of tungsten. The filament is also very hard, it being possible to scratch glass with small particles of it under the thumb nail.

When the incandescent filament is plunged in water there is apparently no effect other than a change in temperature.

One of the unexpected phenomena which have been observed when the new filaments were mounted in a high vacuum and operated at a high temperature was the coating of the globes with pure silicon, due to an intense ionization, forming a mirror deposit. This has been overcome by giving the filament a slight coating of another material which prevents this ionization from starting. Further experiments along this line are being conducted and the results are extremely promising. One of the filaments experimented with in this manner has already shown a life of more than 600 hours at a satisfactory efficiency, and is still burning with no appreciable diminution in candle-power or change in resistance.

It has been found that a Helion filament made to operate under the conditions which produce the most intense ionization can be utilized as an "Adion" in the de Forest system of wireless telephony with most satisfactory results, and experiments are now in progress to utilize the filament as a detector in wireless telegraphy and telephony.

While the development of this lamp may appear slow, it must be remembered that between each step, as progress is made, there must be a countless number of trials, life tests and experiments, and a long period of time is required to secure accurate data and ascertain the effect of each experiment. The constant effort has been to reach a point where filaments of uniform composition and resistance, and of the highest efficiency, could be produced invariably. Considerable progress has also been sacrificed in adapting the filaments and mountings to utilize standard glassware and the standard appliances and auxiliaries now used in the production of the present commercial types of carbon-filament incandescent lamps. We have now met with such success that we feel it is entirely reasonable to assume that a commercial Helion lamp will be available in the not distant future.

In addition to the standard types of lamps, experiments are progressing with a view of adapting the Helion filament to such forms as are called for in miniature lamps, tubular lamps, headlights and searchlights. A novel construction, with which considerable success has already been attained, is one in which are used four filaments in parallel, each filament connected to a single neutral point. Where each filament is of ten candle-power the lamp originally gives forty candle-power. If one of the filaments should burn out or be broken through accident, the lamp will continue to give thirty candle-power. If another filament is broken it becomes a twenty-candle-power lamp, and when but one filament remains it is still a ten-candle-power lamp. In this way the same lamp can be removed from one circuit and placed in a position where a smaller amount of light is required, thus extending its service over a very great period of time.

Flame Arc Lamps.

By W. H. Jones.

DURING the past three years many improvements have been made in the various types of illuminants, foremost among which are those pertaining to the flaming arc. Introduced into this country as an advertising novelty, it has attracted and held the attention not only of the public at large, but of the manufacturers as well.

On account of its remarkable illuminating power and the ever-increasing demand for more efficient units the flame lamp fills a long-felt want for certain classes of illumination, especially the lighting of large areas foggy with smoke or dust. As an advertising medium it has had a marked success and will continue to hold its present prominent position until supplanted by an illuminant more efficient and more pleasing in appearance.

Flame lamps of foreign manufacture were for a time the only types known, and it did not take the American manufacturer long to appreciate the inroads being made by them into his markets. Realizing the possibilities of this type of lamp and the necessity of giving the public a lamp conforming to American standards and practice, many types have been placed on the market, among which may be mentioned the G. I. flame lamp manufactured by the General Electric Company.

This lamp, shown in Fig. 1, has the same appearance as the standard line of enclosed lamps manufactured by this company under the same trade name. These lamps are extremely simple in design, rugged in construction and reliable in operation, having, instead of the usual complicated and delicate clock mechanism, chain feed and escapement common to the foreign lamps, a screw feed arrangement which comprises but few parts and which is equally as efficient.

This arrangement of the feeding mechanism is a pronounced improvement since the introduction of the flame lamp in this country, and with equal efficiency and steadiness of light gives it a distinct advantage where maximum illumination is desired. This lamp is of the converging carbon type, and so designed that the carbons are both supported in holders and are not dependent upon buttons, stops or a special rib on the carbon itself. There is nothing below the arc to obstruct the light in any way and when the lamp is in operation the whole globe appears to be a luminous sphere uniformly illuminated.

Photometric curves made in the illuminating engineering laboratory of the General Electric Company show that the light emitted is practically equal in intensity

Fig. 1.—G. I. Flame Arc Lamp.

from twenty degrees below the horizontal to the vertical position, thus permitting the lamp to be hung in a very high position and still give perfect illumination.

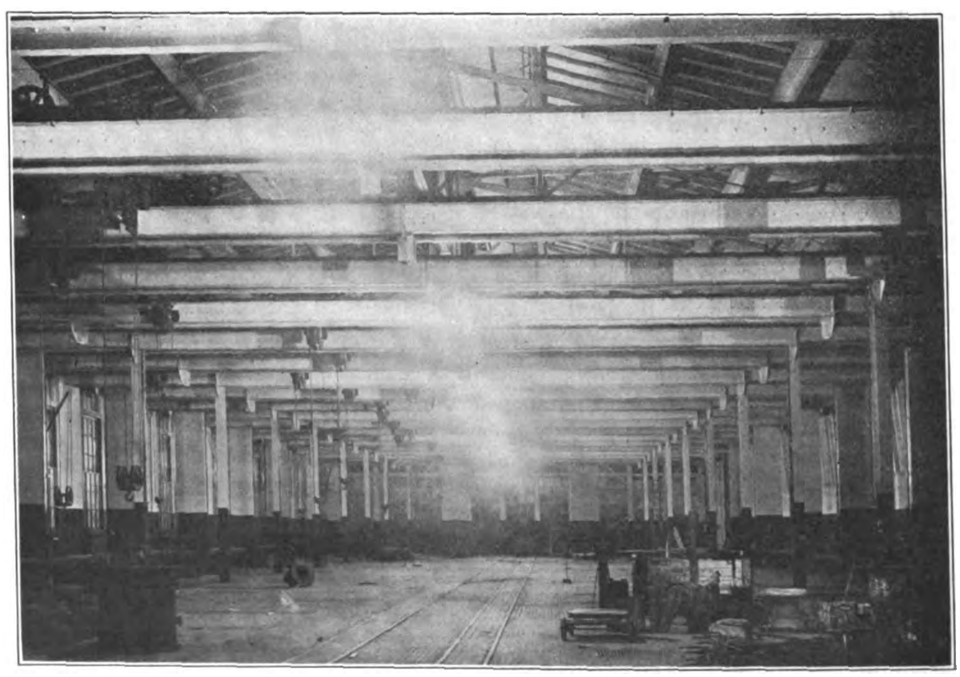


Fig. 2.—Night Photograph in Iron Foundry, Pittsfield Works of General Electric Company. Lighted by Six Twelve-Ampere G. I. Flame Arc Lamps, Run Two in Series on 110-Volt, Sixty-Cycle Circuit. The Space Lighted is 264 Feet Long by Seventy-five Feet Wide. Lamps are Spaced Thirty-five Feet Apart and Suspended Sixteen Feet from the Floor.

In view of this special advantage and the fact that these lamps have been approved by the Factory Mutual Laboratories for the Manufacturers' Mutual Fire Insurance Company, they can be recommended for illuminating machine shops, erecting shops, train sheds, ferry houses and similar places having large free areas.

Fig. 2 shows an interior view of a foundry, 264 feet long by seventy-five feet wide, illuminated by six G. I. flame lamps. These lamps are operated two in a series, on 110-volt multiple alternating-current circuits, and are adjusted for twelve amperes. They have a power-factor of seventy-five per cent, and at this value, 990 watts are consumed by each pair of lamps, or 2,970 watts for the six lamps. The total floor space illuminated is 20,670 square feet. Thus it will be seen that the actual watts per square foot in this installation is but 0.14. In order to give a comprehensive idea of the brilliancy of the illumination, which can not otherwise be given on account of lack of photometric data, the writer would call attention to the fact that he was able to read ordinary printed matter in any part of the room, and with his back toward the source of light.

The lamps mentioned above were trimmed with carbons emitting a golden-yellow light, and it should be remembered that for similar installations, or for the illumination of docks, ferries or train sheds, where the atmosphere is foggy or filled with dust, the yellow light is much more beneficial on account of its penetrating qualities and adaptability to the human eye.

Manufacturing concerns throughout the country are seriously considering the question of illumination from every viewpoint, and in many instances have changed over their entire lighting system to flame lamps. This has been made possible by the advent of the American-made flame lamps with their excellent qualities of efficiency and economy in operation, as well as their low selling price.

Although the maintenance charges are somewhat higher for the flame lamp than for other illuminants, it is rapidly increasing in popularity, a partial reason for which is given by the data set forth in the following table:

ALTERNATING CURRENT FLAME LAMP.

Amperes	12
Volts	55
Watts at terminals	500
Hemispherical candle-power	1,167
Spherical candle-power	874
Watts per hemispherical candle-power	0.428
Watts per spherical candle-power	0.572
Hours life per trim	12

Rapid Introduction of Tungstoliers.

A representative of the ELECTRICAL REVIEW a few days ago met E. J. Kulas, vice-president and general manager of the Tungstolier Company, of Cleveland, Ohio, west-bound on the Twentieth Century Limited. Mr. Kulas was very enthusiastic over the new Tungstolier units which are being marketed by his company. In response to an inquiry, Mr. Kulas stated that approximately 27,000 of these Tungstoliers, each meaning a complete fixture, shade equipment and tungsten lamps, had been marketed since the beginning of shipments in April. Over fifty salesmen are now devoting their entire time to the introduction of the Tungstoliers. These salesmen are working from nine established branch offices. Mr. Kulas added: "The future before this tungsten lighting system is far and away beyond our original conception. Within six months we expect to have 200 salesmen, working from sixteen or twenty branch offices, and we believe that the old methods of purchasing lamps, fixtures and the component parts of the lighting unit from several different companies will be changed, to a very great extent, by the sale of the complete Tungstolier unit. The Tungstolier will revolutionize electric lighting and make possible 'daylight' at an enormous saving in cost."

The Just Tungsten Lamp in America.

J. Auerbach, president of the Electrical Accessaries Company, New York city, returned recently from an extended trip to Europe, where he visited and inspected the factories producing the Just tungsten lamp.

The average life of these lamps is not less than 1,000 hours, when burned under proper conditions. The factories have made progress in their manufacturing methods, and the company is turning out at present the standard twenty-five, forty, fifty and 100-candle-power lamps for 100 to 125 volts, as well as the fifty-candle-power lamp for 200 to 250 volts. The company is also making a 200-candle-power and 400-candle-power lamp which should create quite a demand for the replacement of arc lamps, not only for interior lighting, but also for street lighting.

Mr. Auerbach is particularly enthusiastic over the special Type D lamp, in which the entire filament is supported in springs. This lamp can be burned at any angle, and the life of these lamps, he states, will be found to be just as great as the vertically burning lamp. The construction of the Type D lamp is original, and embodies some exclusive features obviating the difficulties which have been found in other types when burned at an angle. This type of lamp at present is made in twenty-five and forty-candle-power sizes.

From its inception the Just tungsten lamp has been distinguished by its neat design and compact appearance.

The Electrical Accessaries Company has arranged for large shipments to be delivered regularly, and the company carries in its New York warehouses about 100,000 lamps of the different candle-powers and voltages for immediate delivery.

The company expects to bring out shortly a line of special transformers of an entirely novel construction. The transformers will reduce a current of 100 to 125 volts or 200 to 250 volts to sixteen volts, thereby making it possible to install five, eight and sixteen-candle-power tungsten lamps. These transformers are so small that they may be readily attached to the canopy of the chandelier, placed on the wall, or applied directly to the lamp, if necessary. With this transformer it will be possible to install sixteen-watt tungsten lamps for direct use on any voltage up to 250. The loss caused by the transformer is about one watt per lamp. The transformers will be built for one, two, four or six lamps, and it is expected that the cost of lamp and transformer will not be greater than the present price of tungsten lamps.

The lamps will contain one heavy filament, giving an increased life to the lamp, and will also mean the introduction of the tungsten lamp in lower candle-powers.

A feature of considerable importance with the Just tungsten lamp lies in the fact that when the lamp is screwed in the socket every extending part of the base is insulated, thus conforming with the most recent suggestions of the Underwriters' Laboratories.

The company is arranging for the appointment of local agents in the larger cities throughout the country, and will have a number of the most prominent houses represent it in the various centres of the industry.

An Interesting Installation of Just Tungsten Lamps.

S. Gruhn & Company, 1947 Broadway, New York city, announce that on March 17 an installation was made in one of the largest billiard academies in New York city of sixty forty-candle-power and thirteen 100-candle-power Just tungsten lamps, in place of 165 sixteen-candle-power carbon-filament lamps. The company's client was formerly on a wholesale rate, guaranteeing a fixed amount per month. Just before the installation of these lamps he entered into a contract with his landlord whereby he purchased current at or about five cents per kilowatt-hour. When on the wholesale rate the bills averaged from $170 to $220 per month. With the installation of the tungsten lamps the average of the bills was cut to $28 to $45 per month. The total cost of renewals since March 17 has been $7.50.

The company states that there is no perceptible diminution in illumination and that the lamps receive pretty rough usage, being cleaned three times a week.

North Carolina Independent Telephone Association.

At the third annual meeting of the North Carolina Independent Telephone Association, which was held recently at High Point, N. C., the following officers were elected: President, W. A. Wynne, Raleigh; vice-president, H. P. Grier, Statesville; secretary and treasurer, B. W. Levitt, Southern Pines. Executive committee: W. A. Wynne; J. B. Morris, Roxboro; H. P. Grier; H. P. Stephenson, Smithfield, and J. F. Hoyden, High Point.

Tube Lighting.

By D. McFarlan Moore.

THAT vacuum-tube lighting is advancing steadily is evidenced by the fact that the United States Government has again placed a large order with the Moore Electrical Company for additional apparatus. The order comprises 3,192 feet of one-and-three-quarter-inch lighting tube in twenty-eight sections. Each section of 114 feet will operate from its individual terminal box containing the transformer and regulating apparatus. It will be remembered that a perfect vacuum, if obtainable, would be the best insulator known, and therefore all so-called vacuum tubes must contain enough residual air or other gas to conduct the electricity, which produces the light, through them. About one ten-thousandths as much gas remains in a Moore tube as would be present if the vacuum pump had not been applied. Also, this one ten-thousandths must not vary either way more than one one-hundred-thousandths in order that the light in a vacuum tube remain at a constant intensity and also in order that the light may continue more than several minutes. In other words, to be practical the tube must be fed extremely minute particles of air or other gases at intervals of every few minutes. This is the function of the simple, though sensitive, automatic feed-valve within the terminal box.

FIG. 1.—MOORE TUBE WITH FRINK REFLECTOR IN REGISTRY DIVISION, NEW YORK CITY POST-OFFICE.

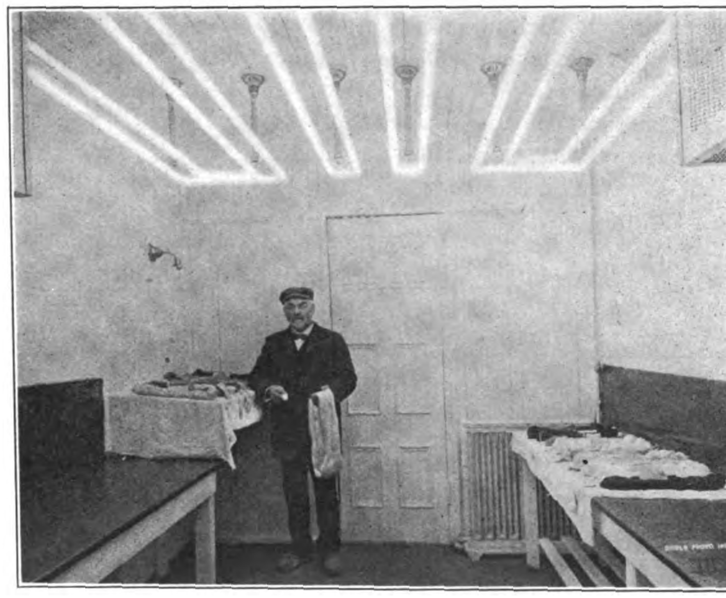


FIG. 3.—MOORE HAIRPIN UNITS IN THE COLOR-MATCHING DEPARTMENT OF THE WEIDMANN SILK MILLS.

When this valve is supplied with ordinary air a pink-colored light results, but if the oxygen of the air is automatically removed by simply causing the air intake to first pass through a bottle containing phosphorous, the gas which passes on to the feed-valve is practically pure nitrogen, which changes the color of the light to a golden yellow that resembles sunlight. It not only produces about thirty per cent more light, but has many other advantages over ordinary air and is, I believe, the most efficient form of light known for illuminating comparatively large areas. Some of the Moore tubes above referred to, which are about to be installed in the New York Post-Office, will be in the form of loops, that is, tubes, the ends of which return upon themselves and some in the form of perfectly straight single tubes, each one and three-quarter inches in diameter and 114 feet long.

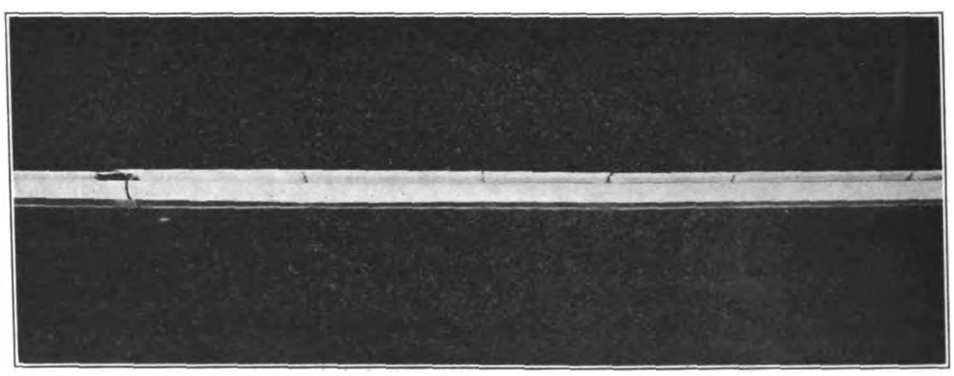


FIG. 2.—MOORE TUBE WITH FRINK REFLECTOR INSTALLED IN REGISTRY DIVISION, NEW YORK CITY POST-OFFICE.

Several months ago three new-style Moore tubes were installed in the New York Post-Office. Two of them are shown in Fig. 1. Heretofore Moore tubes have been installed in almost any length and shape, but it has been found very advantageous to decide on certain definite units. These three new tubes are in the forms of large hairpins—that is, the tubing extends fifty-seven feet from a terminal box and then returns upon itself, the two legs being only six inches apart. The total length of the entire light-giving tube is therefore 114 feet. It will be noticed that these units are held within a few inches of the ceiling by simple cast-iron fixtures placed every eight feet, and that they also support mirrored glass reflectors directly over the two legs of these tubes.

Fig. 2 shows the first Moore tube equipped with a corrugated mirrored-glass Frink reflector. Altogether such a combination makes a lighting device that lends itself with great facility to the solution of all illumination problems involving comparatively large areas. These new standard units are designed to operate on 220 volts, sixty cycles. They consume 2,400 watts and produce a distributed illumination of about 1,300 Hefners that is almost ideal. The ceiling is thirteen feet seven inches high, but with the two hairpin units in operation over the area shown there results an intensity of about nine Hefner feet on the tables used for sorting and distributing the mail. Due to the great responsibility involved in handling registered mail, it is important that a system of lighting be used that will permit all employés to be easily and clearly distinguished over long distances.

During the past few months the various claims for the Moore light have been amply corroborated by numerous investigations, tests and reports by thoroughly disinterested parties. As time passes the fact is emphasized that the fundamental principles of vacuum-tube lighting are correct and are in direct line with the tendency of the development in all classes of illuminating devices.

As regards maintenance charges, with its extremely long life, the vacuum tube will produce an illumination that is so well diffused that its illuminating efficiency is really better than is represented by five candle-power-hours for one cent, or about 0.25 watt per square foot of floor area for each foot-candle.

The determining of the best kind of gaseous conductors for vacuum tubes represents almost a virgin field of large dimensions, the discoveries in which will soon be of vital importance to the whole lighting industry. For example, helium gas offers large possibilities, but so far as color values are concerned it is very doubtful whether any form of gas will ever be obtained which will more closely imitate average natural diffused daylight than does carbon-dioxide in an automatically fed vacuum tube. It should be, and I firmly believe will be, adopted as the standard of light both as regards intensity and color. In fact, at the present time all other forms of light, so far as their color values are concerned, should be expressed in terms of the carbon-dioxide vacuum tube.

Fig. 3 shows one of the largest silk dyers in the world, Jacob Weidmann, in the color matching room of his large works at Paterson, N. J. It is well known that hardly any business requires more accurate color determinations than that of dyeing silk, yet it has been found by over a year's severe tests that in one respect matching colors under the Moore tubes is preferable even to diffused daylight, because the light of the tubes is always the same, while natural light varies widely under different atmospheric conditions and at different hours of the day, different months of the year, etc. The remarkable color values of the carbon-dioxide tube have proven valuable also in photography, where skylights have been equipped on their under sides with the tubes in a somewhat similar manner, so that, so far as the photographer's business is concerned, practically no difference exists between daytime and night-time.

The Moore vacuum tubes are aiding all the new forms of efficient lights in proving to central stations and other interested parties the at first seeming paradox that the cheaper the operating expense as regards current the greater their business will finally be due to the resulting increase in the quantity of light used.

Some Recent Developments in Arc-Lamp Construction.

By Dwight D. Miller.

PROFESSOR ANDREWS has said in his admirable paper on long flame arc lamps that "it is interesting to note that all the marked improvements made in arc lighting within recent years have been effected by using arcs of from ten to fifteen millimetres in length, and investigation shows that the great improvement in efficiency is directly or indirectly due to this increased length."

These new lamps can be arranged in two distinct classes: (1) Those arranged with inclined carbon rods and (2) those arranged with vertical or coaxial carbon rods as in the ordinary enclosed arc lamps. To the first class belong the "Polar" flaming arc lamp and the "Carbone" lamp, while the "Radiante" and "Radiante Economy" lamps belong to the second class.

As stated above, the "Polar" flaming arc lamp is arranged with inclined carbon rods which are secured in metal holders and slide down substantial guide rods converging at a point immediately below the economizer within the globe. Only one globe is used. The whole appearance of the lamp is very pleasing and attractive. The case is sheet steel and ordinarily furnished in black finish. The carbon holders are of ample strength and size to prevent heating. The lamp works on the differential principle—that is, the feeding mechanism is actuated by the resultant pull of a series and shunt magnet working at right angles to each other. This principle of operation insures a sensitive, nice and accurate feed of the carbons, resulting in a reliable and steady-burning arc. This feeding mechanism is absolutely shut off from the main body of the lamp; contained in a separate weather and dustproof case, provided with a rubber gasket and sealed before sending out. The guide rods, carbon holders and rods are below the feeding mechanism in the main body of the lamp, and are readily accessible for trimming by simply lowering the case by means of thumb hooks provided therefor.

The arc itself burns in the economizer, which takes the place of the inner globe in an ordinary enclosed arc lamp. This economizer is composed of highly refractory material, cup-shaped and deeply recessed. The effect of this economizer is (1) a concentration of the heat of the arc, producing thereby a greater intensity of light; (2) prevention of an excess of oxygen reaching the arc, which means longer life to the carbons; (3) as the carbons burn, a pure white metallic oxide is deposited in the inside of the economizer which is an excellent reflector, increasing the diffusion of light, and (4) protection of the arc from drafts. This protection is further supplemented by furnishing glass wind shields which project below the economizer and increase the burning hours ten per cent.

This type of lamp requires but forty-two volts at the arc with a current consumption of ten amperes—producing upwards of 3,000 candle-power. They burn most economically two in series on 110-volt and four in series on 220-volt circuits, with a consumption of 550 line watts per lamp.

Carbons cored with different metal salts are used, giving either a rich golden or brilliant white light as desired.

Too much stress can not be laid upon the substantial construction and reliable operation of these lamps. They burn steadily and uninterruptedly during the entire length of life of the carbons, and automatically cut themselves out when the carbons have burned their full time. Many thousands are in daily use and have been for several years past. In fact, ninety-five per cent of the exterior lighting in Berlin, Germany, is by means of the long-flame arc lamp.

The "Polar" flaming arc lamp is handled in this country in two sizes. One, known as the short type, two feet eight inches long over all, takes a carbon 400 millimetres in length, burns twelve hours

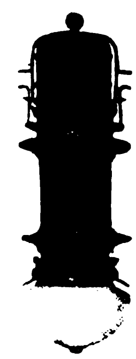
"POLAR" FLAMING ARC LAMP.

on one trim and weighs twenty-six and one-half pounds, while the long-type lamp is three feet six inches over all, taking a carbon 650 millimetres long, burns twenty hours on one trim and weighs thirty-three pounds. The lamp burns equally well when connected in multiple and on any circuit.

It is interesting to note that a very successful test of this lamp has been completed at one of the largest power-houses in New York city, burning three in series on a 200-volt, twenty-five-cycle alternating-current circuit. The test lasted through a period of three weeks, during which time the lamp demonstrated beyond the question of a doubt its stability on such a circuit.

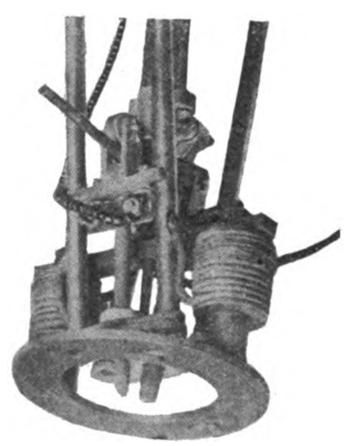
We come now to the second lamp in Class 1, namely, the "Carbone" lamp. Here again we have a lamp working on the differential principle with inclined carbons converging at a point within the economizer in the globe. In outward appearance the "Carbone" lamp is very similar to that of the "Polar" flaming arc lamp, the standard finish of case and the special shaped "Pilz" globe, a patented article, being the same in both cases.

By the use of pure carbon rods all fumes and gases are avoided and we obtain what is the most striking feature of this lamp, namely, its light, which is pure white, of great brilliancy and purity, and absolutely steady.



"CARBONE" LAMP WITH MUSHROOM GLOBE.

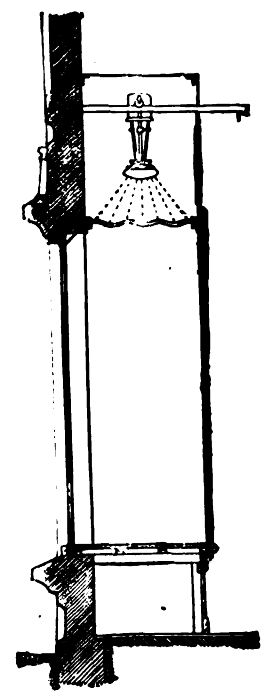
The "Carbone" lamp works on a high arc voltage—eighty-five volts for the direct-current and seventy volts for the alternating-current lamp—so that it burns in multiple on 110 to 120-volt and two in



MAGNETIC-RING CONTROL OF THE "CARBONE" LAMP.

series on 220 to 240-volt circuits. The effect of this high voltage is that the crater of the arc forms on the very end of the carbon tips and is held fixed there by a very ingenious device, patented by Mr. Carbone, known as magnetic-ring control. This consists of a closed metallic circuit in the form of a ring, concentric with and placed just above the economizer of the lamp. On this ring are mounted two solenoids with a soft iron bar connected across the tops, and the position of the arc is rigidly controlled by the magnetic leakage from this closed circuit. Naturally, the leakage is greatest where the solenoid cores enter the ring, and this is further increased by boring holes in the ring itself in such a manner that the field produced by this leakage holds the arc in the desired position, spreading it out in a semicircular, shadowless and steady flame.

The efficiency of this lamp is very high, taking but 0.6 of a watt per candle-power, and producing 1,350 candle-power of pure white light with a consumption



CROSS-SECTION OF SHOW-WINDOW, SHOWING METHOD OF CONCEALING LIGHT.

of only eight amperes. It is handled in two sizes of approximately the same dimensions and weight, as in the case of the "Polar" flaming arc lamp, the short type burning eleven hours and the long type sixteen hours. This lamp also burns on twenty-five to 150 cycles, alternating current.

The science of illumination requires that not only shall there be the proper quantity and quality of light, but also, what is more essential, that this light shall be correctly diffused. By means of various types of shades, globes and reflectors, direct, semi-direct or indirect illumination can be produced, according to the specific requirements of the particular problem under consideration. By using the special-shaped "Pilz" globe the distribution of light becomes exceedingly uniform. Again, by using special shapes and shades of glass and opaque reflectors the light is thrown in various directions and reflected back to the eye much softened and properly diffused. All shadows are also eliminated.

We now come to the second class of lamps, with coaxial carbon rods. This construction is found in the "Radiante" and "Radiante Economy" lamps. These lamps are a direct outgrowth of the "Carbone" lamp, and put upon the market to meet the demand for a longer-life lamp. Thus they combine the pure white, steady, daylight effect of the "Carbone" lamp with long life and efficiency.

Here again pure carbon rods are used with soft cored centres. The rods are arranged vertically one over the other as in the well-known enclosed-arc construction but provision is made for lengthening the arc, thus eliminating all shadows from the lower carbon. The lower carbon is stationary and the upper feeds down as it burns away. The proper trimming height of the lower carbon is marked by a notch in the lower carbon holder which is centered accurately with the upper holder ensuring perfect alignment of carbon rods and an even, steady and economical burning of the carbons. The feeding mechanism is of simple construction, consisting of a magnet working against gravity. This control is positive in its action, accurate and nice in its adjustment, which results in a steady arc. The arc is only partially enclosed, the object being to obtain long life of carbons and yet avoid the disadvantages of the completely enclosed arcs, such as bluish color and unsteadiness of flame. The lamps are very attractive and pleasing in appearance, the same material and standard finish of case and "Pilz" globe being used as in the case of the "Polar" flaming arc and "Carbone" lamps.

The efficiency is again very high as the lamp takes but 0.5 of a watt per candle-power.

These lamps also burn with a high-voltage arc, requiring eighty volts, and at present are designed to burn on direct-current circuits only, in multiple on 110 to 120 volts, and two in series on 220 to 240 volts; but an alternating-current lamp of this type is promised by the manufacturers in a short time. They are made in two sizes: The "Radiante," two feet seven and one-half inches long over all, takes a carbon 400 millimetres in length, burns fifty hours on one trim, and weighs eighteen pounds, and the smaller type, known as the "Radiante Economy" lamp is twenty-one inches over all, takes a carbon 300 millimetres in length, burns thirty-two hours on one trim, and weighs nine pounds.

The "Radiante," with a consumption of eight amperes, gives a light of 1,200 candle-power, and the "Radiante Economy," with four amperes, gives 600 candle-power of pure white, steady light.

As in the case of the "Carbone" lamp different degrees and types of illumination can be obtained to meet specific requirements, by using the same kind of shades, globes and reflectors. In the case of the "Radiante Economy" lamp a milk glass reflector is provided in addition. The field of these lamps is almost unlimited, but they are especially recommended for lighting interiors where the highest grade of lighting is essential and desired, and true color reproduction necessary.

No hard and fast rules can be laid down as to which type of illumination should be used, and each case should and must necessarily be considered according to its specific requirements and the effect it is desired to obtain, but it is obvious that where the ceilings are high or strong light necessary, as for instance, where black threads and material are treated, direct illumination is the logical choice. While, on the other hand, in rooms with low ceilings or where no shadows are desired, semi-direct or indirect lighting would give the better effect.

A very novel, as well as effective and economical, method of lighting show windows, known as "Standard Show Window Illumination," in connection with the "Carbone," "Radiante" and "Radiante Economy" lamps, has just been introduced in this country. It seems that the majority of merchants have been and are laboring under the fallacy that the more and stronger light they have the better the customers can see the goods displayed, overlooking entirely that very vital point of diffusion. This fallacy becomes at once apparent if, on a perfectly clear summer day, one goes out at noontime, when the sun is directly overhead and its light least diffused by atmospheric conditions, and tries to look directly at it. The effect is blinding. Yet here is the strongest and best type of light known, but the difficulty is there is no diffusion. The object of show-window illumination is to attract passersby and cause them to look at the goods therein displayed. This is done most effectively when the source of light is entirely concealed, because then the whole attention can be concentrated on the contents of the window and the eye left entirely free from any glare. The illustration herewith gives a cross section of a show window showing this method of concealing the light and how the desired effect is obtained. The lamps are arranged high up in the window and entirely shut off from the gaze of the onlooker by heavy fluted glass, while the light itself is diffused and the window illuminated with a pure white light, bringing out the color values of the goods accurately.

These lamps are the product of the Carbone Light Gesellschaft, of Berlin, Germany, and are handled exclusively in the United States and Canada by the electrical department of Fox Brothers & Company, 126-130 Lafayette street, New York city.

THE KUZEL LAMP.

BY PAUL M'JUNKIN.

The Kuzel lamp continues to make substantial progress, and although it is not yet manufactured in this country, negotiations are progressing toward that end. In the meantime increasing quantities are being imported, as the European manufacturers are able to spare lamps for this market.

This lamp has been the standard in Europe for some months, and burns in any position. The standard candle-power is twenty American candles, twenty-five watts, for the 110-volt lamp. This type of lamp is made almost to the entire exclusion of the higher candle-powers.

The lamp is rugged physically, which is due partly to the ingenious anchoring employed, but principally to the superior quality of the filament itself. The colloidal process employed by Dr. Kuzel produces a filament of perfect homogeneity and great elasticity, as well as purity.

The lamps at present are made in bulbs of practically equivalent sizes to those used for carbon lamps of corresponding candle-powers, and are fitted with the same style of base as is used on all low-candle-power carbon-filament lamps.

The Kuzel lamps are now manufactured in Austria, Germany, Sweden and Great Britain, and the solidarity of the business is typified by the new factory which has been erected in Vienna. This factory, which is being operated by Kremenezky, has a present capacity of 25,000 lamps per day. Every precaution has been made to increase the plant and equipment to 60,000 lamps per day as rapidly as it may be necessary. Kremenezky has been recognized for years as the leader in high-class carbon-lamp manufacture in Europe, and he has naturally devoted his best energies to the equipping of the new tungsten-lamp factory with the most perfect machinery that has been developed for tungsten-lamp manufacture up to the present time.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

TWIN CITY RAPID TRANSIT COMPANY.

The report of the Twin City Rapid Transit Company, Minneapolis, Minn., for the month of July and seven months ended July 31, shows July gross of $606,373; expenses, $278,138; July net, $328,235; charges, taxes and preferred dividend, $128,361; July surplus, $199,874. Seven months' gross, $3,589,222; expenses, $1,813,728; seven months' net, $1,775,494; charges, taxes and preferred dividends, $877,788; seven months' surplus, $897,706.

UNITED STATES TELEPHONE COMPANY.

The annual report of the United States Telephone Company, of Cleveland, Ohio, for the year ended December 31, 1907, shows gross of $435,013; expenses and taxes, $184,135; net, $250,878; other income, $34,965; total income, $285,843; charges, $116,877; balance, $168,966; preferred dividends, $51,150; balance, $117,816; common dividends, $69,750; surplus, $48,066.

UNITED RAILWAYS COMPANY.

The report of the United Railways Company, of St. Louis, Mo., for the month of July and seven months ended July 31, shows July gross of $898,210; expenses, $578,528; July net, $319,682; charges, $232,852; July surplus, $86,830. Seven months' gross, $6,061,765; expenses, $3,946,037; seven months' net, $2,115,728; charges, $1,618,399; seven months' surplus, $497,329.

NEW ORLEANS RAILWAY AND LIGHT.

The report of the New Orleans (La.) Railway and Light Company and controlled companies for the six months ended June 30 shows gross of $3,054,535; expenses, $1,714,429; net, $1,340,106; charges, $991,521; surplus, $348,585; other deductions, $27,144; balance, $321,441. Of the balance there is to be reserved $23,338 for rehabilitation of tracks and cars and other equipment.

CUYAHOGA TELEPHONE COMPANY.

The annual report of the Cuyahoga Telephone Company, of Cleveland, Ohio, for the year ended December 31, 1907, shows gross of $781,586; expenses and taxes, $346,913; net, $434,673; charges, $207,458; surplus, $227,215; dividends, $131,222; net surplus, $95,993.

CUMBERLAND TELEPHONE AND TELEGRAPH COMPANY.

The report of the Cumberland Telephone and Telegraph Company for the month of July and seven months ended July 31 shows July gross of $500,094; expenses, $283,473; July net, $216,621; charges and taxes, $37,347; July surplus, $179,274. Seven months' gross, $3,557,072; expenses, $2,065,681; seven months' net; $1,491,391; charges and taxes, $260,357; seven months' surplus, $1,231,034.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

The report of the American Telephone and Telegraph Company for the first seven months of 1908 shows gross earnings of $15,097,966; expenses, $1,223,807; net earnings, $13,874,161; interest, $4,026,937; balance, $9,847,223; dividends, April and July, $5,262,056; surplus, $4,585,168.

WESTCHESTER ELECTRIC RAILROAD COMPANY.

The report of the Westchester (N. Y.) Electric Railroad Company for the quarter ended June 30 shows gross of $97,747; expenses, $104,102; deficit, $6,355; other income, $137; deficit, $6,218; charges, $3,819; total deficit, $10,037.

MONTREAL STREET RAILWAY COMPANY.

The report of the Montreal Street Railway Company for the month of July and ten months ended July 31 shows July gross of $326,524; expenses, $162,413; July net, $164,111; charges, $65,012; July surplus, $99,098. Ten months' gross, $2,999,187; expenses, $1,814,428; ten months' net, $1,184,159; charges, $515,888; ten months' surplus, $668,971.

SEATTLE ELECTRIC COMPANY.

The report of the Seattle Electric Company, Seattle, Wash., for the month of June and twelve months ended June 30 shows June gross of $358,207; expenses, $202,875; June net, $155,332; charges, taxes and sinking fund, $93,695; June surplus, $61,637. Twelve months' gross, $4,384,438; expenses, $2,594,122; twelve months' net, $1,790,316; charges, taxes and sinking fund, $1,017,674; twelve months' surplus, $772,642.

GALVESTON-HOUSTON ELECTRIC COMPANY.

The report of the Galveston-Houston (Tex.) Electric Company for the month of June and twelve months ended June 30 shows June gross of $92,442; expenses, $53,235; June net, $39,207; charges, taxes and sinking fund, $21,009; June surplus, $18,198. Twelve months' gross, $1,069,016; expenses, $625,598; twelve months' net, $443,418; charges, $237,977; twelve months' surplus, $205,441.

MINNEAPOLIS GENERAL ELECTRIC COMPANY.

The report of the Minneapolis (Minn.) General Electric Company for the month of June and twelve months ended June 30 shows June gross of $70,766; expenses, $31,838; June net, $38,928; charges, taxes, $31,507; June surplus, $7,421. Twelve months' gross, $955,510; expenses, $434,040; twelve months' net, $520,670; charges, $348,021; twelve months' surplus, $172,649.

BUFFALO & LAKE ERIE TRACTION COMPANY.

The report of the Buffalo & Lake Erie Traction Company for the quarter ended June 30 shows gross of $134,656; expenses, $91,937; net, $42,719; other income, $5; total income, $42,724; charges, $95,640; deficit, $52,916.

INTERBOROUGH RAPID TRANSIT COMPANY.

The report of the Interborough Rapid Transit Company, New York city, for the quarter and twelve months ended June 30 shows gross earnings for the quarter of $6,248,224; operating expenses, $2,796,102; net earnings, $3,452,142; other income, $305,307; total income, $3,757,449; interest and taxes, $847,622; rentals, $2,025,485; total charges, $2,873,107; surplus, $884,342. For the fiscal year the gross earnings were $24,059,290; operating expenses, $10,722,695; net earnings, $13,336,604; other income, $1,220,170; total income, $14,556,074; charges, $10,856,116; surplus, $3,700,658.

NORTHERN OHIO TRACTION AND LIGHT COMPANY.

The report of the Northern Ohio Traction and Light Company for July and seven months shows July gross of $200,392; expenses, $105,377; July net, $95,015; charges, $44,052; July surplus, $50,963. Seven months' gross, $1,039,134; expenses, $624,037; seven months' net, $415,097; charges, $305,212; seven months' surplus, $109,885.

SCHENECTADY RAILWAY COMPANY.

The report of the Schenectady (N. Y.) Railway Company for the quarter ended June 30 shows gross of $220,110; expenses, $158,559; net, $61,551; other income, $916; total income, $62,467; charges, $30,883; surplus, $31,584.

BIRMINGHAM RAILWAY, LIGHT AND POWER COMPANY.

The report of the Birmingham (Ala.) Railway, Light and Power Company for the month of July and seven months ended July 31 shows July gross of $170,-

777; expenses and taxes, $113,425; July net, $57,352; charges and sinking fund, $44,075; July surplus, $13,277. Seven months' gross, $1,235,602; expenses and taxes, $796,202; seven months' net, $439,400; charges and sinking fund, $307,370; seven months' surplus, $132,-030.

MEMPHIS STREET RAILWAY COMPANY.

The report of the Memphis (Tenn.) Street Railway Company for the month of July and seven months ended July 31 shows July gross of $140,461; expenses and taxes, $89,017; July net, $51,444; charges, $35,465; balance, $15,979; reserve funds, $2,500; July balance, $13,-479. Seven months' gross, $915,529; expenses and taxes, $583,418; seven months' net, $332,111; charges, $243,905; balance, $88,206; reserve funds, $17,500; seven months' surplus, $70,706.

DETROIT UNITED RAILWAY COMPANY.

The report of the Detroit (Mich.) United Railway Company for July and the seven months ended July 31 shows July gross of $679,447; expenses and taxes, $417,869; July net, $261,577; other income, $6,462; total income, $268,-039; charges, $135,978; July surplus, $132,061. Seven months' gross, $3,964,-875; expenses and taxes, $2,528,176; seven months' net, $1,436,698; other income, $35,072; total income, $1,471,770; charges, $948,952; seven months' surplus, $522,818.

TOLEDO RAILWAYS AND LIGHT COMPANY.

The report of the Toledo (Ohio) Railways and Light Company for July and seven months shows July gross of $199,-237; expenses, $111,665; July net, $87,-572; other income, $91; total income, $87,663; charges and taxes, $71,751; July surplus, $15,912. Seven months' gross, $1,429,612; expenses, $794,054; seven months' net, $635,558; other income, $2,874; total income, $638,432; charges and taxes, $491,887; seven months' surplus, $146,545.

KNOXVILLE RAILWAY AND LIGHT COMPANY.

The report of the Knoxville (Tenn.) Railway and Light Company for July and seven months ended July 31 shows July gross of $51,720; expenses and taxes, $26,330; July net, $25,390; charges, $11,483; balance, $13,907. Seven months' gross, $323,820; expenses and taxes, $171,027; seven months' net, $152,-792; charges, $80,160; seven months' surplus, $72,632.

NASHVILLE RAILWAY AND LIGHT COMPANY.

The report of the Nashville Railway and Light Company, Nashville, Tenn., for the month of July and seven months ended July 31, shows July gross of $127,-936; expenses and taxes, $78,215; July net, $49,721; charges, $33,101; balance, $16,620; reserve funds, $3,858; July surplus, $12,762. Seven months' gross, $887,986; expenses and taxes, $542,399; seven months' net, $345,587; charges, $221,162; balance, $124,425; reserve funds, $26,528; seven months' surplus, $97,897.

LITTLE ROCK RAILWAY AND ELECTRIC COMPANY.

The report of the Little Rock (Ark.) Railway and Electric Company for July and seven months ended July 31 shows July gross of $53,560; expenses and taxes, $30,095; July net, $23,465; charges and sinking fund, $10,874; surplus, $12,-591; reserve funds, $3,000. Seven months' gross, $364,293; expenses and taxes, $198,717; charges and sinking fund, $68,875; reserve funds, $21,000; seven months' surplus, $95,701.

BOSTON ELEVATED RAILWAY COMPANY.

The report of the Boston Elevated Railway Company for August shows an improvement over the results for July. Figures for the last four months compare as follows: May, $1,214,000; June, $1,224,000; July, $1,158,000; August, $1,133,000. While the receipts show a comparative decline in gross for two successive months, the actual decrease in gross receipts for August was $37,000, a loss of 3.1 per cent, which compares with a July decline of $76,000, or 6.1 per cent.

Canadian Independent Telephone Association.

The third annual convention of the Canadian Independent Telephone Association was held in Toronto, Ontario, on September 9. The following papers were presented at the meeting: "Bell Connections," Dr. W. Doan; "Independent Telephones at Railway Stations," C. Skinner; "Mutual *versus* Joint Stock Companies," A. R. Walsh; "Rural Line Equipment and the Best Way to Serve the Farmers," F. A. Dales; "Rates to Be Charged and the Best Form of Collecting," A. Hoover; "To What Extent Should Free Service Be Given?" A. D. Bruce; "Division of Territory Between Telephone Companies," Levi Moyer; "Toll Line Connections: How Best Effected," Alex Neilson and Henry Sneath; "Western Situation and Its Future," F. Dagger; "Our Interests in Towns and Cities," M. Gee; "The Independent Movement in Towns and Rural Communities," T. R. Mayberry, M.L.A.; "Exclusive Franchises and Government Regulation," Dr. A. Ochs.

BOOK REVIEW.

"Wissen and Können." Dr. Richard Henning. Johann Ambrosius Barth, Leipzig, Germany. Boards. 199 pages. 6x9 inches. 61 illustrations. Price 4 marks ($1.25).

This is the eighth volume of a series of books ("Knowledge and Ability") published at regular intervals, by different authorities, on pure and applied science, and gives the history and development of telegraphy and telephony. The author goes back to ancient times and shows how the old Greeks were eager to develop means for a speedy transmission of intelligence to which the term telegraph fitly applied; starting with a wigwagging of hands and flags and the building of bonfires. A further development was the erection of signal towers of the most primitive type. With the advent and development of electricity came vast possibilities. The various types of magneto-electric and chemical-electrical telegraphs are described, up to and including the Morse telegraph and cipher code. The modern telephone and cable telegraph are described and illustrated, wireless telegraphy, however, not being mentioned.

Probably the most interesting feature of the work is the statement of the opinions of the inventors of the various instruments and devices at the time of their invention.

The volume is written in a clear and forcible manner and should appeal not only to the engineer but to the every-day reader.

The Buckeye Electric Company Conference.

The Buckeye Electric Company, Cleveland, Ohio, during the week of August 29 held its most successful annual conference. During the week there were in attendance fifteen direct branch managers and salesmen of the company, as well as about ten guests. Everything in connection with the incandescent-lamp business was discussed very thoroughly, especial attention being devoted to the discussion of the newer types of lamps. The company is confident that this meeting will bring excellent results, both to itself and its customers.

The company is starting the season in better shape this year than it ever did before, and in substantiation of this makes the statement that its business for August, 1908, is at least twenty per cent greater than it was for August, 1907.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Just-Wolfram Lamps for 220 Volts.

To overcome the difficulties which have appeared in the manufacture of long metal filaments of small cross-section, and to turn out serviceable metal filaments for forty watts at 220 volts, for commercial purposes, the Physikalisch Technische Reichsanstalt, at the request of the Wolfram Company, made extensive tests with fifty-watt lamps operating at 220 volts. The tests proved that the intensity of light between the high and low-voltage lamps varied but little, and the durability and life of the lamps were the same. The test of the Reichsanstalt consisted of burning twelve lamps for 1,600 hours each on direct current. The results showed that the average life of the lamps was 1,141 hours. Up to 1,400 hours the average intensity of the light remained the same and the specific current consumption increased 1.5 per cent, being 1.23 watts per candle (Hefner). A test at the factory on alternating current gave, after 1,000 hours, 1.25 watts per candle (Hefner), with an average life of 1,224 hours.—*Translated and abstracted from the Journal für Gasbeleuchtung und Wasserversorgung (Munich), August* 8.

The Transmutation of Copper.

Sir William Ramsay and A. T. Cameron announced, about a year ago, that they had observed the production of the alkaline metals and lithium in solutions of copper salts submitted to the action of radium emanation. It was concluded that in the presence of the emanation, copper underwent a degradation into the elements, potassium, sodium and lithium. A recent issue of *Comptes Rendus* of the Paris Academy of Sciences contains an article by Mme. Curie and Mlle. Gleditsch, giving an account of the attempts that they have made to repeat this experiment. The extreme difficulty of obtaining chemical products free from lithium is pointed out. This metal was found in distilled water and in nearly all the reagents. If a reagent free from lithium is allowed to stand in a glass vessel, traces of this metal are found after some time. Both opaque and transparent quartz were found to contain notable amounts, the latter furnishing the larger proportion. The experiments were carried out in such a manner that the solutions came in contact with platinum only. The water and acids necessary for the experiment were redistilled from platinum and preserved in platinum bottles. After this treatment no lithium could be detected in the residue from twenty-five cubic centimetres of nitric acid, twenty-five cubic centimetres of hydrofluoric acid, and 250 cubic centimetres of water. About the same quantities of copper and radium emanation as those used in the original experiment were employed. Spectroscopic examination of the salt residue obtained showed it to consist of salts of sodium with a little potassium. The presence of lithium could not be proved. The authors conclude that they have been unable to confirm the experiments of Messrs. Ramsay and Cameron.—*Abstracted from Nature (London), August* 20.

The Lucerne-Engelberg Hydroelectric Transmission System, Switzerland.

For supplying current to the city of Lucerne and vicinity, the water of a natural collecting basin, of 2,471,000 cubic feet capacity, fed by streams and glaciers of the Engelberg, is utilized at a power plant at Obermatt, about seventeen miles from Lucerne. Current is transmitted at 27,000 volts. The turbines, of which four are at present installed, are of the impulse type, operating under a head of 1,023 feet. They are connected to 2,000-horse-power, fifty-cycle, 6,000-volt generators, making 300 revolutions per minute. These generators have a capacity of 1,850 kilovolt-amperes, three-phase, or 1,380 kilovolt-amperes, single-phase. This plant also contains one reserve unit for the Stansstad-Engelberg railway system. This is an impulse turbine coupled to a 540-kilovolt-ampere, 780-volt, 32.5-cycle, three-phase generator, which has a bus-bar system of its own. The current from the main generator is stepped up by 700-kilovolt-ampere single-phase transformers to 27,000 volts. On each side of the transformers are two separate ring bus-bar systems, one for single-phase (light), and the other for three-phase (power). All the transformers are single-phase. There are three transformers for single-phase light supply and two groups of three single-phase transformers, connected in delta, for power service. Between the power transformer groups is one single-phase transformer which serves as a reserve unit for both groups. The transformers are of the oil, water-cooled type. If the water supply falls below the normal an automatic electric signal system gives notice of this condition. The aerial conductors are carried on lattice-steel towers. A feature of the construction is the cantilever arrangement of supporting them above the shores of Vierwaldstaetter Lake. There are several transformer stations along the line which step the line voltage down to 5,000 and 350 volts for local distribution. The whole system is well protected by lightning arresters among which is the combination of the horn lightning arrester and water-flow grounder, a system much favored in Continental practice.—*Translated and abstracted from the Elektrotechnische Zeitschrift (Berlin), August* 6.

The Use and Conservation of Water-Power Resources.

H. von Schon, the author of the present article, holds that water power is the expression of the dynamic energy of falling water, eighty per cent of which may be realized as mechanical energy, and seventy per cent as electrical energy. Theoretically, all the fall and flow of a river is available for power development, but the practical limit is a question of economics. Successive dams may be placed so that the lower pool of one becomes the upper of the next, but this may prove, in cases, wasteful in cost, as economic dam sites are not always arranged by nature with such regularity. The volume of available flow is as important a factor as the fall, as the product of fall and weight of volume represents the source of water-power energy. Without the consideration of flood-flow storage the determination of available flow basis should be developed from a consideration of the market demand, and the value of the output, in order to decide how large an investment in auxiliary power plant or electric storage equipment the enterprise will stand; and the capacity of this, added to the low-flow output, will point to the volume which may be accepted as the available flow. As far as accurate data are concerned, we find ourselves in the position of the man who has done business without keeping books. For some time to come we can not take an inventory of our water-power asset. It appears that from data collected by the author, the undeveloped water power of New England, New York, Pennsylvania, the middle and southern states, and the Pacific coast watershed, sums up to a grand total of 10,000,000 horse-power, based on the unconserved flow. A reasonable estimate of our available water-power assets appears to be about 20,000,000 horse-power, representing the annual equivalent in steam fuel of about 300,000,000 tons. At $100 per horse-power this would require an investment in water-power works of approximately $2,000,000,000, and a further investment in hydraulic and power-generating equipment, at $50 per horse-power, of $1,000,000,000. At a valuation of $35 per horse-power per annum—about 0.75 cent per kilowatt-hour—for continuous service, the income at three per cent represents a total earning on about $20,000,000,000. Results which will conserve the entire benefits of the water-power resources, and render this conservation economical and profitable, can be realized only by the combined resources and powers of the whole people. The investigations of flood-storage opportunities should be carried on by the state. If storage of flood waters were determined to be feasible, a state commission should have authority to designate the reservoir sites as a state water and forest reserve, and acquire title by condemnation to sufficient land to control the reservoir feeders. They should then lease the same to the lowest bidder for the construction of the necessary storage works and their maintenance and operation, fixing the amount of tolls at a certain per cent on the investment for land and works, which should be covered by a state bond issue. The power development works should be exempt from taxation for a period of years, during which the principal of the capital investment remains a charge against them, conditioned upon a specified programme of serial retirement of the securities and of their total redemption. The water-power company should be chartered by the state, the latter reserving the right to periodical inspection of its works and of regulation of the rates charged for the product. Finally, the Federal Government, upon the request of the state, should examine the feasibility of creating navigation on the stream, its extent and cost; and if the findings are satisfactory, a proper navigation lock should be constructed with each power development dam, under the supervision of the government, and the cost thereof and of buildings and appurtenant navigation locks should be defrayed by the United States Treasury, as well as the expense of any canalization or deepening of channels between such power sites. This would secure the co-operation of individual enterprise, and of the powers of the community, state and nation, toward the object of conserving the water and all its collateral assets, thereby placing within the reach of every community hydroelectric power products.—*Abstracted from the Engineering Magazine (New York), September.*

Illumination and Our Eyesight.

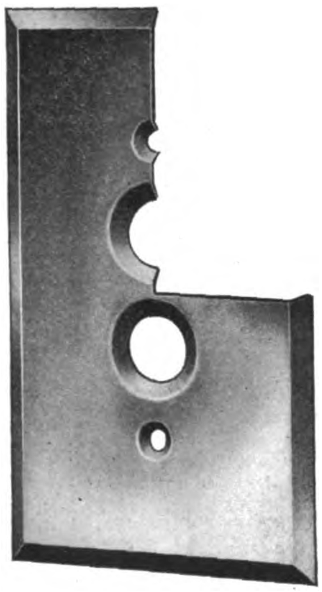
The introduction of powerful electric incandescent lamps fitted with metallic filaments has increased the complaints of the deleterious effect upon the eyesight of the high illumination which is being adopted in many places where artificial light is employed. Lamp manufacturers are anxious to meet the objections, and the question came up recently at the annual meeting of the German electrical engineers, the Verbund Deutscher Electrotechniker. In a paper by F. Schanz, M.D., and Dr. C. Stockhausen it is pointed out that the ultra-violet rays are a source of danger, and that with the improvement of our lamps we have been receiving more and more ultra-violet rays. The spectrum of the light of a paraffine or wax candle and of an ordinary rape-seed oil wick is hardly longer than that of the visible rays. When the combustion is rendered more energetic by the aid of a chimney, the ultra-violet rays increase. In the incandescent gas light, in the electric and Nernst lamps, and particularly in the mercury arc, ultra-violet rays abound. These conditions are masked to a certain extent when we surround the sources of light with glass shades, for the glass absorbs a good many rays; but ultra-violet rays find their way through ordinary glass. That ultra-violet rays, especially of very small wave-length, set up irritation of the skin, is sufficiently known from extended observation and special experiments. These rays cause injury and seem also to cure diseases under certain conditions. At any rate, they are active. Rays of greater wave-lengths are less directly injurious. Some physicians, like Dr. Schanz, ascribe to them the so-called opthalmia electrica, which resembles snow blindness. Both the crystal lens and the retina of the eye are said to be affected by ultra-violet rays. Dr. Voege, of the physical government laboratory of Hamburg, has recently described experiments which he undertook as a result of the paper before mentioned. His chief announcement is that sunlight is far richer in ultra-violet rays than most of our modern artificial lights, with a few exceptions. In his experiments Dr. Voege makes use of a kind of photometric arrangement. Two dim glass plates are so placed that they appear equally bright to the observer. The one plate is illuminated by the diffused light of the sky, the other by the lamp under test. When the photometric adjustment has been effected, photographs are taken, always under exactly similar conditions, with similarly emulsified plates. As the field consists of two halves, we should get two dark spots of unequal intensity if there is any difference in the proportion of actinic rays. The field is further subdivided by placing a screen of window glass over the upper half, and a screen of quartz glass over the other. Thus four sectors are obtained. Dr. Voege concludes that, provided we arrange our lamps in such a way that we do not directly see the glaring filament and the arc, the eye receives less ultra-violet light from the lamps than it receives with sunlight of equal intensity. The eye, however, does not resemble a sensitized plate, and we have to rely upon our own experience unless we are ready to submit ourselves to dangerous experiments, such as Dr. Burch and others have undertaken for the direct study of fatigue of the eye. Individuality, no doubt, plays an important part. As long as we do not understand the problem general care is most advisable. Too much light may be nearly, if not quite, as bad as too little.—*Abstracted from Engineering (London), August 21.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The "H. & H." Struck-Up Plate.

The Hart & Hegeman Manufacturing Company, Hartford, Ct., has placed on the market a struck-up plate for push switches. An idea of the appearance of this plate can be gained from the accompanying illustration. This device is made in single plates only, and can be used with other makes of push switches



"H. & H." Struck-Up Plate.

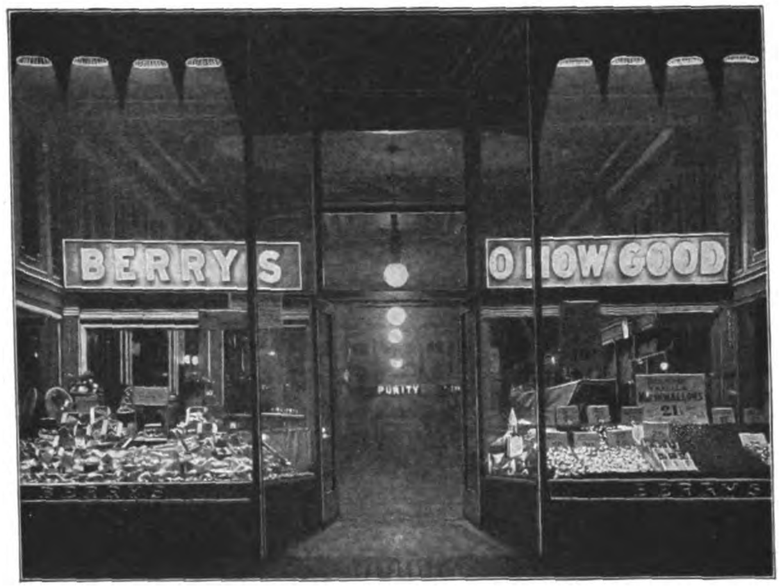
as well as the "H. & H." The plate is made of sheet brass 0.05 inch thick. It can be bought for quite a little less than a solid plate, and, the company states, looks just as well and will answer every purpose. The finishes are nickel, old brass, brush brass and oxidized copper.

Westinghouse Postponement.

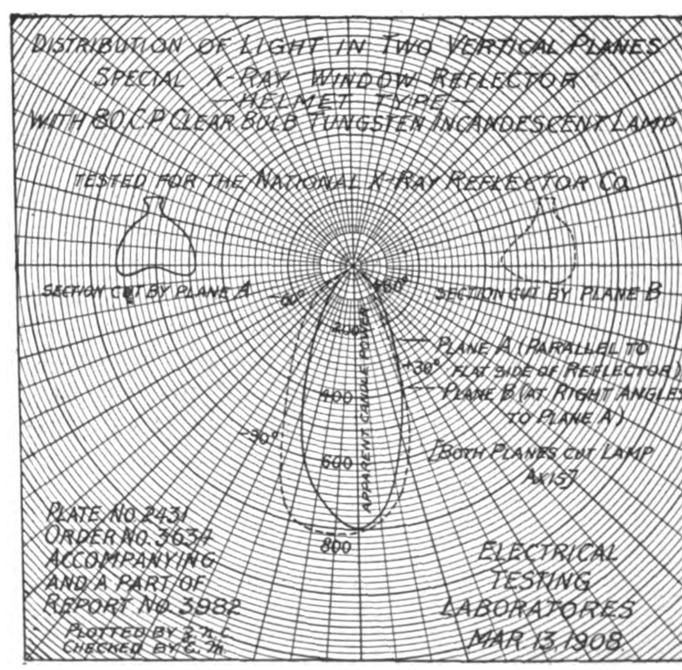
It has been announced that there will be no meeting of the readjustment committee of the Westinghouse Electric and Manufacturing Company to hear the report of the creditors' committee until September 21. September 1 was the last day for the acceptance of the proposed readjustment plan by the creditors and shareholders. The plan provides for the acceptance of new full-paid stock by the mercantile creditors in exchange for their claims; for a pro rata subscription by present shareholders to $6,000,000 new stock for working capital; and for the acceptance by banking creditors of fifty per cent in convertible five per cent bonds and of fifty per cent in fifteen-year five per cent notes.

The New Helmet-Tungsten System of Show-Window Lighting.

The accompanying illustration of Berry's candy-store windows, at 180 State street, Chicago, Ill., affords an interesting demonstration of up-to-date methods in illuminating show windows. The dimensions of the window are eight and one-half feet long, six feet deep and twelve feet high. The former lighting arrangement of the windows consisted of twenty-five feet of continuous trough reflector installed at the top of the window on all four sides, and operated with twenty-five sixteen-candle-power lamps giving approximately 1,250 downward candle-power, consuming 1,400 watts. The new installation consists of four Helmet reflectors, each reflector equipped with a



Show-Window Illumination with Special X-Ray Reflector of the "Helmet" Type.



Distribution of Light in Two Vertical Planes with Special Window Reflector of the "Helmet" Type, Equipped with Eighty-Candle-Power Clear-Bulb Tungsten Lamp.

100-watt tungsten lamp. This gives an illumination intensity of 3,200 candle-power in each window, with a consumption of 400 watts, effecting an actual saving of 1,000 watts per window, and giving an increased illumination of almost double the candle-power.

The Helmet reflector operates at its best efficiency in windows over ten feet high. This reflector was primarily designed on scientific lines for window lighting in connection with sixty or 100-watt tungsten lamps. The photometric curves shown herewith give an intensity of illumination of 800 downward candle-power.

The company states that with the original installation the total maintenance cost per year was $280, as against a cost for similar maintenance of $88 with the new installation.

The Displaying of Lighting Fixtures.

The proper displaying of lighting fixtures in the showrooms of the various dealers throughout the country has long been an unsolved problem, and until recently few attempts have been made to so arrange and display fixtures that both the artistic and lighting effects of different units could be effectively demonstrated.

In many instances it has seemed that the chief object of a display room has been to collect and assemble in as small a space as possible, a large and varied assortment of metal structures, and place them regardless of style or size. Consequently the prospective buyer is led into a maze of metal and frequently emerges from the display room with rather a hazy idea of just what has been seen or purchased.

Recognizing that this method of displaying fixtures is not conducive to good selection by the customer or satisfactory sales, the Central Electric Company, Chicago, has completely equipped a series of artistic display rooms, one room of which is shown in the accompanying illustration. The other rooms are all conveniently connected and fully equipped with appropriate furnishings.

Each fixture is so located and connected that the lighting effects as compared with another style of fixture, can readily be shown. Crowding of fixtures has been avoided by using large rooms, the furnishings of which are selected with good judgment and taste.

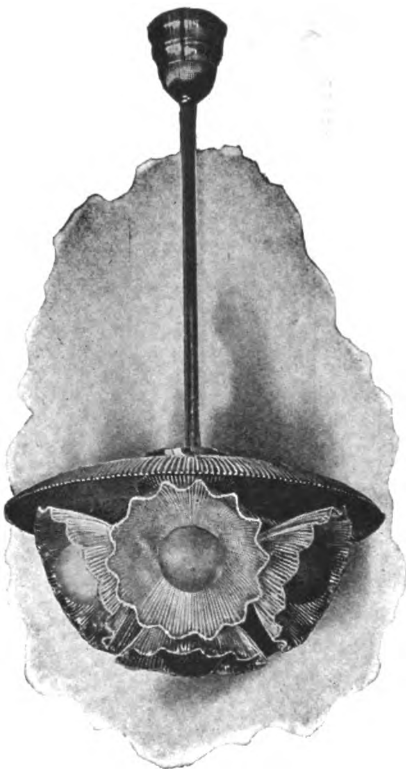
Illuminating and consulting engineers, architects and contractors find the conveniences offered by these new display rooms very useful in bringing clients to a final decision in selecting lighting effects.

Fixture-Display Room, Central Electric Company, Chicago, Ill.

Holophane Arcs with Tungsten Lamps.

Official announcement is made by the engineering department of the National Electric Lamp Association that it is now safe and practicable to burn forty and sixty-watt tungsten lamps at an angle. This means that these lamps may now be used with the popular Holophane arc.

With characteristic conservatism the Holophane company has waited for official sanction from the lamp engineers before recommending this unit with tungsten lamps, although for many months it has been well known that these lamps could be so burned without danger. As long ago as last May an installation of thirteen No. 66 Holophane arcs was made in the "Knox Five and Ten Cent Store," in Bloomington, Ill. Three months later it was reported that not a single lamp had burned out, despite the fact that during one of the three months the lamps were in service two-thirds of the entire day, it being a very dark and rainy month. Similar installations were made by J. S. Maltman, of the Kankakee Electric Light Company, Kankakee, Ill., who states that he has had some twenty Holophane arcs equipped with sixty and 100-watt tungsten lamps in service for over three months. Mr. Maltman says, "We have not as yet found any trouble with the tungsten lamps burning at an angle, and I do not hesitate to recommend to our customers the burning of tungsten lamps in the Holophane arc."



Holophane Arc No. 66, with Brass Stem Support.

With the sanction of the engineering department of the National Electric Lamp Association and the favorable experience of its customers, the Holophane company is now recommending the Holophane arc for all classes of commercial services with tungsten lamps of the forty and sixty-watt sizes.

Daniels Boulevard Lighting System.

The accompanying illustrations show several units of the "Daniels Boulevard Lighting System"; a line of ornamental lighting specialties recently perfected and placed on the market by the Jandus Electric Company, Cleveland, Ohio. Although no attempt has been made to vigorously exploit the system, the interest manifested by electrical engineers, central stations, architects and civic federations has been most gratifying and confirms the manufacturer's belief that the boulevard lighting system has an important function to perform and that its establishment in the lighting field not only insures better illumination but heralds the disappearance of antiquated and barbaric productions in lighting fixtures.

Fig. 1.—Ionic Column, Showing Method of Attaching Lamp Mechanism.

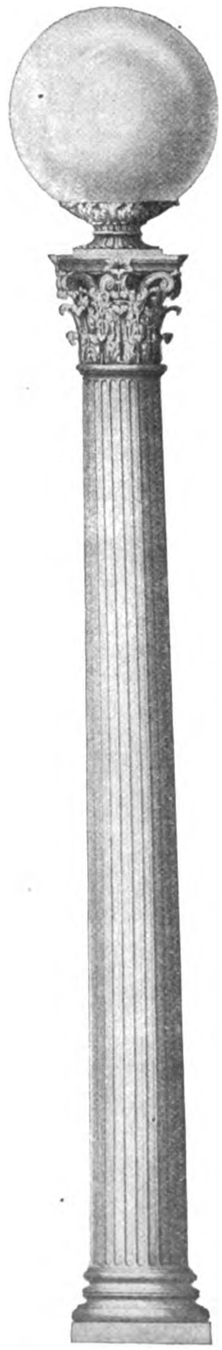


Fig. 2.—Column of Corinthian Design.

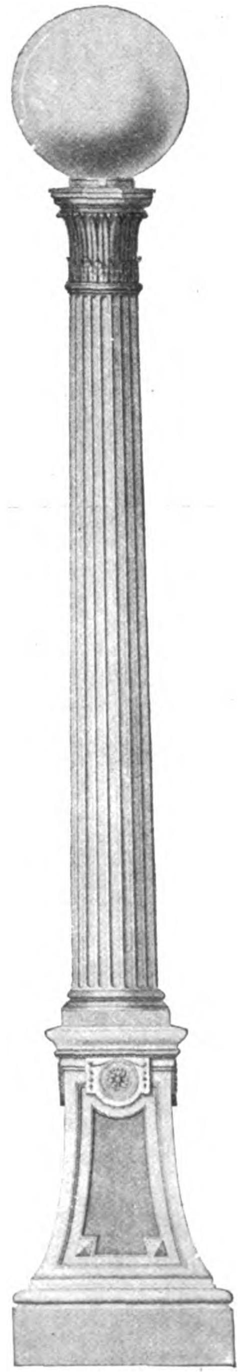


Fig. 3.—The "Billings Post."

Although arc lamps have been used for general illumination for thirty years, it is only recently that electrical engineers have devoted much time to the subject of art in the design of outdoor lighting fixtures. In their eagerness to produce apparatus having higher efficiency and greater mechanical strength they have overlooked to a marked degree the development of apparatus embodying artistic as well as utilitarian qualities, and have not fully appreciated the inherent possibilities of making outdoor lighting part of a general decorative scheme.

Each unit of the boulevard lighting system consists of a reinforced-concrete post, shaft and capital of classic design, surmounted by a complete arc-lamp mechanism enclosed within a twenty-inch opal glass globe. The post is ordinarily made of reinforced concrete and by proper mixture of ingredients can be made to correspond to sandstone, marble or granite. It is stated that the outfit complete sells for one-half the price of cast-iron; that it is indestructible, requires no painting and is more ornamental than cast-iron jib and goose-neck posts. Cast-iron, pressed-steel,

Fig. 4.—Boulevard Principle Adapted to Wall Brackets.

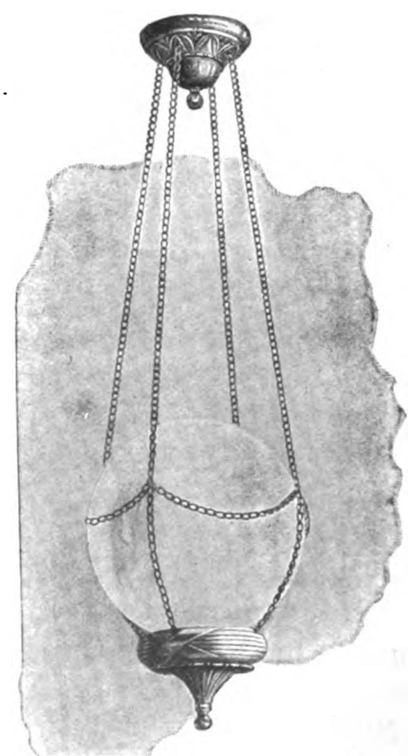


Fig. 5.—Jandus Ornamental Hanging Lamp.

copper or bronze posts are furnished when desired.

The lamp mechanism is somewhat shorter than the regular type of arc lamp

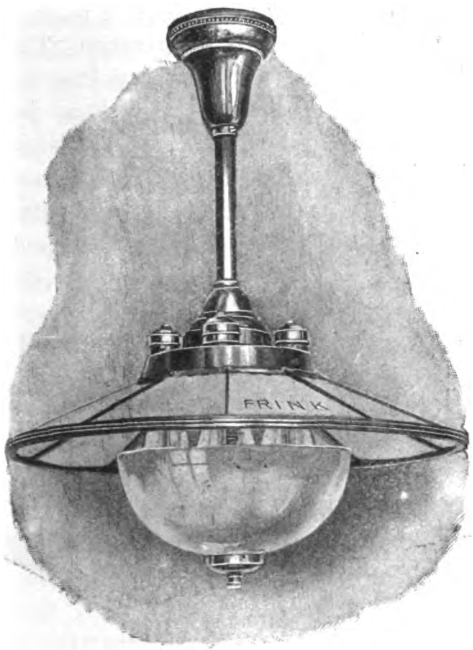


FIG. 1.—TUNGSTEN CLUSTER, WITH SILVER-PLATED, CORRUGATED GLASS REFLECTOR.

but allows the use of nine-inch upper and four-inch lower electrodes, thus insuring a life of 125 hours on multiple direct-current and alternating-current types and 100 hours on series direct-current and series alternating-current types. The use of the large globe insures perfect diffusion, entirely does away with uneven distribution of light due to the travel of the arc and produces a quality of light heretofore unequalled. The system must be seen in operation to be fully appreciated.

Fig. 1 shows the Ionic column and method of attaching the lamp mechanism thereto while Fig. 2 shows the Corinthian design. Fig. 3 shows the "Billings Post," designed by the J. L. Mott Iron Works, New York city, which is particularly attractive. The boulevard principle is applied to wall brackets as indicated by Fig. 4.

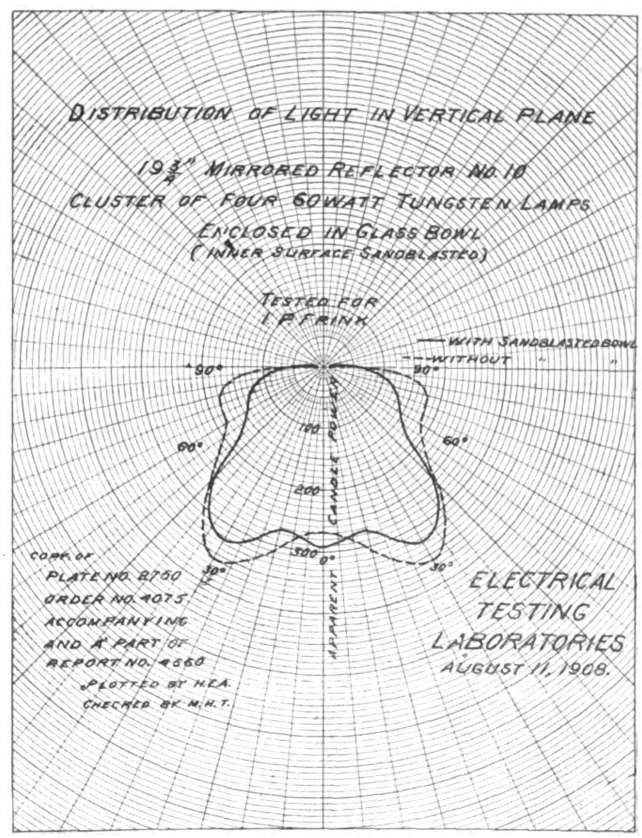
A modification of the types above described, the Jandus ornamental hanging lamp, is shown in Fig. 5. This type of arc lamp, designed particularly for store and other indoor lighting is something entirely novel and promises to be a popular specialty.

The lighting of boulevards, parks, public squares, public buildings, capitol grounds, business blocks, private drives, amusement parks and many other applications fall within the sphere of the boulevard lamp.

Frink Reflectors for Tungsten Lamps.

Coincident with the great improvement which has been brought about in the recently developed forms of metallic-filament incandescent lamps, manufacturers of reflecting mediums have shown a great deal of energy and ingenuity in devising auxiliaries which are adapted to utilize with the greatest advantage the increased illumination given by the new light sources. Prominent among the manufacturers of reflectors to create new designs for use with the tungsten lamp is the firm of I. P. Frink, 551 Pearl street, New York city. The accompanying illustrations show some of the most recent designs which this company has placed on the market.

These fixtures have been demonstrated by test to be very efficient for lighting stores, offices, public buildings and show windows generally. The utilization of these forms of reflectors with incandescent light sources is valuable, particularly because they eliminate shadows, there is no flickering, and no glare in the eye of the observer of the illuminated objects.



CURVES SHOWING DISTRIBUTION OF LIGHT IN VERTICAL PLANE, WITH MIRRORED REFLECTOR, SHOWN IN FIG. 1.

Fig. 1 shows a tungsten cluster, the reflecting medium of which is a mirror reflector with a spread of twenty inches and an over-all length of twenty-four inches. This is made in three, four or five-light combinations, for forty, sixty or 100-watt tungsten lamps. The inside of the reflector is lined with the Frink company's special silver-plated corrugated glass, and

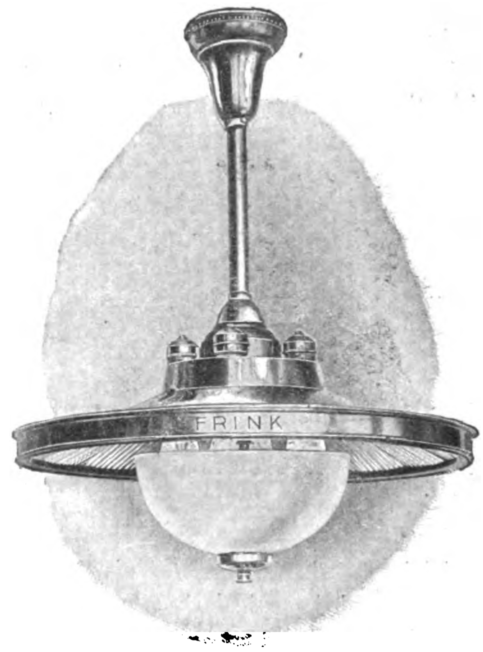


FIG. 2.—TUNGSTEN CLUSTER, WITH SPECIAL IMPORTED OPAL GLASS REFLECTOR.

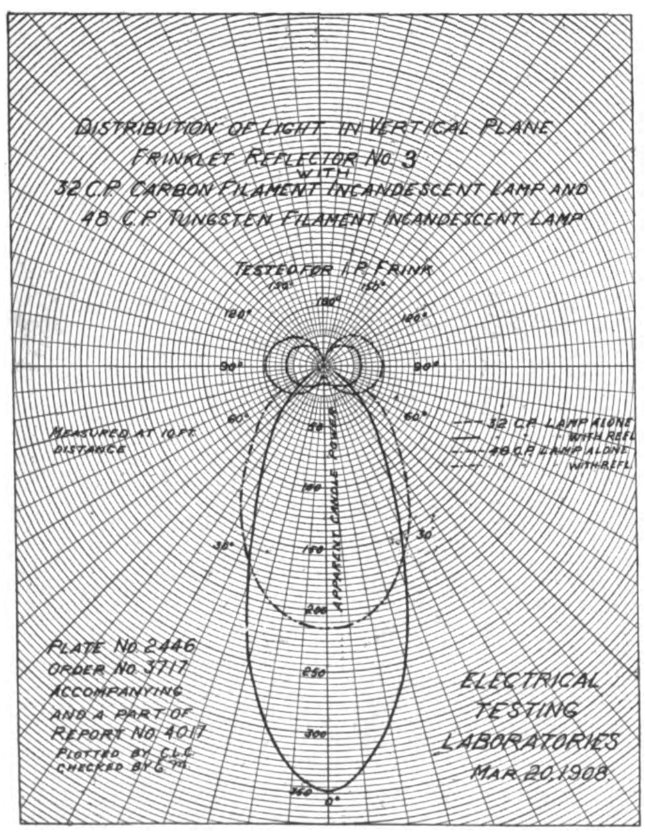
the lamps are surrounded by a hemispherical opalescent globe. This fixture is recommended by the company for the solution of problems in illumination where it is desired to give a maximum downward illumination. The accompanying curves, which have been made by the

Electrical Testing Laboratories, New York city, indicate the great increase in candle-power over the prescribed area which is brought about by the use of this reflector.

Fig. 2 is similar in its dimensions and equipment to the fixture shown in Fig. 1 with the exception that the reflecting medium is lined with the company's special imported opal glass. This fixture is recommended particularly where maximum downward illumination is not required, and where the illumination of the higher parts of the room is important.

Fig. 3.—For Lighting High Windows and Lighting Rooms from Above Glass Ceilings.

Fig. 3 shows a special reflector, twelve inches in diameter, which has thirty-two angles of reflection. This reflector, it is stated, will give 350 candle-power with an ordinary thirty-two-candle-power lamp, and is used for lighting high windows and for the illumination of rooms from above glass ceilings. It has proved very satisfactory for installations where a very great increase of candle-power over a prescribed area is desired. The accompanying curve shows the candle-power distribution of this reflector.



Curves Showing Distribution of Light in Vertical Plane with Mirrored Reflector Shown in Fig. 3.

Fig. 4 is another special reflector lined with the special silver-plated corrugated glass, and is adaptable for the illumination of show windows. From tests made by the company it has been demonstrated

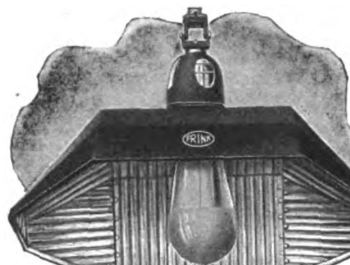


Fig. 4.—Special Window Reflector.

that these reflectors, spaced three feet apart, equipped with sixty-watt tungsten lamps, will give better results than three sixteen-candle-power carbon lamps spaced one foot apart, in ordinary reflectors—that is, there is a consumption of sixty watts, against 168 watts, or a saving of over sixty-five per cent.

Not only are these reflectors made in standard forms, such as are illustrated herewith, but the reflecting medium is of such a nature that special designs can be constructed to meet special requirements, and predetermined results secured with a high degree of accuracy.

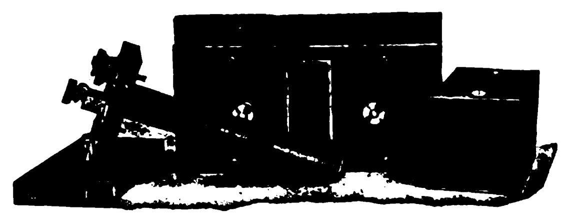
"Cartridge" Jump-Spark Coils.

The "Cartridge" jump-spark coils, manufactured by the Chicago Coil Company, 187 Jackson Boulevard, Chicago, Ill., represent several features of particular merit in spark-coil construction. The "Cartridge" coil derives its name from the fact that the condenser, as well as the secondary winding of the coil, can be replaced readily or reloaded. This is made possible in the "Cartridge" design without requiring the person handling the coil

Chicago Cartridge Coil Assembled.

to disconnect any wires. There are no spring nor screw connections interposed in the battery circuit.

The vibrator used on the "Cartridge" coil is so designed as to give the greatest speed possible, and is provided with contacts both on the armature and adjust-



Exploded View of Chicago Cartridge Coil.

ment screw, made of pure platinum alloyed with twenty-five per cent of iridium.

One of the important features of the "Cartridge" coil is the construction of its windings, both of which employ black enameled magnet wire. The secondary and primary windings of the coils have a layer of very high insulating paper, especially prepared, between each layer of wire. After the coils are wound and put into the containers, these containers are filled with special insulating compound and placed in a vacuum pan, where all air and moisture are withdrawn.

All spring connections on the secondary cartridge and condenser are made of German silver, and bear heavily against three corresponding contact buttons, so that a continuous circuit is maintained at all times.

The designer and patentee of the "Cartridge" coil is H. D. Stroud, for several years an electrical designer and engineer with the Western Electric Company.

Holophane D'Olier Metal Reflectors.

The Holophane Company, New York city, has acquired, and hereafter will have exclusive control of, the metal reflectors designed by, and manufactured under patents of, Henry D'Olier, Jr. It is the policy of the Holophane Company to maintain leadership in the field of illumination, and this policy has been expressed in the constant improvement of Holophane globes and reflectors.

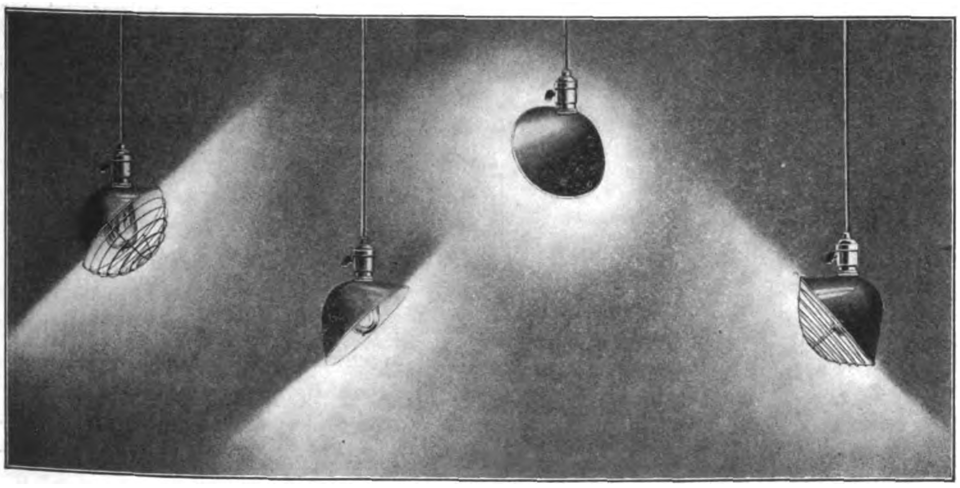
The addition of this line of metal reflectors is a further step in advance. Metal reflectors have a distinct place, and in industrial-plant lighting, in certain classes of display-window illumination, and in many cases where excess of dust and grime or liability to breakage is constant, the use of glassware is almost always inadvisable and frequently absurd.

With the Holophane D'Olier metal reflectors the company is prepared to furnish a line combining scientific design, high efficiency and extreme flexibility.

These metal reflectors are made in twenty-eight sizes and styles, and are furnished in four exterior finishes—brush brass, polished brass, oxidized copper and green enamel. The interior finish in all cases is a "satin aluminum," produced by a secret process, and giving a soft, well-diffused reflection of an almost pure white color.

These reflectors require no shade-holder, as each is provided with an attached clip spring holder reinforced with a heavy steel ring. This can be snapped onto any lamp socket, and while holding the reflector firmly, allows it to be easily rotated about the lamp, thus throwing the light in any desired direction.

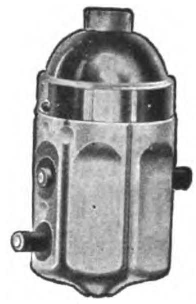
These reflectors are wrapped in waxed paper and packed individually in stout cartons. While they are practically indestructible when in service, they are not proof against rough handling and carelessness upon the part of clerks and stock boys. This is but one of the many innovations made by the Holophane Company when assuming control of the D'Olier reflectors.



Angle-Set Holophane D'Olier Metal Reflectors, With and Without Wire Guard.

A Two-Circuit Pendent Switch.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has placed on the market an elaboration of its push-button specialties which were described a few weeks ago. This is a new two-circuit porcelain pendent switch, and contains the same simple three-piece mechanism as the other push-button specialties. The accompanying illustration gives a good idea of the appearance of this device. The body of the switch is of porcelain, the cap of brass provided with a porcelain bushing.



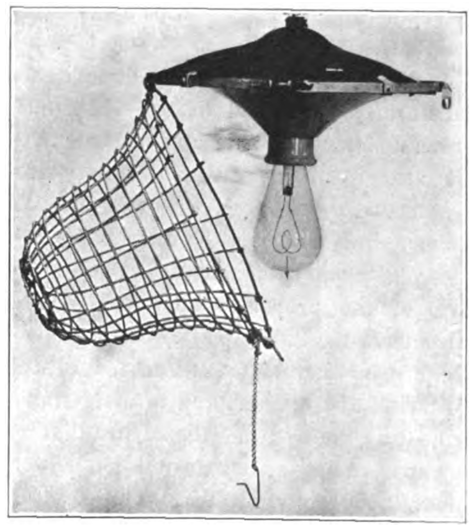
Cutler-Hammer Two-Circuit Porcelain Pendent Switch.

This two-circuit pendent switch will fill a long-felt want. A single one of these switches may be used to control two separate light circuits in any of the standard clusters, or to control two separate clusters of lights; or the switch may be so connected that one push-button controls the lights and the other push-button controls some other electrical device, such, for instance, as a fan. Many other applications of this two-circuit switch will readily occur to those familiar with electrical installations.

The Greenwood Adjustable Street-Lamp Guard.

The accompanying illustrations show the Greenwood adjustable street-lamp guard, made by the Greenwood Manufacturing and Supply Company, 141 Milk street, Boston, Mass. This lamp guard is composed of a flat metal band surrounding the hood, made in two distinct parts, with thumbscrews that allow the fastener to be adjusted from twelve to fifteen inches. The guard is hinged to the flat metal band on one side, and provided with a clasp fastener on the other, thus allowing it to swing when it is necessary to renew the lamp. The wires in the guard are of hard-drawn steel, and are laced with fine wires where they meet. The whole guard is galvanized and warranted not to rust.

Greenwood Adjustable Street-Lamp Guard.



Greenwood Adjustable Street-Lamp Guard, with Guard Down, for Lamp Trimming.

With the introduction of the high-priced, high-efficiency lamps, the electric lighting companies that are using this guard claim a great reduction in breakage. This guard fills a distinct place now that the companies are exercising the greatest possible care to insure long life to the newer types of incandescent lamps.

Air-Blast Transformers for the Calumet and Hecla Transmission System.

The accompanying illustration, Fig. 1, shows an installation of six 500-kilowatt Wagner air-blast transformers at one of the substations of the Calumet & Hecla Mining Company, Calumet, Mich., comprising part of an installation of 500-kilowatt, 2,300-13,200-volt, twenty-five-cycle and 370-kilowatt, 13,200-480-volt, twenty-five-cycle Wagner air-blast transformers, aggregating 10,830 kilowatts, that has been put into operation during the last few years.

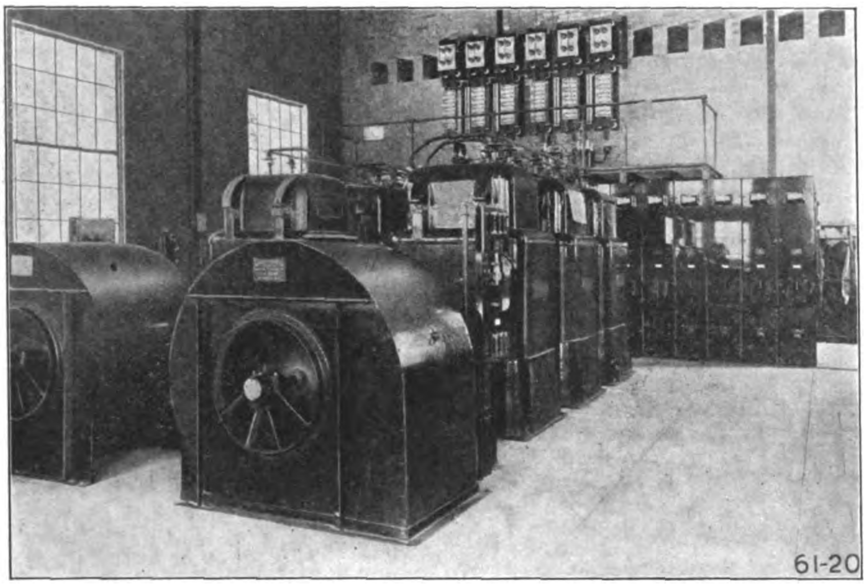


Fig. 1.—View in Calumet Substation, Showing Six of the Present Installation of Nine 500-Kilowatt Wagner Air-Blast Transformers.

The original installation of Wagner transformers consisted of the six transformers shown in Fig. 1 and of three 370-kilowatt, 13,200-480-volt, twenty-five-cycle transformers. In this transmission scheme, power is generated at 13,200 volts, three-phase, and transmitted to various parts of the property controlled by the Calumet & Hecla company. A large portion of the power is transmitted to the substation at Calumet, and is there transformed, by the first-mentioned installation of transformers, at a transmission potentiol of 2,300 volts for various uses about the mines, such as the operation of pumps, machine tool and crushers. Another large part of the power, involving the employment of both 370-kilowatt and 500-kilowatt transformers, is used in the vicinity of the generating station, for operating motors in the stamp-mills and smelters, and other above-ground apparatus; including about 1,500 kilowatts in a new mill that has recently been built about two thousand feet from the generating station.

The generating station is situated at Lake Linden, about seven miles from Calumet, on the property of the Calumet & Hecla Company adjacent to its stamp-mills and smelters.

The original installation proved so satisfactory that a duplicate order, plus an additional unit of 500 kilowatts, was given to the Wagner Electric and Manufacturing Company. Up to the present time the entire installation has worked very satisfactorily under difficult load conditions. Thus, one unusually severe condition has been in the frequent starting of the large motors that are employed on the circuits, which results in occasional extremely heavy overloads. Another feature that had to be guarded against in this installation was the frequent occurrence of severe electrical storms. The storm period in this region lasts throughout the summer months. The transformers were subjected to frequent lightning discharges, but have up to the present time successfully withstood these extraordinary conditions. In one instance the lightning succeeded in getting past the protective devices and into one of the trasformers, but fortunately did no damage beyond burning off a lead, owing to the excellence of the insulation. The transformer was repaired immediately and was put back into service within a few minutes after the occurrence of the discharge.

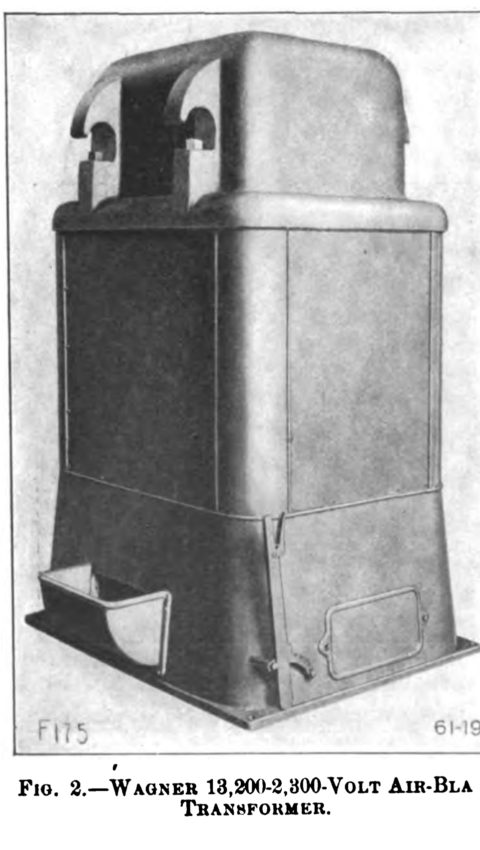


Fig. 2.—Wagner 13,200-2,300-Volt Air-Blast Transformer.

Fig. 1 shows six of the present installation of nine 500-kilowatt transformers in the Calumet substation. The two blowers, each of which is driven by a Wagner 440-volt, twenty-five-cycle, seven-and-one-half-horse-power induction motor, have an aggregate capacity adapted to take care of all of the transformers in the substation. The view also shows the low-tension distributing circuits, the portion of the switchboard comprising the 2,200-volt feeder-circuit equipment, the lightning arresters and the apertures in the wall for the admission of the conductors of the three-phase transmission line from the power station seven miles distant.

The construction of the Wagner air-blast transformer presents several interesting features. As shown in Fig. 2, which is a view of one of the 13,200-2,300-volt transformers above referred to, the air passages are so arranged that the air is taken in at the bottom of the coils, and after passing upward through the coils is forced by deflecting screens to pass downward around the iron circuit, and is then discharged by a separate passage through the base of the transformer.

The shutter in the base of the transformer may be so arranged that in the summer time the warm air may be discharged into an underground duct and during the winter out into the air of the substation for heating purposes.

The transformers are of the shell type, with pancake-coil windings giving maximum cooling surface, and at the same time the most favorable disposition of insulation between primary and secondary, and between coils and iron.

Current Electrical News

DOMESTIC AND EXPORT.

PROPOSED WESTERN POWER PLANT—A large electric light and power plant, costing $6,000,000, is soon to be erected near Marblemount, on the banks of the Skagit River, Wash. It is being financed by a syndicate of Denver (Col.) capitalists. The constructing engineer, with a corps of ten assistants, is on the ground. A track is to be built from Rockport to enable the builders to secure machinery and supplies.

TELEPHONE MERGER EFFECTED—It is announced that a company will be incorporated to lease the properties of the United States Telephone Company, the Cuyahoga Telephone Company, of Cleveland, Ohio, and the Citizens' Telephone Company, of Columbus, Ohio. Options have been taken on these properties by the new company. The United States Telephone Company, operating long-distance wires, is capitalized at about $4,000,000. It operates over 12,000 miles of long-distance wires, connecting 300,000 independent telephones, and controls nine local companies. The Cuyahoga company is capitalized at $3,000,000 and the Citizens', of Columbus, at $700,000.

INTERURBAN RAILROAD ORGANIZED—The Iowa Interstate Railway Company has been organized in Des Moines, Iowa, and officials, all well-known Des Moines men, elected. Articles of incorporation will be filed shortly. The proposed road is to be built from Council Bluffs to Muscatine by way of Des Moines. The promoters of the project state that the final arrangements for a working capital of $10,000,000 have been made. The portion between Des Moines and Council Bluffs will be built first. It will not run directly through Des Moines, but will run into the city from Springhill, by way of the army post. From Springhill the line will run west through Winterset, Greenfield, Fontanelle, Cumberland, Lewis and Oakland, and thence direct to Council Bluffs. The eastern section of the line, to be built later, will run almost due east from Springhill to Muscatine, *via* Indianola, Knoxville, Oskaloosa, Sigourney and Washington. It is stated by the promoters that work will be commenced at once and pushed to completion at the earliest date possible.

ELECTRIC LIGHTING.

REEDSVILLE, WIS.—The municipal light plant has been closed indefinitely. The plant cost about $15,000.

PIQUA, OHIO—L. A. Pearson, of West Milton, has been granted a twenty-year franchise and contract for furnishing the town with electric lights at his bid of $85 per arc lamp per year.

LITTLE ROCK, ARK.—Robert Crowe, of Arkadelphia, is in Nashville figuring on a proposition to establish an electric light plant at that place. The city council, it is said, is disposed to grant the franchise asked for by Mr. Crowe.

WILKES-BARRE, PA.—It is stated that the building of a large new electric power station in Lapland is shortly to be taken in hand. Either the Norr or Soderland Falls will be used. The power available is estimated at 88,000 horse-power.

BUTTE, MONT.—John D. Ryan and other new owners of the Great Falls Water and Power Company, supposed to represent Amalgamated interests, announce their intention to build a new dam on the river at Great Falls and develop 23,000 horse-power.

ANDOVER, N. B.—At a meeting of the members of the electric light district of Andover and Perth it was decided to install an electric light plant in this district at once and to enter into a contract with the New Brunswick & Maine Power Company to supply the power.

ISHPEMING, MICH.—A material enlargement of its water-power plant at Quinnesee Falls, on the Menominee River, is planned by the United States Steel Corporation. It is proposed to use the power for the operation of the machinery at the Aragon property at Norway also.

KIRKLAND, WASH.—A franchise has been granted by the council authorizing the Kirkland Light and Power Company to furnish electric light to this town and the adjoining neighborhood. James Bell and T. L. Kiler are behind the project. The company plans to begin work at once.

TOPPENISH, WASH.—Material is arriving for the electric light and power plant of the Reservation Electric Light Company. The managers are A. H. Campbell and M. Kramer, recently of Seattle. They expect to give a twenty-four-hour service and to have the plant in operation by November 1.

PLATTEVILLE, WIS.—It is said that the Fox interests, which recently purchased Galena's municipal plant, expect to be ready to furnish power and commercial lighting within three months. Eventually they will build a power plant capable of furnishing electrical power for all the mines in the district.

LINDEN, ALA.—A move is now on foot to supply Linden with electric lights. Plans are being perfected whereby J. A. Johnson and his brother, O. A. Johnson, will be granted permission by the city council of Linden to erect, equip and maintain an electric light plant sufficient to furnish at least 800 electric lights.

CHARLOTTE, N. C.—The Southern Power Company has placed an order with Milliken Brothers, of New York, for 2,000 steel towers, at a cost of $250,000. These towers will carry 100,000-volt lines. The company will let another contract representing an expenditure of about $60,000 for the Loray Cotton Mill at Gastonia, N. C.

MACUNGIE, PA.—Macungie will have an electric light and power company. An organization is now being formed, and, it is stated, will start operations as soon as a charter is granted. It is also stated that Slatedale, in Washington Township, will have an electric light and power company. The town has a population of 1,200.

BALLINGER, TEX.—Representatives of an eastern company have made application for a franchise to establish and maintain in Ballinger an electric light and power plant. Ballinger already has a light plant. The new company proposes to furnish the city free of cost ten arc lights and to give service at a rate ten per cent below the present rate.

AUSTIN, TEX.—The Water, Light and Power Commissioners will receive bids until September 19 for constructing a reinforced concrete addition to the municipal pumping station, approximately eighty-nine by sixty-four by thirty-five feet. For specifications, blank forms and other information address Walter G. Kirkpatrick, engineer, Jackson, Miss., or the Water, Light and Power Commissioners, Austin, Tex.

BOONTON, N. J.—Papers of incorporation of the Boonton Electric Company have been filed in the Morris County clerk's office. It is understood that the new company has or shortly will take over the Public Service plant in Boonton on a lease. The authorized capital stock is $100,000, of which $1,000 is paid in. Senator Thomas J. Hillery has eight shares and is the agent in charge. Other incorporators are John J. Hillery and Anna Hillery.

PRESCOTT, ARIZ.—Similar to the work now being done by the Arizona Power Company at Fossil Creek are the plans of the Verde River Power Company, which, at a point four miles below the mouth of Fossil Creek, is preparing to develop 2,500 horse-power by damming the Verde at a point where a considerable fall can be secured. The dam will be in the vicinity of Bloody Basin, in one of the roughest parts of Arizona. The estimated cost of the plant and transmission lines is $400,000.

ALBANY, N. Y.—The Public Service Commission, Second District, has denied the application of the Hudson River Water Power Company for authority to issue $62,000 first mortgage bonds; also the application of the Hudson River Electric Company for consent to transfer to the Hudson River Water Power Company the electric power transmission line running from Ballston Spa to Alplaus, and for authority to acquire $51,000 bonds of the Hudson River Water Power Company in payment therefor.

AUBURN, N. Y.—With an expenditure of approximately $30,000, the Auburn Light, Heat and Power Company contemplates duplicating its present equipment at the North street power-house. Plans for the new work are now ready and the individual contracts will soon be let. The company intends to increase its lighting facilities to correspond with the increased demand for power. Superintendent M. Curry Turpin stated that work on the alterations of the plant will commence soon. It is expected that about four months will be required to make the changes.

EL PASO, TEX.—E. Krause and W. E. Fletcher, of this city, have bought up the water rights along the Penasco River, in the Sacramento Mountains north of El Paso, and will divert the waters of the river into a canal, then into Cox Cañon, near Mayhill, N. M., and from the power thus generated distribute electric current throughout this section of the country. They claim that they will distribute current in El Paso at one and one-half cents per horsepower-hour, and that there will be sufficient to supply Alamogordo, Cloudcroft, Orogrande and other New Mexico towns, in addition to this city. It will take $500,000 to finance the deal, and it is stated that actual construction work will be under way in eight months.

JESSUP, PA.—Jessup has formed a stock company which will construct a modern electric light plant to supply current for street and commercial purposes. The company is capitalized at $25,000, and a ten-year contract has been made with the borough council for fifty street arc lights. The stock has been nearly all subscribed for by local people. The officers are: President, J. J. Sweeney; secretary, B. J. McGurl; treasurer, W. G. Robertson. The contract for the construction of the plant has been awarded to the Scranton Electrical Construction Company, of Scranton. The building will be of brick. The board of directors comprise: Rev. J. M. Smauler, W. G. Robertson, J. H. Hemelright, C. P. Ford, J. J. Sweeney, B. J. Cummings, A. J. Smalco, John Forini, John Slwka, H. V. Lawler and B. J. McGurl.

ALBANY, N. Y.—The Public Service Commission, Second District, has granted the application of the Madison County Gas and Electric Company for consent to issue $45,000 in gold bonds under a first consolidated mortgage. The order is made conditional that the bonds be sold at not less than eighty, and that the capital secured from the sale of the bonds be devoted to and used for the construction of a 60,000-volt transmission line from the steam plant of the Madison County Gas and Electric Company in Oneida to Oneida Castle and for the purchase of the necessary right of way therefor and installation in Oneida of a proper generator and the necessary instruments and appliances, for putting in proper repair an overhead system of the Madison County Gas and Electric Company in Oneida, and changing a part of the system from sixty to forty cycles.

ALBANY, N. Y.—The Public Service Commission, Second District, recently gave a hearing upon the application of the Newburgh Light, Heat and Power Company for permission to issue convertible debenture bonds in the aggregate sum of $350,000. The commission on April 29 issued its order authorizing the issue of eight per cent debenture bonds of the aggregate par value of $330,000. Since the granting of the order the company has taken up a new proposition whereby it is to take over the properties of the Hudson Counties Gas and Electric Company for the supply of electric current generated at Honk Falls on condition that the transmission line be constructed from the generating station in the city of Newburgh through the towns of Newburgh, Marlborough, Lloyd and New Paltz and the station of the Honk Falls Power Company at High Falls on Rondout Creek, and for that reason it has abandoned its proposition to erect a new steam power electric generating station in Newburgh.

ELECTRIC RAILWAYS.

TOLEDO, OHIO—The Toledo, Ann Arbor & Detroit electric line is to be offered for sale by order of the special master in chancery under mortgage foreclosure decree on October 12, at Monroe, Mich.

PHILADELPHIA, PA.—The J. G. Brill Company has received an order for seventy-five pay-as-you-enter cars from the New York City Railway Company. The cars are to be delivered as soon as possible.

CHICAGO, ILL.—The Aurora & Rockford Electric Company is being reorganized. The American Trust and Savings Bank has filed a petition to foreclose the $750,000 mortgage. Two receivers have been appointed.

FREDERICKSBURG, VA.—The preliminary survey for the West Point-Urbanna electric line has been completed. The route surveyed is from Chain Ferry to Saluda, thence across to Urbanna, near Oakes Landing. It is eighteen miles long.

MILWAUKEE, WIS.—Cars are now running from Milwaukee to Cedar Grove over the Milwaukee-Northern road. Cedar Grove is fifteen miles from Port Washington, the present terminus. The extension is being pushed rapidly from Port Washington to Sheboygan.

EASTON, PA.—The promoters of the proposed trolley line to connect the Easton & Washington traction line with Hackettstown and also construct another branch by way of Netcong to Newton say the necessary capital has been subscribed and that the lines will cost $1,000,000.

LANSING, MICH.—Articles of incorporation of the Saginaw & Flint Railway, capital $100,000, have been filed with the secretary of state. The company proposes to connect the two cities with an electric line and also run a branch to Vassar. Alexander Groesbeck, Nelson A. Taber and Mark Mitshkun are the incorporators.

LAPORTE, IND.—The Chicago, South Bend & Northern Indiana Railway has finished the construction of the Laporte extension of the line running west from South Bend. The opening of the road gives South Bend another outlet to the lake, and will connect Laporte and Michigan City with Elkhart, Goshen and Warsaw.

TACOMA, WASH.—Announcement is made by Manager E. J. Felt that the Pacific Traction Company expects to be in a position soon to complete the construction of the extensive street-car system in Tacoma it had heretofore planned. In addition to the line it now has in operation to American Lake the company has franchises for routes covering almost the entire city.

MILWAUKEE, WIS.—The petition of the Milwaukee Light, Heat and Traction Company for a certificate of convenience and necessity for an electric railway line to Hartford, in Washington County, will be heard by the Railroad Rate Commission in Madison, September 17. The proposed line is to run on Fond du Lac road through the towns of Granville, Menominee, Richfield and Polk.

STREATOR, ILL.—Actual construction work on the Chicago, Ottawa & Peoria interurban line between Grand Ridge and this city will be started shortly. D. McAfee, the company's representative, is engaged in arranging the final details for the starting of the work. It is now the intention to start building in this city and push the work as rapidly as possible until it has been completed to Grand Ridge.

FINDLAY, OHIO—Citizens of this place met with the projectors of the Findlay & Marion electric line and agreed to undertake the work of raising $125,000 necessary for the road's financiering. A like amount will be raised by Marion citizens. Already $800,000 worth of bonds has been sold to eastern parties. It is thought that work on the construction of the road will begin at once. It will be forty-eight miles long.

NEW YORK, N. Y.—Operations are to be begun at once on the construction of a double-track trolley line from Flushing to Bayside and Whitestone. The road will be five miles long, and will open for development much new territory along the north shore of Long Island. The franchise under which these improvements will be made was granted to the New York & Queens County Railway Company recently.

PERSONAL MENTION.

MR. FRANK B. KNIGHT, of Dallas, Tex., one of the pioneer telephone men of the United States, is renewing old-time friendships in New York city this week.

MR. VINCENT GRAY, formerly with the Columbia Incandescent Lamp Company, in charge of the Illinois district, has accepted a connection with the Westinghouse Electric and Manufacturing Company, and will have charge of the lamps, detail and supply business of the Milwaukee sub-district office.

MR. WILLIAM H. McKINLOCK, president of the Metropolitan Electrical Supply Company, Chicago, has been spending some days in New York city among old electrical friends and also visiting C. Edward Murray, of the Crescent Insulated Wire and Cable Company at his summer home at Sea Girt, N. J.

MR. EARLE T. HOBART, of Brookline, Mass., has started for San Francisco, whence he will sail for China the latter part of September under a three years' engagement with the College of Science at Pekin, China. He will establish and equip a department of electricity in connection with this institution, and the department will be the first of its kind in China. Mr. Hobart was graduated from the Brookline High School in 1904, at the age of eighteen, and from the department of mechanical and electrical engineering of Cornell University last June. In July he entered the employ of the General Electric Company at Lynn, Mass., and two weeks later received the appointment to China.

MR. R. F. MORRIS, who for a number of years has been manager of the Richmond (Va.) exchange of the Southern Bell Telephone and Telegraph Company of Virginia, resigned on September 1. Albert S. Tanner, long connected with the company at Richmond and other points, will succeed Mr. Morris as manager of the Richmond exchange. Mr. C. W. Connors, manager of the Opelika (Ala.) office of the Southern Bell Telephone and Telegraph Company, has been transferred to the commercial department of the company at Montgomery, Ala. He is succeeded by W. E. Bare, who has been manager at Alexander City. Mr. Robert M. McCandlish has been placed in charge of the Hampton and Newport News (Va.) exchanges. Spencer Henley, who has been in charge of the Newport News office, has been transferred to Lynchburg, Va.

MR. P. S. MUELLER has opened an office in the Electric Building, Cleveland, Ohio, as a general selling agent, where he will keep open house and be pleased to meet his old friends and patrons in the electrical field. Mr. Mueller was graduated from the electrical course of the University of Nebraska in 1898, and shortly afterward entered the telephone switchboard shops of the Western Electric Company, Chicago. He spent two years in the shops and in telephone installation work and on the road. The two years following he was connected with the Chicago office of the Westinghouse Electric and Manufacturing Company, but decided to go back into the telephone business, and in the fall of 1902 entered the employ of the Kellogg Switchboard and Supply Company. He was in the publicity department of this company, and for a short time had charge of the Philadelphia and Cleveland offices. Mr. Mueller will represent in Ohio and West Virginia the following firms: Alfred F. Moore, Philadelphia, manufacturer of insulated wires and cables and all sorts of telephone cordage; the Stackpole Battery Company, St. Marys, Pa., manufacturers of dry cells and carbon products; the Warner-Newton Lumber Company, Grand Rapids, Mich., producers of cedar poles and posts; the Yesbera Manufacturing Company, Toledo, Ohio, builders of telephone booths; the General Insulate and Machine Company, Brooklyn, N. Y., manufacturers of receiver shells and other hard-rubber substitutes.

OBITUARY NOTE.

MR. B. F. ELLISON, for eight years general manager of the Superior Water, Light and Power Company, Superior, Wis., died on September 1 at the home of his brother-in-law at St. Paul, Minn., from a complication of diseases. Mr. Ellison had been ill for some time, and his death was not unexpected. He was born at Utica, N. Y., fifty-five years ago, and previous to his connection with the Superior Water, Light and Power Company was associated with the St. Paul (Minn.) Gas Light Company. He is survived by a widow and four children.

ELECTRICAL SECURITIES.

During the short week the stock market witnessed a somewhat irregular decline, with trading moderately active, and largely professional. Professional sentiment appears to be decidedly bearish, and there was little brought out in the way of news or events to stimulate bull activity. The outcome of the Vermont election, which is generally considered to predict a Republican victory in November, had a hopeful influence on the stock market, while the report of the American Smelting interests had a most depressing tendency. It appears that these stocks, instead of being held by a few strong interests, are widely scattered, with little or no coherence in any endeavor to maintain prices at what appears to be their intrinsic position. There is beginning to be some apprehension concerning the outcome of the crops which are about to be harvested. Disappointing reports have come to hand, and while the yield will be as large as even in record years, it is not apparent that there will be any very great surplus to dispose of abroad. This condition, however, may be greatly changed in favor of the agriculturists before the next report is due.

Dividends have been declared upon the following electrical securities: Chicago City Railway Company; regular quarterly dividend of 1½ per cent, payable September 30 to stock of record September 14. Philadelphia Traction Company; regular semiannual dividend of $2 per share, payable October 1 to stock of record September 5. Interborough Rapid Transit Company; regular quarterly dividend of 2¼ per cent, payable October 1 to holders of stock and voting trust certificates of record September 14. Canadian General Electric Company, Limited; quarterly dividend of 1¾ per cent on the common stock for the three months ended September 30, and a semiannual dividend of 3½ per cent on the preferred stock for the six months ended September 30, both dividends payable October 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED SEPTEMBER 5.

New York:	*Closing.*
Allis-Chalmers common	11⅛
Allis-Chalmers preferred	35
Brooklyn Rapid Transit	54⅜
Consolidated Gas	148⅞
General Electric	146¼
Interborough-Metropolitan common	11¾
Interborough-Metropolitan preferred	33½
Kings County Electric	122
Mackay Companies (Postal Telegraph and Cables) common	68¾
Mackay Companies (Postal Telegraph and Cables) preferred	68
Manhattan Elevated	137
Metropolitan Street Railway	30
New York & New Jersey Telephone	110
Western Union	57
Westinghouse Manufacturing Company	75½
Boston:	*Closing.*
American Telephone and Telegraph	130½
Edison Electric Illuminating	235
Massachusetts Electric	46
New England Telephone	119½
Western Telephone and Telegraph preferred	75
Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	38
Electric Storage Battery preferred	38
Philadelphia Electric	9⅞
Philadelphia Rapid Transit	13⅞
United Gas Improvement	87⅞
Chicago:	*Closing.*
Chicago Telephone	148
Commonwealth Edison	107
Metropolitan Elevated preferred	44
National Carbon common	70
National Carbon preferred	109

NEW INCORPORATIONS.

BURLINGTON, VT.—Cory-Deavitt-Frost Electrical Company. $150,000. Incorporators: F. M. Corry, E. H. Deavitt, I. M. Frost, L. D. Taft and W. T. Dewey.

GALION, OHIO—Marion & Galion Electric Railway Company. $10,000. To build an electric road between Marion and Galion. Incorporators: F. H. Murphy, of Cleveland, Ohio, and others.

COLUMBUS, OHIO—Springfield Light, Power and Heat Company, Springfield. $1,000,000. Incorporators: Joshua D. Price, W. W. Keifer, W. H. Sharp, C. S. Kay, L. M. Ferguson, F. M. Hagan.

TELEPHONE AND TELEGRAPH.

BURLINGTON, VT.—The directors of the Orange County Telephone Company have decided to build a trunk line from East Montpelier to Plainfield.

MUNCIE, IND.—The Home Telephone Company, of Gaston, has completed and placed in operation its system. The company is composed of residents of Gaston.

MAYSVILLE, KY.—J. D. Powers has been appointed receiver for the Central Home Telephone Company, of Louisville, by Judge Cochran, of the United States District Court. The company owns many long-distance lines.

TUCSON, ARIZ.—The Arizona Overland Telephone Company now has its line in operation from Roosevelt to Fossil Creek, where it will be connected with the line from Flagstaff. It is the intention to incorporate the Fossil-Flagstaff line into the Overland, thus bringing it under one management. That accomplished, the new company contemplates getting control of the line between Globe and Mesa.

SALT LAKE CITY, UTAH—Connection by the Utah-Nevada & Idaho Telephone Company with Nevada-Salt Lake points has been completed. This is the first link in the system which will ultimately connect Salt Lake with San Francisco and Los Angeles. The crews have been laid off with the completion of this 211-mile line, and work will be resumed at Shafter in September for the completion of the line to Ely. The opening of the line to Wells gives telephone connection with all of Elko County, furnishing direct conection with Elko, Deeth, Tuscarora, and as far north as the Duck Valley Indian reservation, leaving a gap of less than thirty miles to be constructed in order to secure communication with Gold Circle, Golconda and Winnemucca, at which points the company is already operating telephone plants. Arrangements are being made for taking over the system at Pioche, with the radiating toll lines. It is the company's intention to build as quickly as possible between Ely and Pioche, which will bring this southern system of telephones in direct communication with Salt Lake City.

INDUSTRIAL ITEMS.

THE NOVELTY INCANDESCENT LAMP COMPANY, Emporium, Pa., is issuing a pretty calendar card for September.

HARVEY HUBBELL, Bridgeport, Ct., has ready for distribution some attractive literature devoted to the Hubbell pull socket and Hubbell attachment plugs for electric fans and fixtures.

THE DALE COMPANY, Ninth avenue and Hudson street, New York city, has published a neat booklet devoted to the Dale designs for tungsten lamps. Copies of this booklet will be furnished upon request.

THE ECONOMY ELECTRIC COMPANY, Warren, Ohio, is making some very attractive announcements concerning its large supply of renewed lamps. The company offers a 3.1-watt lamp at an extremely low figure.

THE M. W. DUNTON COMPANY, 65 Atlantic avenue, Providence, R. I., announces a new line of special friction tape which will be known as the "Black Diamond." A free sample of this tape will be sent upon application.

THE BRUNSWICK REFRIGERATING COMPANY, New Brunswick, N. J., will be pleased to send to those interested upon request some new literature devoted to refrigeration in model homes, and general data concerning refrigerating apparatus.

D. C. & WILLIAM B. JACKSON announce that they have moved their western office from Madison, Wis., to the Commercial National Bank Building, Chicago, Ill., and that Mr. William J. Crumpton will be in immediate charge of the Chicago office.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has opened a new office in the Gumbel Building, Kansas City, Mo., for the sale of Crocker-Wheeler motors, dynamos, transformers, switchboards, etc. The office is in charge of A. W. Paine.

THE WHEELER CONDENSER AND ENGINEERING COMPANY, West Street Building, New York city, has ready for distribution bulletins describing the Edwards patent air-pumps and the company's products and facilities. Copies of these bulletins will be furnished to those interested upon request.

THE NERNST LAMP COMPANY, Pittsburg, Pa., has published a handsome catalogue describing and illustrating the Westinghouse Nernst lamp. This catalogue is of particular interest at this time, as an entirely new unit, and one which will prove a decided factor in lighting conditions, is described. A comparative table of Westinghouse Nernst and other electric lamps introduces some very interesting figures.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is distributing bulletin No. 3,135, devoted to single-phase induction motors, frame 32DD, one-tenth, one-eighth and one-sixth horse-power, light-load start, for intermittent service; bulletin No. 3,706, devoted to electric buffing lathes for alternating and direct current; bulletin No. 3,958, devoted to motors for family washing machines.

THE AMERICAN CIRCULAR LOOM COMPANY, Boston, Mass., announces that its new factory at North Cambridge, Mass., is now in full operation, and that all orders for "Circular Loom" will be filled promptly. The factory is equipped with the most modern and improved machinery, and the company states that the high standard hitherto set in the manufacture of its product will not only be maintained, but will be heightened by new methods.

THE METROPOLITAN ENGINEERING COMPANY, New York city, on the occasion of the Sherman notification celebration at Utica, N. Y., recently, lent to the Utica Gas and Electric Company a sign constructed of eighteen-inch "Attraction" letters containing 400 sixteen-candle-power lamps. The sign produced the illuminated word "Welcome" on both sides. This is a feature of the Metropolitan company's business that is frequently called for by central stations in every part of the country.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., reports that its incandescent lamp sales for the first half of the present year are more than double its sales for the corresponding period of 1907. This condition of affairs is attributed partly to the fact that the company carries in Chicago, for immediate shipment, a large stock, in all standard voltages and candle-powers, of high-efficiency units, such as Columbia tungsten and tantalum lamps, as well as Columbia carbon-filament lamps, and due also to the excellent quality of the Columbia products.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, Waverly Park, Newark, N. J., has issued circular No. 7, descriptive of new Weston instruments for both alternating and direct currents. This is divided into three parts. Part 1 describes and illustrates switchboard and alternating-current ammeters and voltmeters in two sizes, models 151 and 156; part 2, portable alternating-current ammeters, milli-ammeters and voltmeters, model 155, and part 3, "Eclipse" direct-current switchboard instruments of the electromagnetic type, models 159 and 160. The company will be pleased to send this circular upon request to any one interested.

THE EDISON MANUFACTURING COMPANY, Orange, N. J., announces that it has acquired the business of the Battery Supplies Company, of Newark, N. J., manufacturer of the Gladstone-Lalande battery and the BSCO battery, together with all patents, rights, etc., appertaining to the manufacture of these batteries. The name of the Battery Supplies Company has been discontinued and that company merged with the Edison Manufacturing Company. As the Gladstone battery elements were designed to be interchangeable with the Edison types, the Gladstone-Lalande battery will be retired, and sales or renewals of the Gladstone-Lalande battery will hereafter be ordered by the Edison types. The Edison Manufacturing Company will continue to make the BSCO 350-ampere-hour cell for railroad work, and, in addition, the same type of cell with special low-temperature electrolyte for the same class of work at points where low temperatures affect the ordinary sodium-hydrate electrolyte. This battery will also be manufactured in the 200-ampere-hour size, in two different styles, one with a liquid-tight, steel-enameled jar for portable engines and marine engines used on fresh water; the other with a liquid-tight porcelain jar for use on launches running in salt water and on stationary engines.

Directory of Electrical and Allied Engineering and Scientific Societies.

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Cosmos Club, Washington, D. C.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Dr. J. W. Richards, Bethlehem, Pa. Fall meeting, New York city, October 30-31.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, 352 Willis avenue, New York city.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Dr. Richard Moldenke, Watchung, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West Thirty-ninth street, New York city.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN RAY SOCIETY. Secretary, Dr. G. C. Johnson, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Professor Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Fifty-seventh street, New York city.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 29 West Thirty-ninth street, New York city.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, A. P. Folwell, 239 West Thirty-ninth street, New York city. Annual meeting, Atlantic City, N. J., October 20-23.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth street, New York city. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, Elmer M. White, treasurer Birmingham Railway, Light and Power Company, Birmingham, Ala. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION. Secretary, B. B. Davis, claim agent Columbus Railway and Light Company, Columbus, Ohio. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, J. W. Corning, electrical engineer Boston Elevated Railway Company, Boston, Mass. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION. Secretary, George B. Keegan, 2321 Park Row Building, New York city. Annual convention, Atlantic City, N. J., October 12-16.

ARKANSAS ASSOCIATION OF PUBLIC UTILITIES OPERATORS. Secretary, J. E. Cowles, superintendent of lighting Hot Springs Light and Railway Company, Hot Springs, Ark. First annual convention, Little Rock, Ark., September 17-18.

ARKANSAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. W. Freeman, vice-president and general manager Edison Electric Illuminating Company, Brooklyn, N. Y. Annual meeting, Lenox, Mass., September 15-17.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington street, Newton, Mass.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Wisconsin Central Railway, Milwaukee, Wis.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION. Secretary, L. E. W. Pioda, Oak and Broderick streets, San Francisco, Cal.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Canada.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Acton Burrows, 33 Melinda street, Toronto, Ontario.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, W. F. Milholland, secretary and treasurer Indianapolis Traction and Terminal Company, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. F. Dostal, Denver, Col. Annual convention, Glenwood Springs, Col., September 16-18.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, F. W. Poole, Bridgeport, Ct.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water street, Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine street, St. Louis, Mo.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA, Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA, LIMITED. Secretary, William R. Stanley, Royal Insurance Building, Montreal, Canada.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall street, New York city. Board of directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau street, New York city.

ENGINEERS' CLUB OF PHILADELPHIA. Secretary, H. G. Perring, 1317 Spruce street, Philadelphia, Pa.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt street, New York city.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. A. Camp, Henry, Ill.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Van Rensselaer Lansingh, Engineering Societies Building, 33 West Thirty-ninth street, New York city. Annual convention, Philadelphia, Pa., October 5-6.

INDEPENDENT TELEPHONE ASSOCIATION OF TEXAS AND LOUISIANA. Secretary, C. A. Shock, Sherman, Tex.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. S. Norton, Indianapolis, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ward, Grand Rapids, Mich. Secretary's office, Monadnock Building, Chicago, Ill.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Iowa.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Iowa.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Annual meeting, Pittsburg, Kan., October 8-10.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. G. Turpine, Henderson, Ky.

MAINE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, M. E. Crow, Houlton, Me.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshal, Port Huron, Mich.

MICHIGAN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. A. Burch, Battle Creek, Mich.

MISSOURI ELECTRIC LIGHT, GAS AND STREET RAILWAY ASSOCIATION. Secretary, Claude L. Clary, Sikeston Electric Light and Power Company, Sikeston, Mo.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, George W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee street, Utica, N. Y.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, John F. Gilchrist, Commonwealth Edison Company, Chicago, Ill.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln.

NEBRASKA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. E. Mattison, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 60 State street, Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl street, Boston, Mass. Meetings held on fourth Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 West Thirty-ninth street, New York city.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, R. N. Kimball, Kenosha, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, O. O. Welsheimer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Ballard, Cleveland, Ohio.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

OLD TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York city.

ORDER OF THE REJUVENATED SONS OF JOVE. C. B. Roulet, Mercury, Dallas, Tex. Annual meeting, Buffalo, N. Y., October 15-16.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. S. Smith, Towanda.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second street, Philadelphia.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa. Annual meeting, Washington, D. C., October 13-15.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, J. A. Myler.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, J. G. White & Company, New York, N. Y.

TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 382 Ohio street, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION. Secretary, Clement C. Smith, president Columbia Construction Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

DATES AHEAD.

Association of Edison Illuminating Companies. Annual meeting, Lenox, Mass., September 15-17.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Old Time Telegraphers' and Historical Association, and Reunion of Military Telegraphers, Niagara Falls, N. Y., September 16-18.

Arkansas Association of Public Utilities Operators. First annual convention, Little Rock, Ark., September 17-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 5-6.

Empire State Gas and Electric Association. Annual meeting, New York city, October 7.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Pittsburg, Kan., October 8-9.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

Railway Signal Association. Next meeting, Chicago, Ill., September 8. Annual meeting, Washington, D. C., October 13-15.

Order of the Rejuvenated Sons of Jove. Annual meeting, Buffalo, N. Y., October 15-16.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Record of Electrical Patents.

Week of August 25.

897,273. TROLLEY CATCHER. Michael G. Delaney, Detroit, Mich., assignor to William Degenhart, Buffalo, N. Y. An electromagnet in circuit with the trolley pole actuates the detent controlling the ratchet.

897,278. WIRELESS TELEGRAPHY. Reginald A. Fessenden, Washington, D. C. A receiver is placed in the secondary of an inductive coupling.

897,279. MEANS FOR GENERATING HIGH-FREQUENCY ELECTRIC OSCILLATIONS. Reginald A. Fessenden, Washington, D. C. One of the terminals is made of very thin sheet metal.

897,280. AUTOMATIC STOKING-INDICATOR MECHANISM. Robert Forsyth and William W. Hanscom, San Francisco, Cal. A motor-driven worm mechanism with a complementary audible and visual signal system.

897,291. METHOD OF RENDERING ELECTROLYTIC COPPER HOMOGENEOUS. Marcel A. Jullien and Emile L. Dessolle, Levallois-Perret, France. The metal is electrolytically deposited on a rotatory cylinder.

897,300. ELECTRIC CABLE CLAMP. Ernest W. Muller, Brooklyn, N. Y., assignor to Hubert Krantz, Brooklyn, N. Y. The conducting core is clamped between opposing wedge-shaped insulators.

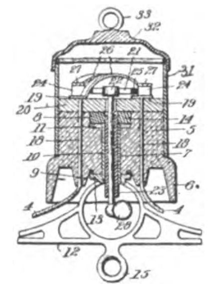
897,304. CONTINUOUS TRACK LIGHT AND AUTOMATIC SIGNAL. John M. Pitney, Jr., Lorain, Ohio. The headlight and a sound signal are operated simultaneously upon the movement of the car.

897,312. ELECTRIC LOCOMOTIVE. Elmer A. Sperry, Brooklyn, N. Y. Each axle is equipped with a motor, and means are provided for rotatively coupling the axles.

897,318. OZONIZER. Jan Steynis, New York, N. Y., and Henri Chaumat, Paris, France. One set of electrodes is stationary and the other movable.

897,326. ELECTRIC HEAT UNIT OR DEVICE. George H. Wade, Atlanta, Ga. Two ribbons of insulating and heat-resisting material are connected by a wire having a high temperature coefficient.

897,350. ELECTRIC STOP MOTION FOR MOTORS AND SIGNAL FOR THE SAME. Adam Cochrane, Lowell, Mass. The circuit is controlled through the medium of a centrifugal governor.



897,457.—Hanger for Electric Lamps.

897,355. ELECTRIC BLOCK-SIGNALING SYSTEM. John W. Davis, Los Angeles, Cal., assignor to Mills-Piddington Cab Signal Company, Los Angeles, Cal. The insulated sections of the rails are provided with magnets effecting the electric connections.

897,394. ELECTROMAGNETIC LOCKING DEVICE. Charles O. Peters, Winthrop, Mass. The core of the electromagnet serves as a detent, and the latch serves as an armature.

897,401. ELECTRIC SIGNALING SYSTEM. Harry C. Reagan, Butler, Pa., assignor of one-half to John H. Barrett, Mars, Pa. A safety stop bar is operated through a single wire for drawing the current-collecting device on the car away from the trolley wire.

897,402. TROLLEY FINDER. Joseph P. Reed, Muncie, Ind. The trolley harp is provided with lateral spring members for taking up rebound.

897,410. CARBON HOLDER. Oscar A. Ross, Chicago, Ill. The electrode is held in a resilient socket member.

897,413. SIGNALING CIRCUIT. Harry O. Rugh, Sandwich, Ill. A pole-changing device acts with a polarized relay to make normal or alternate contacts.

897,454. TELEGRAPHIC TRANSMITTER. George A. Cardwell, New York, N. Y., assignor to Telegraph Transmitting Instrument Company, New York. A keyboard and key levers effect various combinations in the line circuit.

897,455. CLUSTER FIXTURE FOR ELECTRIC LIGHTS. John H. Caldwell, Philadelphia, Pa. A wireless cluster.

897,457. HANGER FOR ELECTRIC LAMPS. George Cutter, South Bend, Ind. A weatherproof insulator and cutout.

897,472. JAR FOR STORAGE BATTERIES. Joseph Marx, Buffalo, N. Y. The inner cell is fitted with an annular rim fitting over the ledge of the outer shell.

897,474. INDICATING FUSE PLUG AND HOLDER. Claude E. Mentzer, Denver, Col., assignor of one-third to Leon A. Freeman and one-third to George L. Bettcher, Denver, Col. An indicating device is released by the burning of the fuse.

897,475. ALTERNATING-CURRENT MOTOR. Maurice Milch, Schenectady, N. Y., assignor to General Electric Company. The primary member is provided with a winding distributed over a portion only of the said member. The secondary member is provided with a short-circuiting winding connected to the segments of a commutator.

897,484. PNEUMATIC CONTROL SYSTEM. Philipp Pforr, Berlin, Germany, assignor to General Electric Company. A contact device for equalizing pressures in the reservoir of an air-brake system.

897,492. ELECTRIC SWITCH. Oran O. Rider, Schenectady, N. Y., assignor to General Electric Company. A double-throw switch having its open position between its two closed positions.

897,497. STARTING AND SPEED-REGULATING RHEOSTAT. Frank J. Seabolt, Schenectady, N. Y., assignor to General Electric Company. A regulating rheostat with a double series of contacts and an electromagnetic device for closing the motor circuit through one of said resistances.

897,501. SYSTEM OF ELECTRICAL DISTRIBUTION. Matthew O. Troy, Schenectady, N. Y., assignor to General Electric Company. A phase-changing rectifier system.

897,507. SYNCHRONOUS MOTOR. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. The field is provided with phase-splitting means.

897,508. ALTERNATING-CURRENT MOTOR. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. The laminated primary member carries two windings of different pole numbers.

897,514. LATCH MECHANISM. Paul Behr, Berlin, Germany, assignor to General Electric Company. An automatic circuit-breaker tripping mechanism.

897,524. BLOCK-SIGNAL SYSTEM. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. The signal-controlling relay has one winding connected to the track rails and a plurality of windings supplied with current from a plurality of different circuits.

897,525. ELECTRIC SWITCH. Frank C. De Reamer, Schenectady, N. Y., assignor to General Electric Company. A double-pole fused switch.

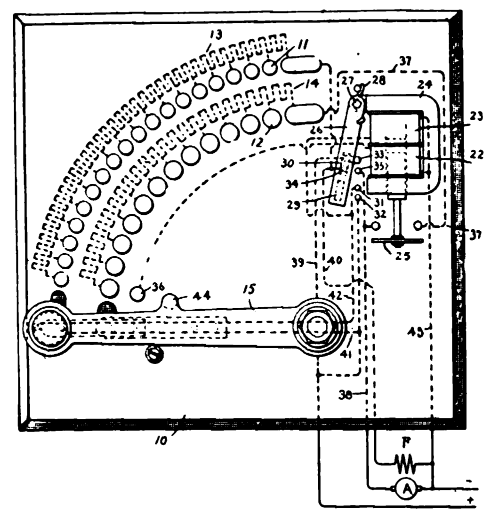
897,531. BLOCK-SIGNAL SYSTEM. Laurence A. Hawkins, Schenectady, N. Y., assignor to General Electric Company. An alternating-current relay control block-signal system.

897,536. MERCURY METER. Frank Holden, London, England, assignor to General Electric Company. The index is moved in the tube by a flow of mercury therein.

897,537. ELECTRIC CONTROLLING SYSTEM. John D. Ihlder, New York, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. The electrodynamic brake circuit automatically controls the resistance in accelerating the motor.

897,538. SYSTEM OF MOTOR CONTROL. Leopold Janisch and Wilhelm Naumann, Berlin, Germany, assignors to General Electric Company. Means are provided for connecting the resistance in parallel with the armature when the controller is moved toward its off position.

897,544. RECTIFIER SYSTEM. Osias O. Kruh, Schenectady, N. Y., assignor to General Electric Company. Mercury rectifiers in series are interpolated in the several phases of the system.



897,497.—Starting and Speed-Regulating Rheostat.

897,545. SINGLE-PHASE COMMUTATOR-MOTOR. Marius C. A. Latour, Paris, France, assignor to General Electric Company. The main field coils are adapted to produce a relative phase displacement of currents.

897,548. ARC-LIGHT ELECTRODE AND METHOD OF MAKING THE SAME. Charles F. Lindsay, Schenectady, N. Y., assignor to General Electric Company. A mixture containing iron oxide and titanium oxide is partly reduced and thereafter subjected in the finished electrode to a reducing action.

897,564. PANEL BOX. Frank S. Wahl, Olean, N. Y. A stamped sectional panel box.

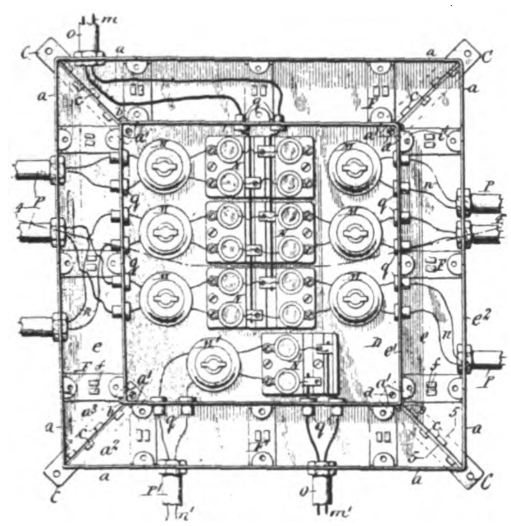
897,569. MEANS FOR PRODUCING ARTIFICIAL LIGHT FOR PHOTOGRAPHERS' USE. Frank E. Barentzen, Malden, Mass., assignor to William G. Burns, Boston, Mass. A closed compartment is separated from the main room by a partition of translucent light-diffusing material.

897,585. ELECTRIC TIME SWITCH. Jules Cauderay, Lausanne, Switzerland. A motor imparts intermittent, partial revolutions to the clock shaft.

897,590. SUBSTATION PROTECTOR. Frank B. Cook, Chicago, Ill. Carbon lightning arresters are connected in series with the fuse members.

897,602. CONTROLLER REGULATOR. Frederick M. Du Bois, Syracuse, N. Y., assignor, by mesne assignments, to American Automotoneer Company, Philadelphia, Pa. An interlocking ratchet movement.

897,603. BUFFING AND GRINDING APPARATUS. Frederick B. Duncan, Madison, Wis., assignor to Northern Electrical Manufacturing Company, Madison, Wis. A self-contained motor-driven buffing and grinding machine.



897,564.—Panel Box.

897,607. AUTOMATIC CALLING-ON SIGNAL. William H. Elliott, New York, N. Y. The signals are capable of being actuated when the section is occupied.

897,614. CLUSTER-LAMP SOCKET. Charles D. Gervin, New York, N. Y., assignor to the Dale Company. A wireless cluster.

897,633. ELECTROLYTIC CELL. Gilbert C. Landis, York, Pa. A tubular metal-carbon cell.

897,657. ELECTRIC AND PNEUMATIC GOVERNOR. William K. Rankin, Philadelphia, Pa., assignor to John E. Reyburn, Philadelphia, Pa. The action of the diaphragm governs the electrical circuit.

897,662. TELEGRAPHIC SELECTIVE SYSTEM. Alfred M. Roberts, Buffalo, N. Y. The selecting magnet responds to the direction of current flow.

897,667. TROLLEY WHEEL. Edward P. Sharp, Buffalo, N. Y. An integrally connecting hub is fitted with rigid outside flanged members.

897,669. INSULATOR. Frank J. Siegwart, Pittsburg, Pa. Means are provided for carrying the connector in an insulating groove.

897,670. ELECTRICAL IMPULSE RECORDER. Augustus K. Sloan, Jr., Brooklyn, N. Y. The moving member of the solenoid is provided with a stylus.

897,674. TERMINAL FOR ELECTRIC FITTINGS. Frederick A. Swan, Cliftondale, Mass. Means are provided for taking the strain off the conductor.

897,681. TELEPHONE SWITCH. Clarence Truitt, Moscow, Ida. Means are provided for signaling another station without calling the telephone exchange.

897,683. CONDUIT CAP FOR ELECTRIC INSTALLATION. Wheeler H. Vibber, New London, Ct., assignor to the Gillette-Vibber Company, New London, Ct. An insulating pipe cap.

897,692. ELECTRIC ORGAN ACTION. William R. Whitehorne, Brooklyn, N. Y., assignor to Whitehorne Organ Action Company, Jersey City, N. J. Each key is provided with a switch, stop mechanism and valve-controlling magnet winding.

897,702. ELECTRIC SIGNAL SYSTEM. Anthony A. Barbera, Philadelphia, Pa. The operation of the semaphore arm actuates an alarm member mounted in the tower house.

897,711. TIME SWITCH FOR ELECTRIC CIRCUITS. Hayden W. Brown, Waterbury, Ct. Means are provided for adjusting the switch mechanism in a predetermined position.

897,713. MOTOR STARTER. Anthony J. Burns, Oswego, N. Y. Means are provided to hold the contact member at open circuit position.

897,716. TRANSMITTER. Jesse T. Curtis, Bement, Ill. The transmitter is equipped with two diaphragms, one diaphragm having adherent to its sunken portion a carbon cup.

897,718. TELEPHONE INSTRUMENT. Wilford R. Daniels, New York, N. Y. An exterior piece for mounting over the ear piece of an ordinary receiver.

897,723. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. The line signal is controlled by a relay.

897,731. SIGNALING DEVICE FOR TELEPHONE EXCHANGES. Thomas W. Gardner, Nashvile, Tenn. Two balanced windings have a common core, and there is a condenser in series with the operator's head-piece receiver.

897,752. OSCILLATING DESK FAN. Evrah C. Lipps, Warren, Ohio, assignor to the Peerless Electric Company, Warren, Ohio. The fan body is oscillated by means of a deflecting vane.

897,758. PROCESS FOR MANUFACTURING INDURATED FIBRE. Israel W. Marshall, Yorklyn, Del., assignor of one-half to Thomas E. Marshall, Yorklyn, Del. A plurality of vegetable paper sheets are subjected to a chemical process whereby they are partially gelatinized.

897,765. MULTIPLE TELEGRAPHONE SYSTEM. George Morin, Habana, Cuba. A plurality of revoluble members are adapted to hold magnetic impressions analogous to sound waves.

897,766. ELECTRIC CIGAR LIGHTER. Ernest P. Muller, Brooklyn, N. Y. Spring contact points are arranged to make contact with an igniting member.

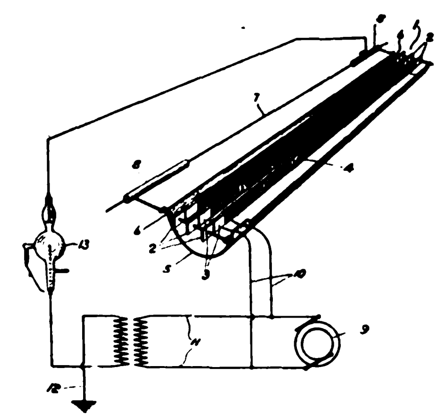
897,779. RECEIVER FOR WIRELESS SIGNALING. Valdemar Poulsen, Copenhagen, Denmark. The signal is impelled by periodically unbalancing or destroying the condition of resonance in the oscillation circuit.

897,800. LIGHTNING ARRESTER. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. A combination of spark-gap terminals and a resistance formed of an oxide, the resistance of which decreases when heated.

897,805. INCANDESCENT LAMP SOCKET. William F. Wegner, New York, N. Y., assignor to Stephen T. Williams, New York, N. Y. The socket is adapted to retain the lamp by a direct thrust.

897,812. INVERSE TIME-LIMIT RELAY. Peter Bendmann, Berlin, Germany, assignor to General Electric Company. The armature is operated in a strong magnetic field.

897,823. MARINE SIGNALING LAMP AND THE LIKE. Henry Endall, Southampton, England. A water-tight casing contains an illuminating means.



897,831.—Means for Preventing Offset in Connection with Printing.

897,824. POLE SHOE. William R. Everett and Edwin J. Newton, Chicago, Ill. The pole shoes are equipped with extended arms, these arms being offset on opposite sides.

897,831. MEANS FOR PREVENTING OFFSET IN CONNECTION WITH PRINTING. John Hergesheimer, Philadelphia, Pa., assignor to the Curtis Publishing Company, Philadelphia, Pa. Means are provided for effecting a discharge of the static electricity in the moving sheets.

897,852. SAFETY FUSE. Joseph Sachs, Hartford, Ct., assignor to the Sachs Company, Hartford, Ct. The fuse is comprised of a plurality of separately insulated and sheathed conductors connected in multiple to common electrodes.

897,858. AUTOMATIC CIRCUIT-BREAKER. Henry P. Ball, New York, N. Y., assignor to General Incandescent Arc Light Company, of New York. A double- throw switch which is spring-actuated to its open position.

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

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CONTENTS

THE PENNSYLVANIA ELECTRIC ASSOCIATION.

At the Chicago convention, last May, of the National Electric Light Association, various amendments to the constitution and by-laws were adopted. One important amendment was to the effect that upon application of five Class A members, or two-thirds of all the Class A members, if less than eight, in any state, territory or dependency of the United States or provinces of Canada, the executive committee should authorize the applicants to organize a geographic section of the National Electric Light Association, to which all members of the association in such geographic section should be eligible for membership. When this amendment was adopted it was hardly expected that it would have a working out in a very short time. It is, therefore, at once a matter of congratulation and anxiety that the members of the Pennsylvania Electric Association, which held its first annual convention at Eagles Mere, Pa., last week, unanimously voted to reorganize as a state branch of the National Electric Light Association.

If we mistake not, the idea in the minds of the original members of the Pennsylvania Electric Association was that the national body should be supplemented by a distinct state organization, which organization would necessarily be in entire sympathy with the requirements of the corporations doing business in the state of Pennsylvania, and would be effective to a greater degree statewise than the national organization could possibly be. The presence of the very capable president and several members of the national organization, and the assistance which they were undoubtedly able to render in formulating plans for the development of the state organization, unquestionably made it easy to decide to become part of the greater association, rather than go it alone. The tremendous impetus which the National Electric Light Association has proved itself to be is a matter of immediate concern to every public-utility corporation interested in the supplying of electricity for light and power.

The working out of the present situation will be watched with a great deal of interest, as in almost every state in the Union where there is a state organization, a large number of the members are also members of the national organization. The amendment just discussed, if its advantages are properly applied, will work greatly to the benefit of the member companies, in that it will eliminate a great deal of organization and routine work which, if carried on by a central bureau, would tend to considerable economy, would make effective the strength of all for the benefit of each, and at the same time interfere very little, if at all, with the autonomy of the state organization.

WOOD PRESERVATION.

During the last four or five years the United States Department of Agriculture has given a great deal of attention to the matter of wood preservation, and its files contain much documentary evidence of the value of the research and experimentation which have been carried out along these lines, both here and abroad. A recent publication, circular 139, is a very interesting treatise on the subject of wood preservation, by W. F. Sherfesee.

We are familiar with the ordinary forms of decay which affect organic and inorganic matter. The decay of a plant body such as wood is not an inorganic process like the rusting of iron or the crumbling of stone, and is at the same time different from the process of decomposition of organic structures. It is due to the activities of low forms of plant life, called bacteria and fungi. Fungi, although more complicated than bacteria, are almost as low in the scale of creation when compared with familiar flowering plants and shrubs. The bacteria often consist of but a single cell, microscopic in size. Sometimes several such cells are attached to each other, forming a thread or filament. They multiply by the division of the parent cell into other cells, which, in turn, divide again. Fungi consist merely of tiny threads or hyphæ, which are collectively known as the mycelium. In the higher forms of fungi these mycelium form compact masses of tissue, such as are evidenced by the "punk" of rotting logs or the brackets formed on the trunks of growing trees.

The fruiting of these bodies themselves is not the cause of the decay in wood. Spores, which are very primitive substitutes for seed, and which are borne in the countless compartments into which the under surfaces of the fruiting bodies are divided, are produced in infinite number. When seen in bulk they appear as dust, and, like dust, are carried by the wind and strike all portions of the surrounding objects. Fortunately, few species of fungi successfully attack healthy living trees, and only a comparatively small number attack and destroy wood; yet the spores of some find a lodging in dead portions of a tree or in cut timber, and if the wood is moist and in the right condition for the spore to grow, it germinates and sends out a thin film-like white thread, which, by repeated branching, penetrates the entire structure of the wood.

It is well known that wood is composed of minute cells, the chief material of the cell walls being a substance called cellulose. Around these walls there are encrusted many different organic substances, known collectively as lignin. Most wood-destroying fungi destroy only the lignin; others attack the cellulose alone, while a third class destroys all parts of the wood structure. The lignin and cellulose are dissolved by certain substances secreted in the fungi, and thus serve as food for the fungus growth. Finally, the composition of the wood is so greatly changed that its strength is diminished, the texture becomes brittle and disconnected, and the wood is said to be "rotten."

In addition to the wood food, the fungus requires, however, for its growth and development, heat, air and moisture. If any one of these is lacking the fungus can not develop. We can not deprive the growing plant or the cut timber of heat, and only where the wood is sunk under water at great depths can we deprive it of air. Of the four requirements, therefore, these two are beyond control. It is only by depriving the fungi of moisture or of food that the destruction they cause can be prevented.

Seasoning of timber, which means practically that a certain percentage of the moisture contained has been extracted, adds greatly to the structural value of cut timber; but seasoned lumber is hygroscopic, and can reabsorb a considerable amount of moisture content from which it has once been freed. Of course the climate has a great deal to do with the content of moisture contained in standing timber.

The strength of partially seasoned timber, other things being equal, increases as the amount of moisture it contains decreases. Thoroughly seasoned timber of small sizes is sometimes three or four times as strong as the same timber when green.

It is a mistake to suppose that the germs of decay are inherent in a wood, and several processes for the preservation of wood have failed because they have been founded on this false assumption. The wood-destroying agencies start from the outside, and this explains the partial efficacy of certain paints, which merely form a superficial coating over the surface of the timber, but which are poisonous enough to prevent the spores from germinating. An exterior coating, secured by dipping a post into a thin solution or other material that will harden on the timber, for this reason is not a thoroughly effective protection, because, with shrinking or swelling of the wood, cracks form, through which the agents of decay enter.

Of the processes employed for the treatment of timber with antiseptics, those known as the zinc-chloride treatment and the creosote treatment are generally in common use. These antiseptics are applied by what may be called the pressure-cylinder method, the open-tank method and the brush method. In the pressure-cylinder method the timber is placed in a strongly made cylinder and subjected to heating by steam under pressure. The steam is withdrawn, and a high vacuum established in the cylinder; then the preservative compound is forced into the wood in the cylinder under pressure. After remaining under this influence for a certain time, the lumber is withdrawn from the cylinder and stacked in the open air. In the open-tank method the wood is first thoroughly seasoned by either air or kiln drying, and immersed in a hot bath of the preservative contained in an open tank. The hot bath is continued for a certain time, the moisture and air in the timber passing off in the form of bubbles. At the end of the hot bath the timber is immersed as quickly as possible in a cold preservative, which causes the contraction of the air and moisture remaining in the wood, creating a partial vacuum in the wood cells, which can be destroyed only by the entrance of the preservative. In this way atmospheric pressure accomplishes that for which the artificial pressure is used in the other commercial processes. In the brush method the antiseptic is painted on the surface of the timber, the liquid being applied ordinarily with a common paint brush. In this method care must be taken to check all knots and excoriations, as the liquid can penetrate but a short distance into the wood. This process is, of course, not as thorough as either of the other two, but is of great value where the amount of timber to be treated is too small to justify the erection of a small treating plant, or where the land is so rugged that it is impracticable to transport the timber for even short distances.

From such tests as have been made it appears that if proper care is observed in the treatment of timber, all danger from injury from excessive temperatures can be avoided. The amount of moisture remaining in the wood is of greater importance. Creosote retards both the absorption and evaporation of water; hence its presence in thoroughly seasoned wood exposed to humid conditions tends to conserve its strength; whereas, on the other hand, if it is applied to green wood, the strengthening action of water evaporation is retarded. Zinc chloride and the other preservatives which are in water solution have a wholly different effect. Unless the wood structure is already filled with moisture to the point of saturation, more water is injected into it with the preservative, with the result, if the wood is partially seasoned, of decreasing its strength. The original strength of the wood, however, may be regained by seasoning.

The principal point of superiority of creosote as an antiseptic lies, apparently, in its insolubility in water. Once injected into timber it will not wash out. On the other hand, zinc chloride is much cheaper than creosote, and is shipped more easily, and with lower freight charges; but, since zinc chloride is soluble in water, timber treated with it, when exposed to moisture, will lose its preservative through the leaching out of the chloride; hence zinc chloride is used in comparatively dry situations. Creosote, moreover, is one of the few preservatives within commercial reach that offer absolute protection against the marine borers which work havoc among the wharves of the Atlantic, Gulf and Pacific coasts.

The actual saving due to wood preservation has been demonstrated time and time again, and actual figures have been presented before technical societies within recent years, and are available from the files of the United States Department of Agriculture. The question may be raised whether it can positively be proved that the treated poles will last twenty years. The author holds that a sufficient answer to this argument is that the poles need last only 1.6 years longer than untreated poles in order to justify the cost of treatment. But evidence of the value of preservative treatment is not lacking. It is only a few weeks ago that a contracting company, while installing a twenty-four-duct run for the Empire City Subway Company in New York city, owing to realignment necessary from the excavation work for the Hudson River tunnels, unearthed a block of creosoted conduit which had been under ground since 1887. After twenty-one years it was sound and without the least sign of decay. This conduit has been stored, as it was taken up without breakage, and is now on exhibition in the New York office of the company which manufactured it and laid it in the earth almost a quarter of a century ago.

STREET-LIGHTING CONTRACTS AND THE TUNGSTEN LAMP.

Nowhere in the field of electric lighting has the influence of the tungsten lamp been more directly felt than in street illumination. The increased efficiency and excellent life records which are being maintained by the series tungsten lamp in commercial service are attractive enough to the central station to offset the higher cost of each unit and the supplying of a much larger quantity of light for the same price. The essential features of the tungsten lamp ought to be made perfectly clear, however, to municipal officers and bodies influential in the drawing up of contracts, for there is an excellent opportunity for misunderstandings to arise in connection with the comparative efficiencies of carbon, metallized-filament and tungsten lamps if the lighting question is allowed to be settled for a term of years mainly on the basis of lamp economy.

Nothing is to be gained on the part of the central station by trying to minimize or even conceal the reduction in wattage which so distinguishes the tungsten lamp from its predecessors. A frank policy in this respect is worth everything, and no fair-minded city executive should begrudge a central station the benefits of enhanced lamp efficiency, provided the company makes clear that it is willing to share the benefits with the municipality. This it can do without resorting to prohibitive cuts in prices, provided the fact is borne in mind that the town or city is buying light, and assuming that the authorities are reasonable men, satisfied with a reasonable share in improvements which they risked nothing to obtain, and which they would never have enjoyed but for the willingness of the central stations to spend money on trials and experiments.

Local conditions must naturally in each case determine the rates charged for street lighting by tungsten lamps, but in view of the fact that in many instances the substitution of tungstens for carbon-filament incandescents gives the city an increase of from twenty-eight to sixty per cent in the volume of light emitted from each unit, with the added benefit of maintaining the initial candle-power far beyond the period when the gas-mantle lamp would be fit for respectable service and greatly in excess of the capabilities of the carbon lamp, there ought to be little justice apparent in a rate reduction when the new contract is made up on the tungsten lamp basis. Measuring the output of the series tungsten lamp in candle-power-hours one finds that the central station is giving quite enough to the municipal customer if it does not raise the rate per lamp per year, when the total candle-power-hours of other lighting units are figured. It is sometimes hard for the central station to convince the city authorities that the tungsten lamps will give enough better service to require no reduction in lamp rate, but there is a good chance in such cases to exhibit actual lamps which have burned a known number of hours, and let the non-technical city officials see for themselves the lasting characteristics of the old and the new units. Experience has proved, however, that the making of a new contract on the tungsten-lamp basis may result in a higher rate per lamp per year for the municipality, especially if a longer burning is provided under the new conditions. In one case of this kind the price per year for twenty-five-candle-power carbon series lamps was $16.50 per lamp. When the contract expired a new contract was made upon the basis of thirty-two-candle-power tungstens, burning three hours per night longer during six months of the year. The new price per lamp was $19.30 per year, or an increase of seventeen per cent. Such an illustration of reasonableness on the part of the city officials in dealing with a problem of this character augurs well for other companies who approach the making of a new street-lighting contract with tungsten lamps as the working units, in a broad and far-sighted way.

MOTOR DRIVE FOR THE PRINTER.

Probably in no other industry has so much quiet experimentation been carried on in the adapting of motors to driving machinery as has been the case with the publisher and printer. Years ago, when the availability of the electric motor and automatic control for the driving of machinery was demonstrated, the printer was among the first to have the hardihood to install electricity as a source of power. Great were the claims made for the electric motor. The printer, by temperament, is an enthusiastic person, and rarely goes at things in a half-hearted way. Believing implicitly in the claims made by early solicitors he threw out his gas or oil engine and quarreled with his steam supplier, believing he had every one beaten at the start when he made up his mind to install an electric motor. Many and grievous were his disappointments. In most cases he either installed too much or too little power. Where the first condition prevailed, his bills for current were too high, and the service made but a poor showing against his previous costs for steam driving. Where the second condition prevailed, he was at his wits' end more than half the time because of the stalling of the motor and the disrupting of his circuits for a dozen different good electrical and mechanical reasons.

The printer was usually as enthusiastic in expecting the motor to do wonders as the early solicitor was to promise them. When figuring for power he rarely assumed that he would have all of his machines in operation at one time, and this, of course, was taken advantage of in the installation of his motor. As a matter of fact, however, every once in a while he would require all of his apparatus at one time, and machine after machine would be thrown on, until the belts would start to slip, and presently the motor or some part of the circuit would go out of commission. Then, again, in dispensing with his steam service he, in most cases, counted upon saving the engineer's wages. The foreman of a printing plant is usually a man of considerable intelligence and not a little mechanical ability, and upon him, in large measure, devolved the task of running the motor. While things were going smoothly he got along very well. When the motor commenced to cut up capers he, of course, secured all manner of advice from every one who had a smattering of knowledge more or less technical. It is easy to realize that with some of the earlier installations the motors did some truly wonderful things, carrying overloads which the most sanguine designers and manufacturers never expected them to be capable of. The usual method of curing a sparking commutator was the application of a rag well greased with vaseline. Where fuses were used it was only because they would not blow when they should have blown that the circuit remained intact, and that there was not more trouble is one of the things that can be explained only by the immutable perversity of inanimate objects.

The constant improvement in the design and manufacture of internal-combustion motors and the laying of mains through the streets by steam-distributing companies retarded considerably the introduction of the electric drive. These elements at the same time stimulated the electrical engineers and manufacturers to make a closer study of the needs of the printer, and the result has been that nowhere is the electric drive giving so much satisfaction at the present time as in the printing industry.

It must be understood that from very crude methods of simply closing a switch there have been evolved methods of automatic control which fit almost any possible demand which the printer may make. The adapting of automatic control to the perfecting presses used by the daily newspapers has made necessary the exercising of the greatest possible ingenuity and perseverance. An idea of the complexity of the circuits and the necessity for fine control in operating these machines may be gained from the article which is presented on another page of this issue by Mr. S. H. Sharpsteen. The author gives a very lucid idea of the two-motor drive with automatic control which is very successfully meeting the demand for a safe and reliable source of power.

In getting a perfecting press ready for production, the machine must be put through a series of movements which require a motor that will operate from the slowest possible crawling speed up to the high speed necessary for the rapid production of the daily newspaper whose circulation runs into the hundreds of thousands. Plates must be fastened on, paper threaded in, adjustments of every description made, all under control of the man in charge, and at the same time under control of men working at various parts of the press; for it must be understood that this is a machine of great dimensions, and quite a number of operators must be at work at different parts of the press at the same time. The method of push-button control has been elaborated, and yet so simplified that we rarely hear of an accident either to the machine or to the men operating it.

This is only one phase of the many applications of the motor drive and automatic control to printing machinery. There are numerous installations in the loft buildings all over our larger cities which form a fallow field for the electrical engineer and the designer of electric motors and control apparatus. The employing printer, through his trade societies, very quickly learns of the success with which a brother printer meets in the employment of any new device, and now that it has been demonstrated that the electric drive is a source of economy, he is anxious to take advantage of that economy, outside of his natural desire to have his equipment driven by the latest form of power-producing machinery.

THE STATEMENT OF OHM'S LAW.

BY MORTON G. LLOYD.

In 1826 G. S. Ohm announced the relation between electromotive force and current, which has ever since been regarded as one of the fundamental laws of electrical science. The law discovered by Ohm is that in a definite conductor of the first class,[1] under definite conditions, the current is proportional to the electromotive force which produces it, that is, to the total electromotive force in the circuit. It was applied by him to continuous currents, but it is equally true of conductors in which alternating currents are flowing. Since it is true of the instantaneous current it must hold also for values obtained by summation over a complete cycle.

Put into the form of an equation, using the usual symbols, Ohm's law becomes

$$\frac{E}{I} = \text{a constant.}$$

That is to say, if E be varied while all other conditions remain the same, the ratio $\frac{E}{I}$ remains constant. If some other condition, such as the temperature, be changed, I is again proportional to E, but the ratio has now a different value.

If e be the instantaneous impressed electromotive force in an alternating-current circuit, then we must combine with it the self-induced electromotive force, since Ohm's law applies to the total electromotive force. Thus $\dfrac{e - L\dfrac{di}{dt}}{i} =$ constant, where $\frac{di}{dt}$ represents the rate of change of current and L the inductance. If the circuit or conductor be coupled with a secondary circuit, there will be another component of electromotive force to be considered; thus

$$\frac{e - L\dfrac{di_1}{dt_2} - M\dfrac{di_2}{dt}}{i_1} = \text{constant.}$$

When we consider effective or maximum values in an alternating circuit supplied from a source of sinusoidal electromotive force, Ohm's law may still be applied if the inductance of the circuit be definite and constant (*e. g.*, free from iron). The equation then becomes

$$\frac{\sqrt{E^2 - L^2 p^2 I^2}}{I} = \text{constant,}$$

where E is the electromotive force impressed on the circuit or conductor, and LpI represents the self-induced electromotive force.

If there be capacity in the circuit, its potential forms one component of the electromotive force which must be included in the equation. Thus for instantaneous currents, $\dfrac{e - L\dfrac{di}{dt} - \dfrac{q}{C}}{i} =$ constant, where C is the capacity and q the charge; and for the effective values with sinusoidal currents,

$$\frac{\sqrt{E^2 - I^2\left(pL - \dfrac{1}{pC}\right)^2}}{I} = \text{constant.}$$

When put into this form it is evident that Ohm's law holds for alternating currents, and the idea so often expressed that this law does not hold under these conditions is seen to be due to an erroneous point of view. Just as in the case of continuous currents, the value of the constant is changed whenever the conditions are changed, and here a greater variety of conditions may exist. Thus a variation of frequency, if the latter is sufficiently high, may alter the value of the constant, and in this case the variation of L with the frequency would have to be considered also.

The form which Ohm's law takes in the case of alternating currents is not one which is convenient for computation, and it is due to this fact that the formula involving the expression for impedance has taken its place in the discussion of alternating currents. But it should be borne in mind that the law of Ohm is just as true, for the law then takes on a greater significance.

It should be noticed that up to this point the word *Resistance* has not been used, and I want particularly to lay stress upon the fact that Ohm's law can be discussed without mention of it. Resistance is the name which has been given to the ratio $\frac{E}{I}$ in the case of continuous currents, and the practical units of measurement of the three quantities, electromotive force, current and resistance, have been so chosen that the numerical relation $\frac{E}{I} =$ R holds. When a change of temperature or other condition alters the ratio $\frac{E}{I}$ we say that the resistance changes, in order to keep intact the above relation.

Having defined resistance in terms of the conditions in a continuous-current circuit, it then becomes a matter of experience (or extension of definition) as to whether the same relation holds under other conditions, as, for example, with alternating current. As a matter of fact with sinusoidal currents the radio $\dfrac{\sqrt{E^2 - I^2\left(pL - \dfrac{1}{pC}\right)^2}}{I}$ is still called the resistance, and if the value of this ratio changes with the frequency, for example, again we say that the resistance changes, even though all the physical characteristics of the conductor remain unaltered.

Inasmuch as the conception of resistance is a consequence of Ohm's law, it does not seem desirable to use that term in the expression of the law, at least not in the way that it is so often stated, *viz.*: "The current is equal to the electromotive force divided by the resistance." The law is better stated, from the logical standpoint, by saying that the current is proportional to the electromotive force, or that their ratio is a constant.

[1] *i. e.*, metals, etc. Ohm's law does not hold in gaseous conductors.

The Annual Meeting of the American Electrotherapeutic Association.

The eighteenth annual meeting of the American Electrotherapeutic Association will be held in the Engineering Societies Building, 29 West Thirty-ninth street, New York city, on September 22, 23 and 24. The evening of September 23 will be devoted entirely to the exhibit of apparatus and appliances, which will be held in the large room on the fifth floor, adjoining the usual assembly room of the New York Electrical Society. The association has procured the use of the fifth floor for the three days' session, and the members of the New York Electrical Society, the American Institute of Electrical Engineers and engineers in general are invited to be present during the several sessions.

The Education of Street Railway Employés.

A committee has been appointed by President Goodrich, of the American Street and Interurban Railway Association, to study and report upon efforts which are being made by railway companies to train their employés for efficient service. This committee is composed of Professor H. H. Norris, chairman; R. E. Danforth, Newark, N. J., and Professor A. S. Richey. It is likely that the committee will present a preliminary report at the convention of the American Street and Interurban Railway Association, which will be held at Atlantic City, N. J., next month.

The Huddersfield (England) Municipal Street Railways.

The following statistics concerning the working of the Huddersfield street railways are furnished by Consul F. I. Bright:

"Huddersfield, embracing an area of 11,854 acres, has a population of 100,000 and a ratable value of $2,380,448. Probably in no other town in England of the same population is municipal ownership carried on to the same extent. It was the first city in England to own and operate its tramways.

"Steam was superseded by electric power in 1901. The system now has a little over twenty-eight miles of track, over eight miles of which are double track. Each of the seventy cars has a seating capacity for fifty-six passengers. The ordinary number in use is fifty-six, each running on an average 113 miles from 5 A. M. to 12.45 A. M. The passengers carried in 1907 numbered 16,130,334, at an average fare of 2.4 cents; the total miles run was 1,960,329. The 430 regular employés receive a weekly wage of $2,239. Motormen and conductors work nine hours a day; the shed staff, day, nine hours, and shed staff, night, seven and one-half hours.

"The cost of the permanent way has been $984,167, the total outlay for permanent works, cars, twenty-four waiting rooms, and other property being $2,009,383. An open top car weighing ten tons costs $2,579, a covered top car weighing ten tons fourteen hundredweight, $2,823.

"The total working expenses for the year were $202,943, making an average of 8.7 cents per car-mile, after deducting $31,486 for power expenses. The fares charged run from two cents per 1.23 miles up to eight cents per 6.85 miles.

"From 5 A. M. to 8. A. M. and from 4 P. M. to 10 P. M. cars are available to workmen going to and from work at fifty per cent of the ordinary fares.

"The total income for the last year was $412,212, leaving a gross surplus of $209,269, and, after paying certain amounts of interest on capital, redemption of debt, and depreciation account, a net surplus of $31,700 to be applied to the relief of the general rates.

"During the year there were 262 accidents, caused principally from collisions between cars and other vehicles and by passengers alighting from and boarding cars when in motion. There were no fatal accidents, and less than thirty claims for damages were presented. Third-party risks are covered by insurance, and all such claims are adjusted direct by the insurance company, which receives an annual premium of $3,626.

"There is a postal letterbox attached to each car, which is cleared every hour from 8.30 A. M. to 9.30 P. M. and again at 11 P. M. The number of letters carried in 1907 was 720,512.

"There is no thought here at the present time of adopting the motorbus, in use in a few large cities. The working expenses are regarded as too high."

Edison Electric Illuminating Company of Boston Establishes Illuminating Engineering Department.

The Edison Electric Illuminating Company, of Boston, Mass., has opened a department of illuminating engineering at its general office, 39 Boylston street, Boston. The Edison company has always been one of the foremost in inaugurating enterprising departures, and the company for many years has set the standard in its efforts to promote the use of electricity and give to its customers the advantages accruing from such service. The illuminating engineering department is under the direction of Dr. Louis Bell and H. W. Moses.

The number of customers of the Edison company in the twenty-five cities and towns in which it sells electricity has shown a steady increase during the past few years. On June 30, 1906, the company had 18,963 customers; in 1907 the total was 20,375, and in 1908, 21,719, an increase of six per cent over 1907, and of fourteen per cent over 1906.

BOOK REVIEW.

"Electrical Engineer's Pocketbook." Horatio A. Foster. New York. D. Van Nostrand Company. Flexible leather, gilt edges. 1,600 pages. 4¼ by 6⅞ inches. Supplied by the ELECTRICAL REVIEW for $5.

It has always been easy to say a good word for Foster's "Electrical Engineer's Pocketbook." Having praised previous editions so highly, it is difficult to find an expression which will appear commensurate with the greatly improved construction and quality of the present volume, which constitutes the fifth edition. Some idea of the value of the work may be gained if we repeat the enthusiastic comment of an engineer after examining the work carefully and critically. He said: "This is the last word in electrical handbooks."

The work has been divided into a number of sections, and each of the sections has been revised by a specialist eminent in his particular field. The value of such revision can not be gainsaid when the weight of such authority is attached to the revision. The list of contributors includes the following: Symbols, Units, Instruments—W. N. Goodwin, Jr., and J. Frank Stevens; Measurements—W. N. Goodwin, Jr., and Professor Samuel Sheldon; Magnetic Properties of Iron Electromagnets—Townsend Wolcott and Professor Samuel Sheldon; Properties of Conductors and Properties of Conductors Carrying Alternating Currents—Harvey Pender; Dimensions of Conductors for Distribution Systems, Harvey Pender; Dynamos and Motors—Cecil P. Poole and E. B. Raymond; Tests of Dynamos and Motors and Alternating-Current Machines—E. B. Raymond and Cecil P. Poole; The Static Transformer—W. S. Moody and K. C. Randall; Incandescent Electric Lighting—Dr. C. H. Sharp; Arc Electric Lighting—J. H. Hallberg; Illuminating Engineering—Dr. C. H. Sharp; Electric Railways—A. H. Armstrong, C. Renshaw, N. W. Storer and Milton W. Franklin; Electrolysis—A. A. Knudson; Transmission of Power—Dr. F. A. C. Perrine; Storage Batteries—Lamar Lyndon; Switchboards—H. W. Young, B. P. Rowe and E. M. Hewlett; Lightning Arresters—Townsend Wolcott; Electricity Meters—H. W. Young and J. B. Baker; Telegraphy—Charles Thom; Wireless Telegraphy—F. K. Vreeland; Telephony—J. L. Wayne; Electricity in the United States Army—G. H. Powell; Electricity in the United States Navy—J. J. Crain; Resonance—Lamar Lyndon; Electric Automobiles—C. J. Spencer; Electrochemistry and Electrometallurgy—Professor F. B. Crocker and Professor M. Arendt; X-Rays—Edward Lyndon; Electric Heating, Cooking and Welding—Max Loewenthal; Lightning Conductors—Professor Alex G. McAdie; Mechanical Section—W. W. Christie.

The section on resonance, by Lamar Lyndon, affords a particularly lucid presentation of this difficult subject, and the chapter on electric heating, cooking and welding, as well as the chapter on wireless telegraphy, brings down to date some very useful information for which there has been considerable demand within the last few years. The copious index and the thorough system of cross-indexing, together with the marginal thumb references, make the finding of information on any subject almost an instantaneous process.

Public Utilities in Germany.

Consul Thomas H. Norton, of Chemnitz, states that a recent statistical summary of the extent to which public utilities are now under the direct management of German municipalities shows that the movement is constantly gaining in momentum and that the field of activity is steadily being broadened. The consul's review continues:

"There are now fifty-eight cities in the Empire, containing over 50,000 inhabitants. In these cities the leading utilities are owned and conducted by the municipalities to the following extent:

Public Utilities.	Number of Cities.
Gasworks	44
Electric power plant	38
Waterworks	43
Abbatoirs	47
Bath houses	42
Street railroads	10
Removal of garbage and sewage	56
Market halls	16
Tenement houses (chiefly for municipal employés and laborers)	22

"In regard to financial results the gasworks make the best showing. Their total profits amount annually to $10,100,000. Of this sum about $2,500,000 is required for interest on the investment. Electrical works show a profit of $4,200,000, of which $1,300,000 is expended for interest. Waterworks return on an average 8.5 per cent of the capital invested. Market halls and tenements yield but little profit.

"The entire capital invested by German municipalities in plants for public utilities is now estimated at nearly $1,000,000,000. The value of forests and meadows, as well as the capital of municipal banks and loaning organizations, is not included in this total.

"While so much activity in this field is developed by the German cities, there is but little evidence of a tendency to invade indiscriminately the economic territory of general industrial competition. Municipal control is established when there is simply the choice between a public and a private monopoly, as in the case of gas, water, electricity, etc., or else when the desirability of a utility is unquestioned, but the uncertainty as to profitable returns fails to attract private capital. There is but little probability that German municipal enterprise will step outside these limitations.

"The telegraph and telephone in Germany are owned and managed by the Imperial Government, and most of the railway lines are the property of the different states."

Canadian Electrical Power.

In continuation of Consul Shepard's report, Consul A. G. Seyfert writes from Owen Sound that the hydroelectric power transmission plan from Niagara Falls to the towns and cities of western Ontario has at last reached the period when the contract for the erection of the line has been let. Mr. Seyfert continues:

"The total length of line to be built is 293 miles, with 3,176 steel towers. The contract calls for a main line from Niagara Falls to Dundas, with lines from the latter place to Toronto, London, St. Mary's and St. Thomas, and was let to a construction company for $1,270,000, the lowest of twenty-seven tenders, and includes all the lines in one contract.

"The head of the construction company is an American, who was formerly connected with some of the Canadian railways. The line as now planned covers only western Ontario, but there is an important concession clause in it for additional lines of equal length to cover eastern Ontario at any such time as the people of that section of the province may ask for the privilege of Niagara power.

"The contract will necessitate the use of 507 tons of aluminum wire, together with 140,000 pounds of telephone wire. The towers will be sixty-six feet high and consume 6,554 tons of steel to build them. The estimated cost of the towers is $621,000. The work is to be completed by December 1, 1909. The material for the construction of this gigantic electric power transmission scheme is to be Canadian-made as far as it is possible to secure it."

Rapid-Telegraphy Invention.

A report from Consul Joseph I. Brittain, at Prague, states that the European papers have been devoting considerable space to the invention of a Hungarian by which it is said the inventor may transmit 40,000 words per hour over a telephone line. The consul furnishes the following description:

"The machine consists of three parts: a perforator, transmitter, and receiver. The first may be worked by a typewriter, while the other two are automatic, working through the agencies of electricity and photography, and the instrument may be connected by an ordinary telephone line.

"Through operating the keys of the perforator the operator writes messages upon a long paper ribbon. By touching the keys a series of holes is punched in the ribbon, each set of holes representing a letter.

"After taking the ribbon from the perforator, the inventor places it in a small cylinder in the transmitter, and a touch of the switch sets the cylinder revolving and the ribbon with it. Before the ribbon has completely passed through the transmitter, a second broader strip of sensitized paper issues from the receiver, and upon it is written, in plain, legible characters, the actual message which the inventor or operator has written on the typewriter."

Wireless Telegraphy in Pacific.

Consul Julius D. Dreher sends from Tahiti the following information in regard to a network of wireless telegraphy which it is proposed to establish among the scattered islands of the Pacific Ocean:

"Capitalists who are interested in the extensive phosphate operations on Ocean and Pleasant islands of the Gilbert group, and in the new works about to be established on the island of Makatea of the Tuamotu Archipelago, have recently begun a movement to connect nearly all the groups of islands in the South Pacific by a system of wireless telegraphy.

"It is expected that the various governments having possessions in the South Pacific will aid in the establishment of the proposed system. Negotiations have already proceeded so far that the success of the efforts seems to be almost assured. As the nearest available ocean cable office to Tahiti is at Auckland, 2,250 miles away, from which a steamship of the Union Line of New Zealand arrives at Papeete once every twenty-eight days, and a direct communication by steamship of the Oceanic Company with San Francisco, 3,658 miles distant, is had once in every thirty-six days, it will be understood how deeply interested the French colony of Tahiti and its dependencies are in the complete success of these negotiations. Other groups of islands are equally interested in the establishment of this system, which means so much to the inhabitants of these widely separated archipelagoes.

"The name of the proposed company is the Pacific Islands Radio-Telegraph Company. Of the proposed capital of £70,000 ($340,000), the owners of the phosphate deposits on Ocean and Pleasant islands have subscribed £10,000. In this radial system there will probably be ten or twelve circles, the largest having a radius of 1,250 miles, and requiring for each station an engine of sixty horsepower. It has not yet been decided where the main office of the proposed company will be."

[Names of those interested in the enterprise may be obtained from the Bureau of Manufactures, Washington, D. C.]

TWO-MOTOR DRIVE—AUTOMATIC WEB-PRINTING-PRESS CONTROL.

BY S. H. SHARPSTEEN.

When the electric motor commenced to assume commercial shape the printing-press fraternity wanted electric drive. Standard motor parts, the result of years of the best electrical engineering development, were discarded and a poor special motor was demanded. Hand motor control for printing-press purposes was making good progress, when, to a great extent, the printer became interested in and purchased automatic control. Common business sense was the cause of discarding the special motor for one of standard manufacture, and possibly for the same reason much of the automatic electrical apparatus that is now found in the newspaper print shop will be discarded and more simple and durable devices used.

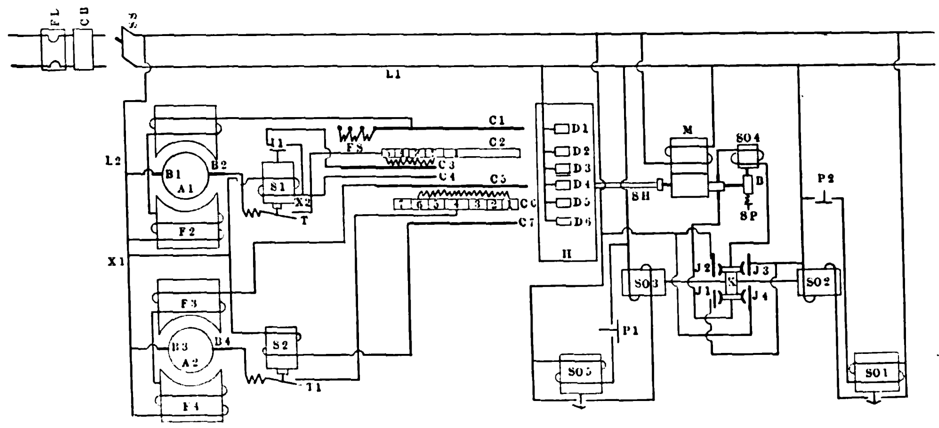
A newspaper web press is, as a rule, a large machine with very many parts. Adjusting, oiling, cleaning, repairing, plating, inking and threading in paper require men to work at its different parts at the same time. Because of the valuable space occupied in the business districts of large cities by these presses, the designing engineers are constantly decreasing the outside dimensions compared to the output of papers; the result is that pressmen have to do their work in close proximity to press parts that sometimes are still, other times moving slowly and often when the whole mass of moving gears and pinions is making a thundering noise and many tons of iron and steel shafts, drums and cylinders are revolving rapidly.

These conditions cause a demand for a means of stopping newspaper presses quickly from convenient places. Large sums of money have been expended for newspaper web-press control, but no device has been put into practical use for properly braking these machines. There are brakes that, when applied, retard the motion of the press, but they are used only in emergency on high-speed newspaper presses and are operated by a circuit of two small wires run around a press with push-buttons convenient for the men to use. This part of automatic or remote control is universally considered as good and proper.

The newspaper web-press builders and users are also of the opinion that automatic control from a number of convenient stations is proper for getting threading and plating speeds, a brake being used to stop the press as soon as a stop-button is pushed. Present methods of braking a web press automatically to stop it quickly are allowable when moving slowly for threading and similar work.

The newspaper man who is responsible for the lives of pressmen and the finances of a large paper—one who realizes the many tons of iron and steel that revolve at a terrific speed high up in the press-room and knows of instances when parts have come loose where certain presses were producing, these parts passing down between drums and cylinders—is inclined to place the production drive of his presses under the absolute control of a cool-headed person who has more than the ordinary mechanical ability.

When all-automatic control was first installed there was no objection to many buttons at each control station, but later, to dispense with costly complication of wiring and the trouble arising from pushing the wrong button when there were too many to select from, the number of buttons was reduced.



TWO-MOTOR DRIVE—AUTOMATIC WEB-PRINTING-PRESS CONTROL.

Certain recent installations have so few buttons at each station that large solenoid windings are closed when the main press switch is put in, thus reducing the cost of installation and the number of buttons at each station, but causing excessive use of current.

In newspaper electric drive and control each station usually contains at least four buttons or switches: one for speed ahead, one for slowing down or stop, one for emergency stop and brake and one for what is commonly called locking the press.

The diagram herewith illustrates two-motor drive with automatic control, A_1 being the armature of the larger motor, its circuit being opened and closed by a contactor, S_1. A_2 is the armature of the smaller motor, its circuit being opened and closed by a contactor S_2.

The movable part of the controller H is moved back and forth on guides by a motor, M, instead of swinging on a stud like the hand controller.

The motor M is shunt wound to produce as nearly as possible a constant speed as soon as its armature circuit is closed when running either way, its field being constantly excited when the main switch SS is in. The motor rotation is changed by reversing its armature current at the switch K, the solenoids SO_2 and SO_3 operating this switch. Assume that push-button P_2 causes the motor M to move the brush carrier H in the forward direction to start the large motor ahead. This button or switch can close a circuit to pass current around solenoid SO_2 or, since it might take more current to operate SO_2 than it would be advisable to carry about the press, the button P_1 could close the coil circuit of a solenoid switch, SO_1, this switch in turn closing the coil circuit of SO_2. When ready to start, pushing button P_2 would cause SO_1 and SO_2 to act as mentioned to force K against J_3 and J_4, passing current to release the solenoid brake SO_4 and turn the armature of M, which by means of the screw SH passes the controller brush carrier H to the left, first exciting the fields of the motors as brush D_1 touches C_1 and brush D_4 touches C_5. D_5 passing on to C_6 closes the armature circuit A_2 in the controller just before D_6 touches C_7, passing current through the coil of contactor S_2 and causing it to complete a circuit through the auxiliary armature A_2 and turn the press and large motor slowly. If a threading speed should be desired the button P_2 would be held down until D_5 reached point 4 on dial C_6, when the starting resistance would be out of circuit with armature A_2 and then released, opening the coil of SO_1, which would, in turn, open the coil of SO_2, releasing and allowing a spring to move switch K to neutral position, thus not allowing current to pass through the armature of motor M and brake solenoid SO_4, dispensing with the power that moved the carrier H and applying a brake to the shaft SH at B, causing it to come to rest immediately.

After threading in paper, and production speed is required, P_2 is again held down, causing the motor M to move the carrier slowly to the left and when D_2 passes on to point 2 of dial C_2 the large motor armature circuit will be completed in the controller ready for the solenoid switch S_1 to pass current through the armature of the main drive when D_3 touches C_3 and C_4 making the final closing in the circuit of armature A_1 at T. For a short time both motors will be furnishing power to drive the press, but there being the proper amount of resistance in circuit with the large armature it will not increase the speed of the press too much at this point, and since the small armature is running in full field it soon ceases to increase in speed as the large motor takes the load. As the carrier H continues to move, resistance is cut out of circuit with the large armature, A_1, and in circuit with the small one, A_2, until D_6 leaves dial C_7, making contactor S_2 open, when the small motor comes to rest. The armature A is connected to the equipment by a ratchet device that permits it to drive but not to be driven. When the desired speed is reached P_2 is permitted to open, allowing carrier H to stand until some change in the press movement is demanded.

If it be desired to diminish the speed of the press, holding down push-button P_1 will cause automatic switch SO_5 to close a circuit and pass current through the coil of solenoid SO_3 forcing the switch K against J_1 and J_2, releasing the brake SO_4, and turning the armature in motor M in the reverse direction, pulling the brush carrier to the right.

When D_4 reaches C_5 the field of the small motor will be excited; later D_5 will touch point 7, dial C_6, and close its armature in the controller, and current will be passed to start this auxiliary machine when D_6 passes on to C_7 causing the contactor S_2 to close at T_1.

When D_5 reaches point 4, dial C_6, the small motor takes the load and all current is cut off from the large motor except, possibly, its fields.

Controller brush D_3 might be adjustable to allow moving to the right or left in the carrier H, permitting the contactor coil circuit S_1 to be excited to pass current at the proper time to close the circuit of armature A_1. For the same reason it would be convenient to have D_6 adjustable.

Point 4, dial C_6, should be long enough to allow the press to be brought to threading speed easily without starting the large motor.

Without a brake to stop the shaft SH when the buttons P_1 or P_2 are released, the momentum of the armature of motor M would possibly carry H beyond the desired point. Motor M being of small capacity the armature could be constructed to start on line voltage. The spring SP applies the brake, the solenoid SO_4 releasing it.

The coil circuit that operates contactor S_1 is connected with one side of the line L_2 at X_1, passes through S_1 and when brush D_3 rests on C_4 is also connected with the other line L_1 through C_4 and D_3. After D_3 touches C_4 and lifts the plunger in S_1, the coil in S_1 has a second branch circuit to D_3 commencing at X_2, passing through I_1 reaching D_3 through the strip C_3. As the brush holder H moves on to the left, D_3 leaves C_4 and opens the coil winding of S_1 that made it pick up the contactor lever and close the armature circuit of the large motor at T, but the exciting circuit of S_1 is kept closed by its auxiliary circuit. If the line current should be interrupted while the press is running for production the movable core in S_1 falls, opening the auxiliary circuit at I_1, the main circuit of S_1 passing through C_4, also being open in the controller; when the current comes on the line the motor armature circuit is open at T and can not be closed until H is returned to let D_3 touch C_4, when the small motor would have the press started and armature resistance would again be in circuit to prevent the large motor from producing too much torque.

Contactors are special devices for opening and closing motor circuits. They are made to rub hard to keep clean at point of contact and a magnetic flux forces out what might cause a burning arc. The controller brush carrier moves the brush slowly, giving an arc time to form and burn. The contactor opens and closes circuits quickly. As the contactor S_2 closes the small motor armature circuit during the reverse motion of H it can not have the usual auxiliary circuit, but since it only moves the press slowly and is of so small capacity, it could do a press no harm by producing extra torque if it were provided with the proper overload release device. The advisability of using a contactor to protect the small motor parts from burning is a question. It should at least have a circuit breaker, which would be the cheaper, saving complication in the brush carrier H.

If a contactor is used it should be supplemented with a fuse and an automatic overload device in the armature circuit of the small motor alone.

As the field-exciting current of the large motor has ample time to come up to full strength while the small motor is starting the equipment, it would seem that good practice would have it opened when the equipment was at rest, even though the service switch be closed. It will make the control a little more expensive but will save current and keep up the efficiency.

The field discharge of a large motor is severe on the insulation, but equipments can be constructed to stand it even though a special discharge path be necessary. Presses are sometimes at rest for hours with the service switch closed, and the current passing through the field coils of the motors is not only wasted but tends to keep up the temperature of the motors and the surrounding space. This heat is bad for the presses in hot weather.

As the auxiliary motor does not have to be reversed, and is of a size that is quickly excited, economy demands that its fields be opened while the press is at rest and the switch closed and also while running for production, thus increasing the efficiency and keeping down the heat.

The contact brushes in the controlling devices and the points in the dials of printing-press control, even though they be the best, sooner or later require adjustment or repairs. The designing engineers of such apparatus have planned these parts so that they are difficult to remove and inspect. If an arm is used, as in manual control, the lift of the springs holding down the brushes causes a strain on the stud around which the arm moves. With automatic control if the brush is worked by gravity or solenoid and the contact pieces get slightly roughened, as often occurs, the brush refuses to move until overhauled. The controller brush carrier illustrated can be constructed to be held in line to prevent the brushes from rocking as the carrier moves. It will be easy to lift out for the inspection of the faces of the brushes, cleaning of the brush holders and to be replaced by an extra carrier if so desired.

The motor M should be designed to allow a large range of speed variation by field change. This arrangement will permit H to be driven to suit the press.

Provision should be made to have the

brush carrier H open the circuit of SO_2 at the extreme travel in one direction and SO_3 at the extreme travel in the other direction to prevent the motor M doing damage if a push-button refuses to operate or is held down too long by an employé. A flexible coupling between the shaft of motor M and screw SH designed to automatically disconnect these revolving parts in case of emergency is also good practice.

Controller brushes conducting the current from the movable controller parts to the dials or metal strips and blocks on controller faces or in automatic controlling devices do not always get the proper consideration. The right carbon or composition controller brush will not cut hard-drawn copper when moving with controller speed and proper brush tension. The brush, instead, gives the copper a smooth finish. It seems reasonable to say that only the best hard copper should be used for this purpose with provision for sufficient brush surface to guard against burn or arc oxidation even though several times the maximum running current might pass. A very large brush capacity compared to the current to be carried might be provided and still have the parts roughened and burned. The brush should be in two pieces at least, each piece provided with a spring, each spring having its own adjustment.

If the brushes are carried or moved by a holder, in which they are supported to feed down as they wear, this holder should be made of hard metal nicely trued and polished inside. The brushes should be accurately fitted to prevent jamming or binding and not loose enough to allow dirt to get between them and the holder. The deeper the holder the less liable the brush will be to tip and touch in a small spot only as it is reversed in motion. If the holder tipped back and forth at the ends of travel the brushes would tend to wear like rockers and present but a small surface to the dial. Pigtail brushes or a brush with a copper cable to be screwed fast to the brush rigging would be good, especially for armature circuits.

Armature resistance dial blocks, when packed solid with mica like a commutator, should have as good construction as a commutator, as they usually get hot from the heat conducted from the grids and if this change in temperature loosens the parts sparking and burning may follow.

If a newspaper web-press controller is what the electrical manufacturer can furnish, and the print shop should have, it will require no grease or vaseline between controller brushes and dials. Old-time controlling devices with copper traveling on copper usually require something to prevent cutting. When weight and space are very important, as in street railway work, this might do, but not in a first-class web-press equipment.

Since there are, in most cases with web-press electric drive, coils always in circuit when the main switch is closed, a switch should be provided with a means of operation that will induce the pressmen to keep it open when the press is at rest. If a good automatic switch, large enough to carry current for the equipment is installed, and its make and break controlled by a series circuit running around the press, and this circuit provided with a push-button switch at each control station, it would be an easy matter for the employé to open the line when the press is standing. Opening the coil circuit of this main switch by means of the small push-button switches at the different stations would answer for a lock, the station switches being in series, and an employé would be assured that the press could not be started if the lock was on at the station near where he was working.

If it were found advisable to place a small circuit-controlling device on the controlling panel to close and open the coil of the main solenoid switch, this smaller automatic switch could have its winding connected into a series circuit for press stations instead of that of the larger switch. The automatic switch and its auxiliary if placed in a cabinet with a glass front and locked up could not be operated by hand when the usual lock was on and some person working in the press. This main automatic switch could be designed to close a brake circuit when the line current was cut off the press equipment. The brake could be applied for emergency by the same buttons that were used for lock. If it were deemed advisable to have a separate button for an emergency brake to save confusion, the customary red push could be placed in the series-lock circuit that would answer for a quick shut-down. A first-class, double-pole circuit-breaker CB is the most reliable device to prevent a destructive inrush of current in case of a metallic cross.

A breaker having a push-button release could be installed and arranged to close a dynamic or other break circuit instead of using the automatic switch for breaking purposes. An equipment with automatic main switch used for lock purposes and a circuit-breaker with a red button circuit both as above described would have three ways of bringing the equipment to rest: First, by the slow-down button which would take time to allow the brush carrier to come to off position; second, the lock button that would cut off the main current and allow the press to slow down without brake—this should be quicker than the first method of stopping; third, the red button to trip the circuit-breaker and apply the brake.

Some designers of motor-control apparatus might advise putting overload relays in circuit with contactor S_1 and armature A_1, also contactor S_2 and armature A_2, in place of using a circuit-breaker. The contactors could be furnished with brake-operating devices and the contactor coils controlled by push-buttons, thus providing emergency stop.

If both sides of the circuit were conducted into the brush carrier H, two sets of brushes and contact pieces would be necessary for this purpose. A cable or cables made up of very fine strands would answer but would not be as neat in appearance as the brushes and contact strips.

The motor that is used to drive a web press for production should be constructed to have speed control by field change sufficient to allow line voltage at the armature brushes at all producing speeds.

The resistance FS at the left end of dial C_1 will be inserted in the field circuit of the large motor after brush D_1 passes from the long strip in dial C_1 causing the motor to increase in speed.

Central Electric Railway Association.

The first bimonthly meeting for the fall of 1908 of the Central Electric Railway Association, of Indiana and Ohio, will be held at Indianapolis, Ind., September 24. Headquarters will be established at the Claypool Hotel. The following papers are announced: "Recent Developments of Lightning Arresters," by David B. Rushmore, engineer, power and mining department, General Electric Company, Schenectady, N. Y.; "The Benefits of the Index Bureau," by Ellis C. Carpenter, general claim adjuster, Indiana Union Traction Company, Anderson, Ind.; "Electric Railway Return Circuit," by E. G. Hindert, chief engineer of power, Cleveland, Southwestern & Columbus Railway, Elyria, Ohio. A paper will also be read by G. H. Kelsay, superintendent of power, Indiana Union Traction Company, Anderson, Ind.

Entertainment will be furnished by the Glee Club of the Indiana Union Traction Company.

THE TEST-METER METHOD OF TESTING SERVICE METERS—V.

(Concluded.)

BY JOSEPH B. BAKER.

A COMMERCIAL TEST METER OF THE "PORTABLE STANDARD" TYPE: THE WESTINGHOUSE PORTABLE STANDARD INTEGRATING WATTMETER.

In general appearance the Westinghouse portable standard integrating wattmeter (Figs. 16 and 17) is not unlike the other forms of commercial test meter that have been described. In the preceding articles it is contained in a polished-wood carrying case with strap and removable cover; it has a large dial, readable from a distance, and a plug switch for changing its capacity to adapt it to the testing of various capacities of service meters; it is started and stopped electrically, so that the use of a stop watch is eliminated; and the testing procedure with it is substantially the same. In fact, except for certain details of construction, to be described, the general description of commercial test meters of the Mowbray type, above, applies (roughly speaking) to this make of test meter.

The theory of its design, however, is entirely different in that this test meter is essentially a *portable standard* meter of adjustable capacity, *i. e.*, an instrument that may be transformed into a test meter of full-load capacity equal to that of the service meter under test, and is not a test meter having a "composite field" winding for giving it a high torque on light load as well as full load of the meter under test.

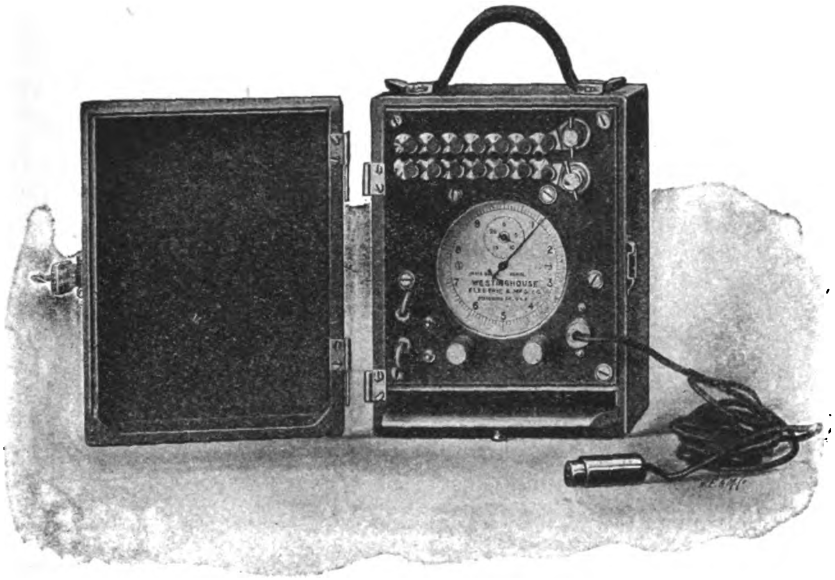


FIG. 16.—WESTINGHOUSE PORTABLE STANDARD INTEGRATING WATTMETER.

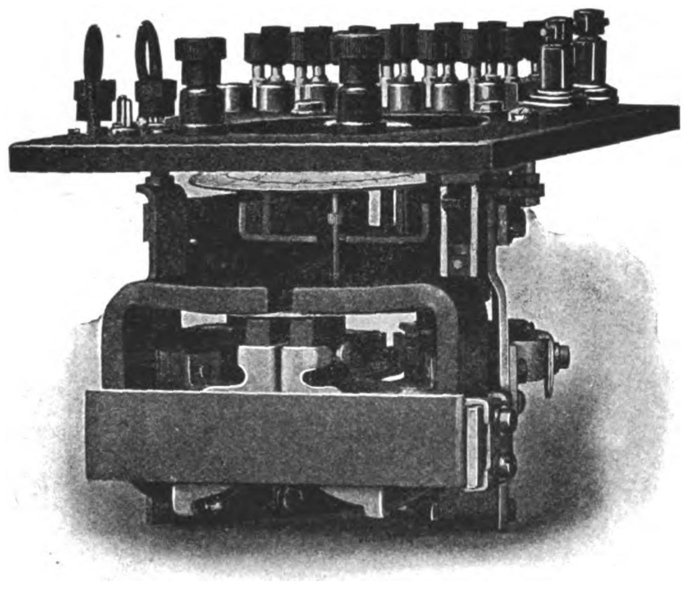


FIG. 17.—INTERIOR VIEW OF WESTINGHOUSE PORTABLE STANDARD INTEGRATING WATTMETER.

In this respect the Westinghouse test meter returns to the original practice of using a portable standard for testing service meters, with the important difference that a single instrument suffices to test service meters of widely varying capacities. Installed meters may run in something like the following distribution in a given central station system: fifty per cent in meters of five-ampere capacity and under; twenty-five per cent in ten-ampere meters, and twenty-five per cent scattering among twenty-ampere, forty-ampere and eighty-ampere capacities.

It is of advantage to have the rotating standard synchronous with the meter under test to save time and risk of personal error. With a test meter having high accuracy on light load (such as is claimed for the Westinghouse induction meters by reason of the ball jewel and light rotating element) this advantage can be attained. Another advantage is that for testing a given service meter the test meter may be connected up to constitute a meter of same capacity as the service meter, which insures comparing the service meter and test meter (which, it may be remarked in passing, should be of the same make), at the same points on their characteristic curve.

The simplicity in testing attained by the use of a test meter synchronous with the service meter under test may be illustrated by the following example: If the service meter (of Westinghouse type, making twenty-five revolutions per minute at full load) makes ten revolutions in a given time, while the test meter makes 10.5 revolutions, the ratio would be 95 +, showing that the service meter is 5 — per cent slow. When the service meter has a different full-load speed than the test meter, an appropriate multiplier must be used. Every Westinghouse portable standard integrating wattmeter is provided with a table to facilitate the testing of service meters in which the full-load speed is other than the standard speed of twenty-five revolutions per minute for Westinghouse meters.

Conditions may arise such that a meter, though accurately calibrated, will be in error several per cent. Then assume that in a certain meter the load error at forty per cent of full load is + 1.0 per cent; that an increase of frequency of ten per cent above normal (from sixty to sixty-six cycles) results in an error of + 1.0 per cent, and that ten per cent lowering of voltage from normal results in an error of + 1.0 per cent. The result is from these coincidal service conditions a total error of + 3.0 per cent in the meter.

The Westinghouse portable standard integrating wattmeter (see Figs. 16 and 17), manufactured by the Westinghouse Electric and Manufacturing Company, is designed for testing 100 and 200-volt alternating-current meters of a wide range of capacity by operating at normal load on five, ten, twenty and forty amperes (full-load speed with 500, 1,000, 2,000, 4,000 and 8,000 watts) by the use of a composite current coil or series field. This wide range means that the portable standard can test, with equal accuracy, a three-ampere, 100-volt or 200-volt meter on light load, and a sixty-ampere, 100-volt or 200-volt meter on full load. It is made available for testing service meters of other capacities by the use of a Westinghouse portable meter transformer, with the secondary connected to the five-ampere current winding. The main pointer revolves twenty-five times per minute under full load and the full-load torque is eight to nine centimetre-grammes. The meter proper, minus the register, is identical with the standard Type B Westinghouse alternating-current service meter, and the calibrating adjustments are therefore the same as in that meter.

A general view of this test meter, standing on one end with its casing removed, is given in Fig. 17. The test meter is operated, however, in a horizontal position (test-meter shaft vertical) like other makes. It is contained in a seven-and-one-half by eight by nine-and-one-half-inch carrying case. The register differs markedly from those of other makes of test meter, as it contains only two dials, having a ratio of 25 to 1 instead of 10 to 1. The main dial, of a good size relatively to the size of the test-meter top, is divided into hundredths and swept by a pointer fixed on the end of the shaft, as usual; but the smaller dial, placed within the main dial, has a pointer which makes one complete revolution for every twenty-five revolutions of the main pointer. The shunt field is subdivided into two windings, which may be connected in series when the test meter is in use on 200-volt circuits, and in parallel for 100-volt circuits, by changing the position of receptacles attached to short cords —in the lower left-hand corner of the top plate, in the position of the test meter in Fig. 16. Instead of a "pendent" snap switch, for starting and stopping the test meter by closing and opening the potential circuit, a push button is employed.

The employment of a push button instead of a switch has the apparent advantages that it is easier with the former to "coax" the main pointer of the test meter into any desired position for beginning a test, and simpler to start and stop the test, by pressing and releasing the button with the thumb.

The push button is connected at the end of a long flexible cord, having a plug at the other end for insertion in a receptacle in the top plate of the test meter (in the lower right-hand corner in the view) to which the potential circuit of the latter is wired. A compartment is provided in the end of the case for stowing away the cord and push button when the test meter is not in use.

Below the register dials and at the left of the push-button plug is a pair of binding posts for the potential connection to the service mains. On the other side of the dials is a plug switch for making the appropriate connections of the "current coils" of the test meter, for obtaining a full load through the latter in testing service meters of various capacities. This test meter contains a single series field winding, made up of a number of sections which may be connected in series-parallel groups of different capacities by means of the plug switch.

The step-bearing of the Westinghouse portable standard integrating wattmeter is of the well-known ball-jewel type, with a one-sixteenth-inch polished-steel ball between a pair of cup-sapphire jewels. On account of the small mass and short-up-and-down "play" of the rotating element, it is considered unnecessary to provide any "lacking device" for this test meter.

As indicated in Fig. 17, the test meter is really double in construction, having two complete magnetic systems, each comprising a shunt and a series field, at right angles to each other.

Cable-Hauling on the New Manhattan Bridge.

The four huge cables that will support the new Manhattan Bridge, connecting the boroughs of Brooklyn and Manhattan, are now being hauled into place. Each cable will contain thirty-seven strands of 256 wires each, a total of 9,472 wires in each cable, which must be strung wire by wire. The enormous amount of work involved will be done by machinery driven by Crocker-Wheeler electric motors.

The stringing of the wires in each cable is accomplished by means of two traveling sheaves carried on opposite legs of an endless steel rope. Each sheave consists of a three-foot grooved wheel fastened to the hauling rope by means of wrought-iron brackets. The hauling rope is three-quarters-inch in diameter and runs above the position of the bridge cables on heavy rollers supported on uprights on the temporary footbridge. There are five of these hauling-rope supports on the centre span, two on each end span and one on each tower.

The hauling sheaves move back and forth across the bridge from anchorage to

THE HAULING SHEAVE IS ATTACHED BY WROUGHT-IRON LEGS TO A THREE-QUARTERS-INCH TRAVELING CABLE.

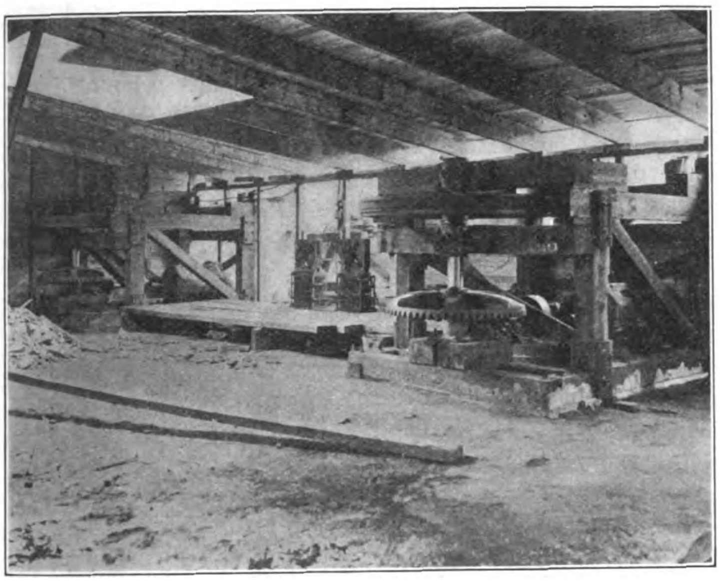
anchorage, a distance of 3,223 feet. They are attached one to each leg of the hauling rope so that they move in opposite directions, one crossing the bridge as the other returns.

The wire is delivered to the bridge on enormous reels or spools, weighing three

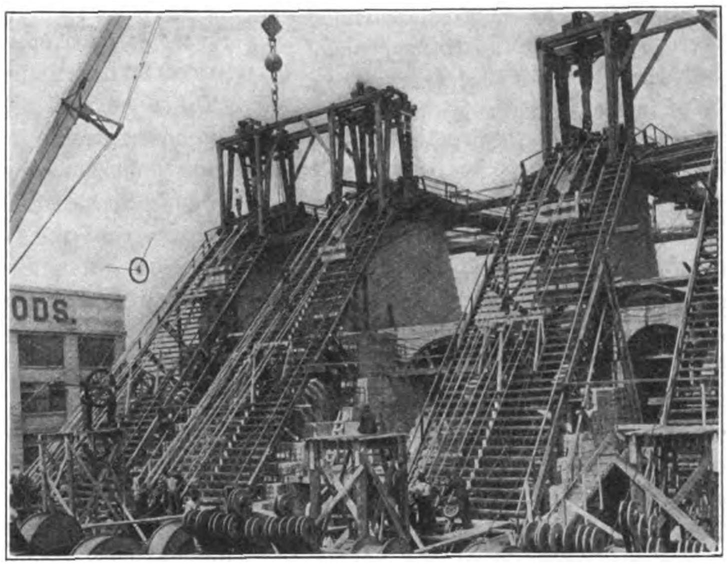
CABLE-HAULING ON THE NEW MANHATTAN BRIDGE. A VIEW FROM THE TOP OF THE ANCHORAGE.

tons each. Half of these reels are placed at each end of the bridge. The end of the wire from a reel at each end of the bridge is put over the hauling sheave at that end and fastened to the anchorage. The machinery is then started and the sheaves move across the bridge, unwinding one wire from each reel. Two wires are thus strung by each sheave every time it crosses the bridge. When the sheave reaches the opposite side of the bridge the bight of the wire is taken off and made fast to that anchorage, and a new wire hauled from that side on the return trip.

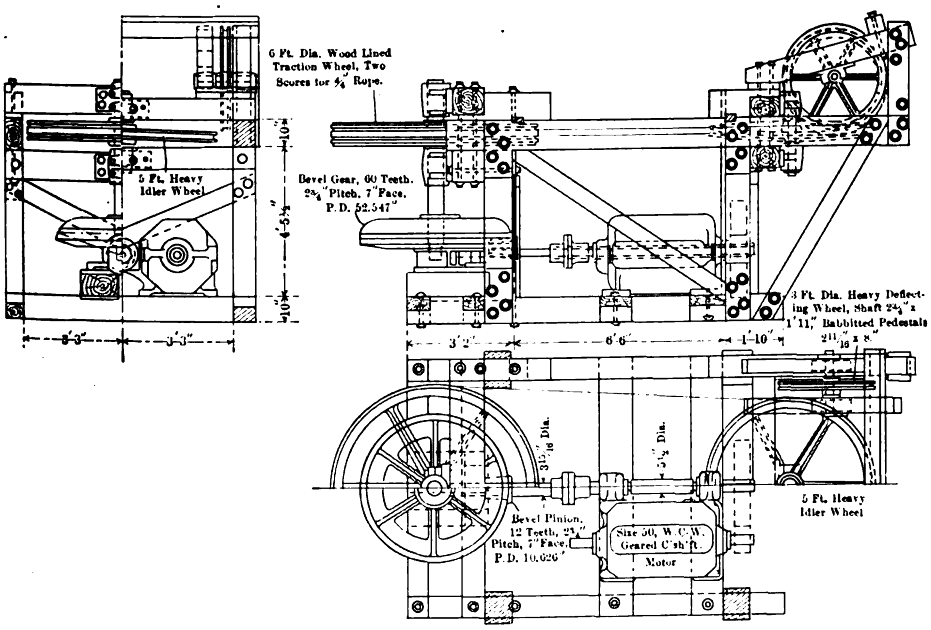
The wires are laid in temporary saddles of four grooved pulleys at each anchorage. As the hauling of each strand of 256 wires is completed the wires are bound together at intervals, and the strand is lifted from the temporary saddle by means of a chain hoist and laid in its proper place in the permanent saddle. Two strands of each cable are wound simultaneously by the two sheaves of each hauling rope.



MILL-TYPE MOTORS DRIVING THE CABLE-HAULING WHEELS THROUGH PINION AND BEVEL GEAR, AND CONTROLLING GEAR, ON THE NEW MANHATTAN BRIDGE.



CABLE HAULING ON THE NEW MANHATTAN BRIDGE BEHIND THE MASONRY CREST ON THE BROOKLYN SIDE. THE EYE BARS ARE A PART OF THE PERMANENT ANCHORAGE.



HAULING-ROPE OPERATING MACHINERY, CABLE CONSTRUCTION PLANT, NEW MANHATTAN BRIDGE.

There is a separate hauling mechanism for each of the four bridge cables, so that they are strung independently of each other. Delays are therefore not cumulative. The delays in one cable affect that cable alone, and the work proceeds on the others. This results in a very considerable saving of time.

Each hauling rope is driven by a fifty-horse-power, 220-volt, Crocker-Wheeler, Form W motor. This is the type of motor designed by the Crocker-Wheeler Company, of Ampere, N. J., for rolling-mill duty, and is well adapted to work of this kind, where sudden overloads and frequent starting and stopping are likely. The motors are fully enclosed and capable of withstanding all kinds of weather and rough handling. The driving mechanism is shown in the illustration. Each motor is geared to a countershaft at a ratio of 5 to 1, and the countershaft is bevel-geared to the driving shaft at a 5 to 1 ratio. On the driving shaft, above the gears, is a wood-lined, grooved, six-foot traction wheel, which drives the hauling rope. A five-foot idler wheel is also provided, so that the hauling rope passes the traction wheel twice to produce the necessary grip.

The hauling rope moves at a speed of approximately 480 feet per minute. It carries the sheaves across the river in about seven or eight minutes. Allowing for the time used in attaching wires at each end, about three trips are made per hour. It is estimated that at this rate the work of hauling will occupy four months, some time being consumed in fixing guide wires for each strand and in adjusting the wires after they are hauled.

The driving motors are all located on the anchorage at the Brooklyn end of the bridge. The reels of wire, as already stated, are stored at both ends of the bridge. The wire was delivered by John A. Roebling's Sons Company, the same people who delivered the wire for the old Brooklyn Bridge thirty years ago. The work of building the cables is being carried on by the Glyndon Contracting Company, of 2 Rector street, New York city.

The hauling equipment for this bridge differs from any previous attempt. It will be remembered that in hauling the cables for the Williamsburg Bridge two steam engines were used, connected to the same driving shaft. It later became necessary to cut this shaft and use the engines independently to avoid accumulation of delays. Even with that arrangement only two cables could be hauled simultaneously. The Glyndon company's plant has double the capacity, besides being electrically instead of steam driven, with the consequent ease of manipulation and control.

CORROSION OF IRON FROM THE ELECTROCHEMICAL STANDPOINT.[1]—II.

(Concluded.)

BY C. F. BURGESS.

ADDITIONAL EXPERIMENTS SHOWING CORRODIBILITY OF STRAINED IRON.

As bearing upon the question whether strained iron has a greater tendency to corrode than the unstrained metal, the following experimental observations may be of interest. These are abstracted from a compilation of results recently obtained by John Thickens, in the applied electrochemistry laboratory of the University of Wisconsin, and also from work carried on under a grant from the Carnegie Institution.

Test rods of mild steel were treated as follows: The rods, eight inches long and three-quarters inch in diameter, were turned down at the middle section for a length of three-eighths inch to a diameter of one-half inch. These were subjected to a stress in a testing machine until the elastic limit had been exceeded and the narrow portion had necked down to a diameter of about 0.4 inch. The entire bars were then turned down to uniform diameter, this being done under running cold water to prevent heating. Bars three inches long were cut from the central portion of the longer bars, and including the strained portion. Some of these bars were subjected to corrosion by suspension in dilute hydrochloric acid solutions, and others by making them the anode in neutral solutions of ammonium chloride and causing current to flow under low current density. In all cases a marked difference was noted in the rate at which the strained portions corroded as compared with the unstrained, and although the sample looked absolutely uniform before corrosion the decrease in diameter of the strained portion after corrosion is marked.

Differences of potential of from five to nine millivolts were noted between two electrodes, one of which constituted the strained portion and one the unstrained.

Another set of samples were strained beyond the elastic limit by torsion. The original bars were three inches by one inch by one inch; they were turned down for a length of one inch at the centre to a diameter of five-eighths inch, the ends being left square. They were subjected to a torsion through 180 degrees, after which the entire length was turned down to a uniform diameter, the specimen in this condition having a uniform appearance on the entire surface. Three grades of iron were employed and are designated by the terms wrought iron, mild steel and electrolytic iron. The last one was prepared from electrolytic iron which had been melted and forged.

These were subjected to corrosion by suspension in dilute acids, as well as by making them the anode in neutral solutions and corroding electrolytically, using a low current density. In all cases a greater corrodibility of the strained metal was noted, as shown by the reduction in diameter, as well as by the general appearance of the corroded surfaces. The greatest difference was noted in the mild steel; it was less marked in the wrought iron and least with the electrolytic iron.

The more rapid electrolytic corrosion of the strained portion appears to be due to the fact that the strained metal is electropositive to the unstrained, the current finding the easier path through the surface of the electropositive metal. Another phenomenon which points to the fact that the strained metal is the more electropositive is noted in immersing the machined test samples in dilute hydrochloric acid. There is a liberation of hydrogen bubbles on the unstrained portion. This is not a temporary condition, but it persists, and indicates that there is electrolytic action, the strained portion serving as the anode and the unstrained as the cathode. It was noted that the purer the iron the less pronounced are the phenomena, and in the case of the electrolytic iron the corrosion as well as the distribution of the evolved hydrogen bubbles were nearly uniform.

The effect of annealing a previously strained bar was noted by heating a machined bar embedded in iron filings to a temperature of 900 degrees Fahrenheit for five hours. The difference in corrodibility between the strained and unstrained portions was then shown to have been completely eliminated by this treatment. In the dilute acid solutions the distribution of the hydrogen bubbles was uniform.

An instance where the increased corrodibility of steel is a matter of practical importance is in the use of punched metal. It is a universal specification in boiler construction that the rivet holes shall be drilled and not made by the cheaper method of punching. The reason for this is that the former method gives better results as far as durability and freedom from corrosion are concerned. In addition to the liability of cracking or otherwise mechanically damaging the metal surrounding the punched hole, it has been found that rivets inserted in punched holes tend to become loose and leaky.

In the process of punching, straining both by compression and tension is produced, the punched disc being compressed and the walls of the hole and the disc having been subjected to tension or shearing. According to those who hold that unstrained metal is more subject to corrosion than the strained, the corrosion around a punched rivet hole will proceed some distance away from the hole; on the other hand, if it is true that the strained portion is electropositive to the unstrained, then the metal nearest the hole should corrode the more rapidly. This is a matter which is capable of settlement by experimental demonstration, and the following experiments were carried out with this object in view:

Some steel plates three-quarters inch thick were punched cold, the punchings having a diameter of one inch. The punched plates were subjected to corrosion, both electrolytic and by dilute acids. It was noted that the corrosion was most rapid on the sides of the hole and in the immediate vicinity.

Some of the punchings were attached to wires and suspended in various corroding solutions. The suspension wires and the point of contact with the iron pieces were protected from the solution by paraffine. It was shown that the sides of the cylinders had a far greater rate of corrosion than had the circular surfaces.

One of the punchings, and a piece of similar size cut from the original steel plate, were suspended as electrodes in a one-quarter normal HCl solution and connected to a mil-ammeter. The current was constant at about one-half mil-ampere for several days, the punching being the anode, and corroding the more rapidly. Similar results were obtained by immersing in a normal KCl solution, the current remaining constant at 0.75 mil-ampere. In both solutions it was noted that on first immersion the current was much higher than the constant value subsequently maintained, this decrease being due to polarization as manifested by an accumulation of hydrogen on the unstrained cathode.

Upon momentarily lifting the two electrodes into contact with the air, and again immersing, the flow of current greatly increased. By blowing air through the solution a similar result was attained, and by adding a very small quantity of sodium

[1] From the presidential address before the American Electrochemical Society, Albany, N. Y., April 30.

peroxide the current quickly rose from 0.75 mil-ampere to over thirty mil-amperes. The effect of oxygen in all of these cases was apparently due to its depolarizing action on the cathode, which allowed more current to flow, and which consequently increased the corrosion of the strained-metal anode. This appears to be in confirmation of the important discovery made by W. H. Walker that oxygen causes oxidation, not by uniting with the iron, but by depolarizing, and allowing other corrosive agents to become active.

The experiments which have just been described are qualitative rather than quantitative, but show in an apparently conclusive manner that strained metal does have a greater solution tension than the unstrained. The results are of technical as well as of scientific interest, and the effects are so pronounced that it appears obvious that our available methods of measuring the differences of potential between strained and unstrained iron when properly applied should yield accurate quantitative data. Further quantitative measurements appear to be desired.

INFLUENCE OF INEQUALITIES OF TEMPERATURE UPON THE CORROSION OF IRON.

As bearing upon the influence of temperature upon the corrodibility of iron, there are presented here the results of some work carried on by S. G. Engle and the writer. These results are more fully described in a thesis by S. G. Engle entitled "The Influence of Inequalities of Temperature Upon the Corrosion of Iron." This investigation was originally taken up in connection with the study of certain peculiar corrosion phenomena which are commonly found in locomotive boilers.

To one familiar with the corrosion produced by stray currents in underground pipes, the pitting and grooving of boiler tubes have the appearance of being electrolytic action. A place where corrosion is particularly noticeable in locomotive boilers is just inside the end shells where the tube is expanded. At one end of the boiler a copper shim is placed between the tube and the end plate, the purpose being to utilize the ductility of the copper in making a tight joint. At the other end the tube is expanded directly to fill the hole in the end plate. If copper shims were used at both ends of the tubes a logical explanation of the fact that tubes corrode in the immediate neighborhood would be that a voltaic couple is set up between the copper and the iron. It appears, however, that the corrosion is just as marked at the end where copper is not used, and other explanation must, therefore, prevail. The one most commonly accepted is that the iron tube on being expanded is thereby strained and this strained metal corrodes more rapidly than does the neighboring unstrained metal. There is not enough data to absolutely fix this point.

There is also an irregular pitting in the tubes, the rapidity of the action depending upon the care taken of the boiler, upon the kind of feed water used and perhaps upon other factors. Among the results of this kind of corrosion are the frequent puncture of the tubes, the extinguishing of the fire, the stalling of trains between stations, and the retirement from commission of valuable machinery. The pitting may be somewhat general in distribution, but usually there are a few deep pits with the surrounding metal apparently intact. It is a matter of general observation that the pitting is more marked on the tubes nearer the shell of the boiler, rather than on those farther toward the interior—in fact, the interior tubes may last as long as several sets of tubes renewed on the lower row. This is explained commonly by the supposition that the circulation of water, also the introduction of fresh feed water, are such as to emphasize corrosive action.

The object of the investigation previously referred to was to determine if possible whether the equivalent of galvanic cells is established in locomotive boilers, due to inequalities of temperature in the different portions. The most highly heated metal in the boiler is the tubes which are exposed to the hottest products of combustion. The lower tiers of heated tubes are probably subjected to this heat. The direction of the flow of heat is from the interior of these tubes to the water, which in turn is in contact with the cooler shell of the boiler. If the boiler tube is, by being hotter, rendered more electropositive than the boiler shell, we would expect a galvanic action resulting in the corrosion of the tube. We would expect the corrosion to be at such places as the current finds the most ready path between the anode and the cathode. The shortest path between the hot anode and the cooler cathode would be between the lower and the side tubes, and the interior of the boiler shell.

An interesting peculiarity in the electrical heating is shown in the decrease of potential which is first produced by the heating and the subsequent rise after the minimum point has been reached. This minimum was not observed in the test where the external heat was applied.

It was desired to carry the temperatures of the iron surface beyond that which was possible by the former methods of heating, and this was accomplished by bending a soft iron wire into a "U" shape, immersing it in the water and heating it by the passage of an alternating current through it. Voltage readings were taken between this electrode and another one of the same material which was not heated by the passage of the current. It was found that there were certain irregularities in the measurements, due to the fact that the wire dipped down through the surface of the electrolyte. This was remedied by passing the wires out through the bottom of the vessel which contained an asbestos stopper. Water taken from the locomotive boiler was again used as the electrolyte. It was found that the heated wire first became more electropositive, then became steadily negative as the heating progressed, until the wire became fused. This tendency for the heated wire to become negative in this case is ascribed to the fact that the wire became hot enough to oxidize when in contact with the water, coating itself with the more electronegative iron oxide.

The experiments thus far indicate decided tendency for a heated surface to become electropositive, as compared with the cooler piece of metal in the same solution. This is a condition which may exist in locomotive and other boilers, although direct conclusions could not be drawn from these experiments without recognizing the fact that these were carried out under atmospheric conditions, while the water in a boiler is usually under high pressure.

If conclusions might be drawn from these data they would be to the effect that the presence of oxygen has a greater influence than has the presence of carbon dioxide in promoting the corrosive action. To compare the corrosive action in the solution as used in the last test to the same solution freed from carbon dioxide, this gas was expelled. Run was made on this same solution by applying heat and raising the pressure to a hundred pounds. This showed apparently that the carbon dioxide has practically no influence on the corrosion current.

The effects of the addition of various other dissolved substances were observed; thus treating lake water with one gramme of soda ash per five gallons of water, a method commonly employed for treating boiler-feed water, gave potentials in the opposite direction, the heated tube being the cathode. This same result was found in a more pronounced way by increasing the percentage of soda ash. However, with a solution obtained from a locomotive boiler which had been treated with soda ash and in which the soda ash had been concentrated by repeated evaporation, the inner tube became the anode. The heated tube was likewise found to be the anode when using one gramme of magnesium sulphate or magnesium chloride per gallon.

It was always noted that no matter what electrolyte was used, the current gradually increased to a certain point and then decreased. It was also noted that in repeating tests without otherwise changing the solution, the successive results always gave lower values of current and pressures. In other words, a fresh solution always causes apparently a higher current and more corrosion than one which has been used. This would coincide with the general belief that it is the fresh feed water in boilers which has the greatest corrosive action. This fact, and the one that each curve shows the current to reach a maximum, after which it decreases, even if the heat be kept constant, require an explanation. Among the suggested explanations is the influence of the formation of a high resistance coating on either the anode or the cathode, formed from corrosion products, and a second factor might be the partial decomposition of the electrolyte or a decrease of such materials in the electrolyte as might promote corrosion. For example—the presence of oxygen acts as a depolarizer at the cathode, and facilitates the flow of current as long as there is any oxygen present. It is natural to expect, therefore, that as the oxygen in the boiler water is eliminated, either by escaping with the steam or uniting chemically with other materials, the polarization will increase, and consequently the measured voltage and current will decrease.

That both of these factors apply in part should undoubtedly be recognized. From the testing apparatus the tube was removed at frequent intervals and in all cases a coating of more or less adherent scum or incipient scale was observed. Upon removing this and again making the test an increased current was noted. An examination of the surface of the tube after various runs revealed the fact that the corrosion had not been uniform but was in the form of pits which could be readily distinguished by the naked eye.

W. H. Walker has given us his opinion that the presence of oxygen in a solution promotes corrosion by acting as a depolarizer and in this way allows a more ready passage of galvanic or corroding currents. His views can undoubtedly find confirmation in the study of boiler corrosion, for it has been repeatedly noted that water which has been thoroughly saturated with air and consequently with oxygen, is especially corrosive when used as feed water. In fact, some of the most injurious cases of corrosion can be found where distilled water is used, distilled water having been allowed to become saturated with oxygen from the air.

The question naturally arises, "Do the currents, as measured in the tests referred to, reach a sufficiently large value to indicate a serious amount of corrosion?" Various of the laboratory tests have shown current of 0.01 ampere. In twenty-four hours this is equivalent to a corrosion of one-quarter gramme of metal; and since this corrosion is not evenly distributed but is confined to a few localities, it is obvious that these laboratory experiments will give basis for the belief that pitting of locomotive boiler tubes is galvanic action, and that the galvanic action is sufficiently rapid to cause perforation of the tube in a few months, or weeks, or even days.

Chicago Telephone Company to Distribute Stock Dividend.

Announcement is made that the directors of the Chicago Telephone Company have decided to distribute a stock dividend of $4,500,000 among the shareholders, the amount to be deducted from the corporation's surplus and reserve accounts of $7,332,038. It has, as well, provided for the authorization of $15,000,000 five per cent first mortgage bonds, which are to be issued in the future for construction and extension purposes. The new stock will be issued October 10, in the ratio of one share of new stock for each five shares of present holdings.

In view of the stock dividend, which will increase the company's capitalization to $27,000,000, the next quarterly dividend, payable December 31, 1908, will be two per cent, instead of two and one-half per cent, as heretofore, and it is proposed to maintain the rate of eight per cent per annum thereafter. It has been decided to finance the company's construction wants for the time being through the sale of first mortgage five per cent bonds. The proposed mortgage of $15,000,000 will be on the property as it stands at this time.

LIGHTNING PROTECTION.[1]

BY E. E. F. CREIGHTON.

During the past three years—in fact, during the past five years—very extensive measurements, starting first in the laboratory and then finally carrying the methods to the line, have been made on the conditions of lightning existing on power circuits. During last summer the entire time was spent at the plant of the Animas Power and Water Company, in Colorado, where they have vicious storms practically every day during the season. The frequency of cloud lightning was measured, and was found to be in the neighborhood of about one million cycles per second. The frequency of the discharge from an idle line was also taken and found to be about 3,000 cycles.

Next, current was not measured but was indirectly calculated from other tests, and it was possible to predetermine just how many amperes of lightning current would flow for every volt on the line. Another interesting point was, What was the voltage induced on the line? We have made no tests on direct strokes of lightning, because it is so very difficult to get them; they occur infrequently, and when they do occur it is best to be out of the way. So the only tests we made were on the induced strokes, and we found potentials momentarily on the line as high as several hundred thousand volts—between 300,000 and 500,000 volts.

The next thing we measured was the quantity of electricity that was in the stroke. That, of course, varies with every cloud and with the relative position of the cloud and the line. The last thing we measured was the duration, and that is a most important thing to know. The ordinary lightning stroke will have a duration of about one one-hundredth of a second; but the trouble is not in the actual duration of the stroke, but in its recurrence. We found numerous cases where a stroke of lightning would come from the clouds and within a second there would be seven successive strokes which would extend over a complete circuit. That is the cause of some of the failures of the multi-gap arrester.

There are a great many causes of the high-potential surges on the line; most of these can be considered due to conditions. The first is the direct stroke of lightning. In the cities a direct stroke of lightning very seldom hits a line; it hits a tree or a building somewhere near, and

[1] Abstract of an address before the Ohio Electric Light Association, Put-in-Bay, Lake Erie, July 27.

there is an induced stroke on the line. Therefore there is no protection for direct strokes of lightning for this reason, that the lightning goes to ground within a very short distance, say within seven poles from where it strikes, and there is not one chance in a thousand that a lightning arrester would be situated at that point.

Then the next question is, whether the lightning arrester would take care of the discharge if it were at that point. It would not be economy to design a lightning arrester to do that, because one could not afford to pay for it. It would be so expensive that it would cost as much or more than the apparatus that it was protecting. The only protection that can be given against a direct stroke is to install an overhead ground wire and ground it frequently. Now that is quite unnecessary in the cities, because the same kind of protection exists in the telephone wires if they run above the power lines, and in the trees and buildings that often overhang the line.

The second kind of a lightning stroke is the induced lightning stroke which comes from the cloud being over the line and inducing a static charge on the line, and discharging at some point near the line. That is a problem that is quite easy to take care of and which is pretty well taken care of at the present time by the multi-gap arrester. The multi-gap arrester in its latest improvement has two or three paths to ground so that it can take care of lightning of a different quantity of electricity—different intensity. The only thing that this multi-gap arrester can not take care of is the multiple strokes just mentioned. Occasionally it will be found that the multi-gap arrester blows up and goes to pieces when lightning is induced on the line, and in most of the cases it has been found that this is due, not to the inefficiency of the arrester, but to the local condition of the circuit.

The third condition on the line, and it is the most important and the hardest one to take care of, will be due to an accidentally grounded phase; for example, the breaking of an insulator so that the arc can play from the line to the pin, or from the line to a green branch, or from the line over to the bushing of the transformer which is grounded. These are the three conditions usually met which are hardest to take care of. Every time that the arc jumps from the line to the insulator—and it does it every half cycle as a rule—there is a surge set upon the other phases of the system which will tend to make it discharge through the internal windings or bushing or insulator elsewhere. In so doing it will cause a short-circuit; of course, an interruptcd circuit. It is far better to interrupt it than to let it play, because of the damage which may occur internally in the transformer. In this case if there is a multi-gap arrester on the circuit and it is designed to take care of the discharge, it will discharge during the first break of the current, which is the half cycle of the discharge. It puts out the arc at the end of the half cycle, but again the potential goes in the opposite direction and starts the arc again, the surge is re-established on the circuit again and the multi-gap arrester discharges. Now the multi-gap arrester can not be designed to carry the current continuously at any commercial cost figure; consequently, under those conditions the multi-gap arrester must necessarily be destroyed. The only lightning arrester that can take care of that condition is the newly developed aluminum arrester.

The fourth condition likely to be met with is something that has come up quite recently and that seems to occur on motor circuits; for example, in a large building where a direct current is operating electric motors for elevators and other purposes. If the load in the building becomes so great that a fuse blows, then that circuit is disconnected from the main circuit, with the meter on the inside, and sometimes the motor fields discharge through the meter and raise the potential, and in that way destroy the meter. If there is a heavy current flowing through a motor and the circuit is suddenly broken, it amounts to exactly the same thing as an induction coil, and the voltage depends entirely on how quickly the circuit is broken. If the fuse breaks the circuit very quickly a very high rising potential results. The protection for that is a direct-current type aluminum arrester.

These then are the four kinds of lightning potentials or surges that usually have to be met: First, a direct stroke of lightning; second, an induced stroke from a cloud; third, an accidentally grounded phase, and the fourth is the inductive kick from a motor circuit through such an apparatus as a meter.

Just one word about the aluminum arrester and the principle that it works upon. There are two forms now that are out, one for alternating current and the other for direct current. The alternating-current arrester consists of a series of cells made up from inverted cones, one inside of the other and separated by fibre washers. Between each cone is poured in a certain amount of electrolyte, making it about half full; then the whole mass is immersed in a tank of oil, the oil having two qualities: first, that of insulating the parts that are not in the electrolyte, and, second, cooling off the surface so that the arrester may operate for a long time. The characteristics of the aluminum cell are the same as the characteristics of the arrester, the arrester being made up of multiple cells. With a 300-volt circuit there would be one cell; with any higher voltage than that the total voltage between the line and ground divided by 300 would give the number of cells that would be placed between the line and ground, or the line and neutral, according to the conditions. The characteristic of each cell is very similar to a storage battery on a direct-current system. The aluminum plate surface goes through a chemical process by which a film is formed of very great thinness. It gives the surface a slightly whitish appearance. This film bears much the same relation to the circuit as does the counter electromotive force in a storage battery floating on the line. With a single cell on a 300-volt direct-current circuit the leakage is reduced to a very small volume; the cell is connected directly to the circuit and left on the circuit. The leakage of current will be about 0.001 of an ampere, but for every volt of pressure-rise above 300 the cell will allow current to flow through it equal to the excess voltage divided by the resistance. Since the resistance is very low, about one-quarter ohm, this means about an ampere for every volt, the arrester acting in all respects as a safety valve on the system. At normal pressure there is practically no discharge, but for abnormal pressures the valve opens up (there are myriads of them on the surface of this aluminum plate), allowing the electricity to flow through. In a direct-current cell the ratio of the current between normal potential and double potential is about one million; in other words, the current increases from 0.001 ampere to 1,000 amperes. So far as can be seen in the study of lightning, this is sufficient to take care of any kind of a discharge that may come on a circuit.

In the alternating-current lightning arresters, made for voltages from 2,300 volts to 110,000 volts, a gap is placed in series in order to prevent the wearing of the plates by the constant action of the alternating current. The alternating current wears the plates very much more rapidly

Storage-Battery Regulation of a Sixty-Cycle Alternating Load.

During the recent reconstruction of the Madison avenue power-house of the Elmira Water, Light and Railroad Company, Elmira, N. Y., there was installed a Gould regulating battery system embodying several novel features.

This plant supplies all the electrical power for Elmira and vicinity, which, in addition to the incandescent and arc lighting, consists of direct-current railway, direct-current power, alternating-current power and high-tension alternating-current power to interurban and suburban railway substations. The power is generated at 2,200 volts, three-phase, sixty cycles (with the exception of some of the old equipment held as reserve only), and the problem presented was to regulate the various fluctuating loads so that they could be carried by the generators supplying the lighting circuits without rendering this service unsatisfactory or requiring the operating of additional capacity to carry the momentary peaks.

In order to obtain advantage of the staggering of the peaks on the various fluctuating load circuits, the entire fluctuating load was concentrated on an auxiliary bus, the direct-current load being supplied through rotary converters, and treated so far as the regulation control was concerned as an alternating-current load, as shown on fundamental diagram of connections (Fig. 1).

The battery installed consisted of 280 cells of the Gould Storage Battery Company's type S-615 in type S-623 lead-lined tanks, having a discharge capacity of 560 amperes for one hour (ultimate capacity when the tanks are filled of 880 amperes for one hour), and capable of delivering momentary discharges up to three times the one-hour rate (Fig. 2).

This battery in series with a 140-volt, 600-1,700-ampere booster driven by a 2,200-volt, three-phase, sixty-cycle induction motor, is connected across the direct-current railway buses, the same being supplied from the variable-load alternating-current bus by transformers, and a 750-kilowatt, 600-volt rotary converter. The field of this booster is automatically controlled by an exciter set. The operation of this set is identical with that commonly employed on direct-current regulating systems with the exception that an additional machine is added in order to remove the influence of any changes in the direct-current line voltage, and that the usual regulating field-winding is replaced by a fine-wire winding controlled by a Gould regulating converter. This converter, which is driven by a small synchronous motor (Fig. 3), is fed by a series transformer placed in the totalized variable-load connection, and delivers a direct-current output proportional to the true energy component of the current in the alternating circuit. An auxiliary series transformer with sectional secondary taps brought to a compensator head mounted on the switchboard is connected in the alternating-current leads of the regulating converter, thus providing means for changing the effective ratio of the series transformer and permitting the average load supplied to the variable-load bus to be changed at will. It will be seen that the action of this system corresponds exactly with that of the usual direct-current system, the series transformer, compensator and regulating converter taking the place of the shunts and adjusting switches of the direct-current system. Any increased

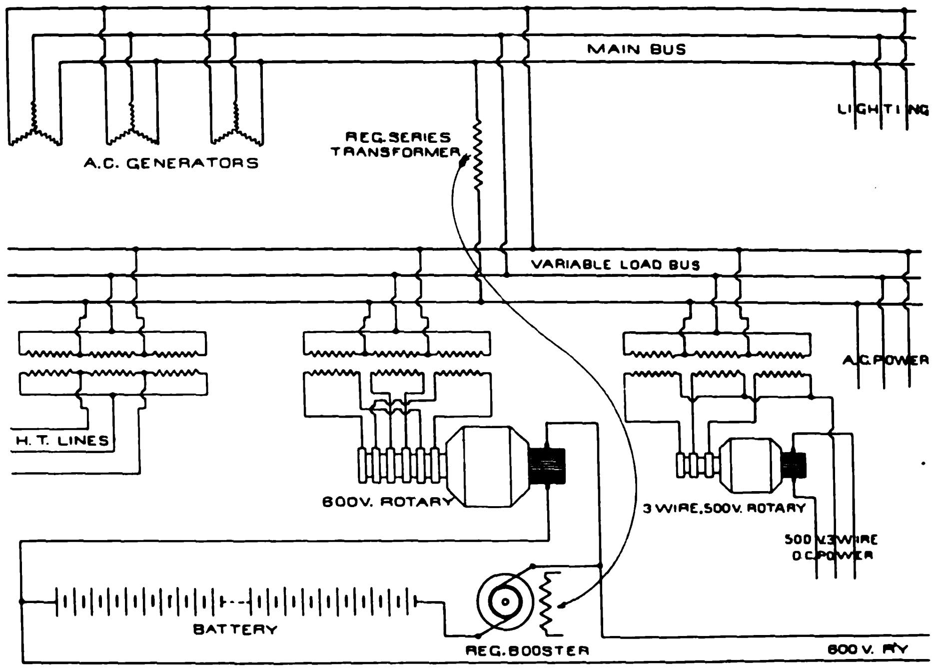


Fig. 1.—Diagram of Fundamental Connections, Elmira Water, Light and Railroad Company, Elmira, N. Y.

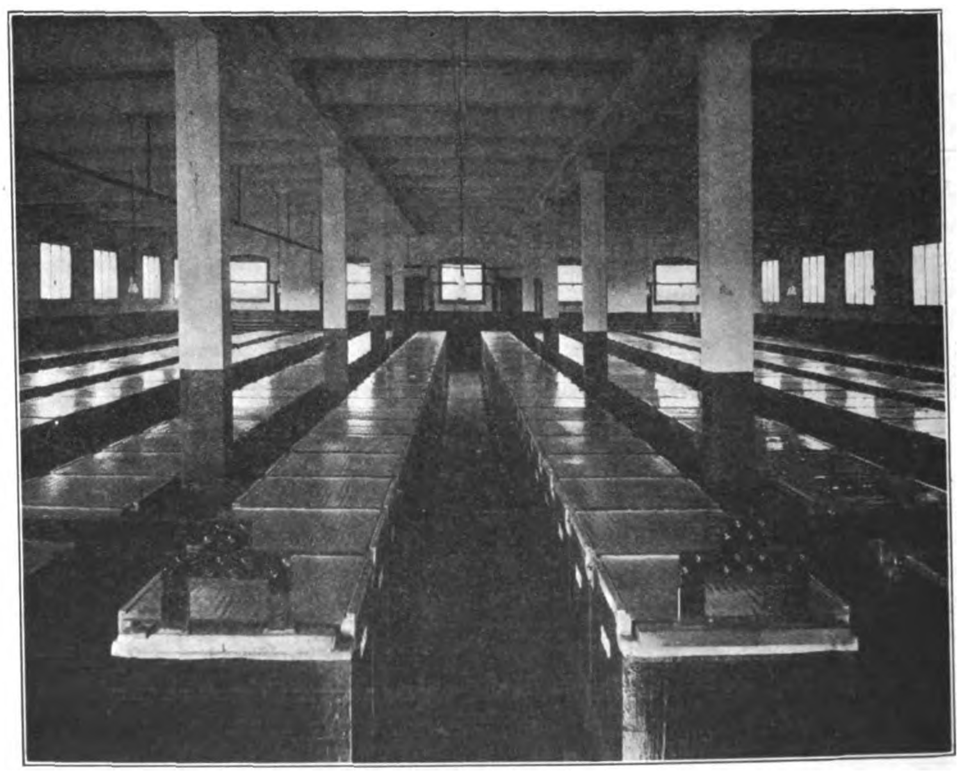


Fig. 2.—Battery Room of the Elmira Water, Light and Railroad Company, Elmira, N. Y.

demand for true energy on the variable-load bus causes an increased output from the series transformer in phase with the voltage wave, thus increasing the direct-current output from the regulating converter and causing the battery to discharge, or to charge when the demand on the bus falls below the average for which the adjustable transformer is set.

As long as the demand on the direct-current feeders is greater than the battery discharge, the action of the battery is to relieve the station of a portion of the direct-current load, the battery discharging directly to the direct-current feeders and reducing the load on the rotary. When the load conditions are such that the battery discharge is greater than the direct-current demand on the station, the battery first supplies the entire direct-current load and then inverts the surplus through the rotary and transformers to the 2,200-volt, three-phase bus. The ordinary peaks on the station do not require this actual inversion, the same only taking place at times of heavy peaks on the outgoing alternating-current feeders with a low average load on the variable-load bus, thus giving the alternating regulation with only an exceptional inversion and omitting the losses that would be incurred by a double transformation. The duty required of the rotary is approximately the same as operating without the battery, the peaks being slightly less with the battery in use.

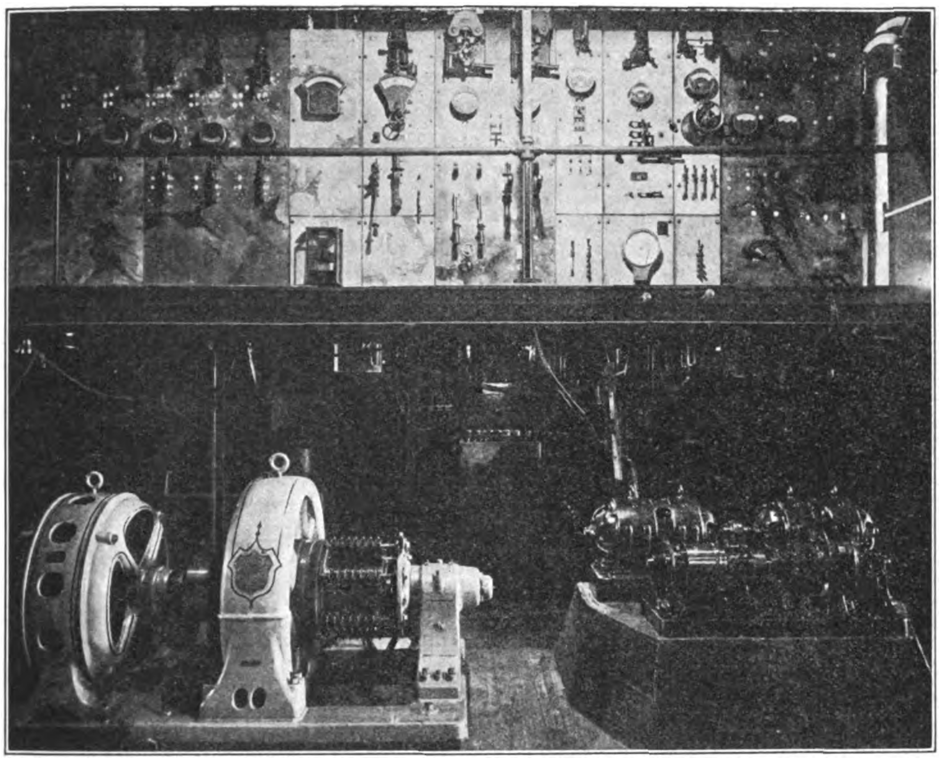


Fig. 3.—Regulating Apparatus, Elmira Water, Light and Railroad Company, Elmira, N. Y.

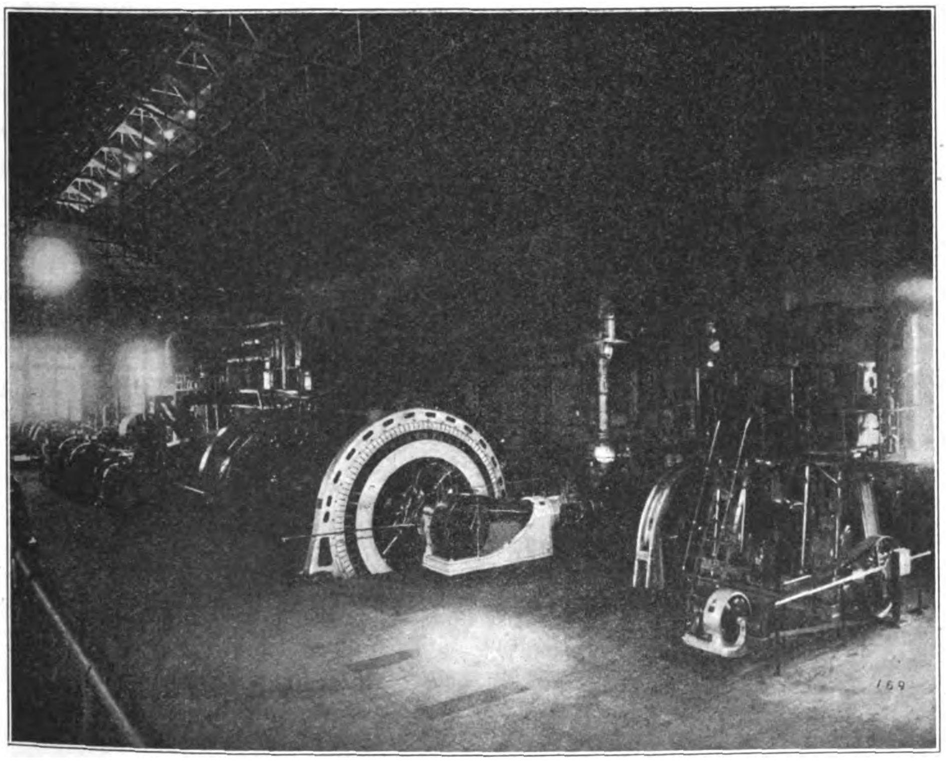


Fig. 5.—Interior of Power-House, Elmira Water, Light and Railroad Company, Elmira, N. Y.

This plant has been in successful operation for several months, the energy supplied to the variable-load bus being held constant within the limits of plus or minus four per cent, thus permitting the variable load to be carried as a steady "lighting" load, and at the same time the connections used eliminate the probability of any of the lighting energy passing through the battery and converting apparatus and thus reducing the effective capacity of the same or increasing the losses by unnecessary storage.

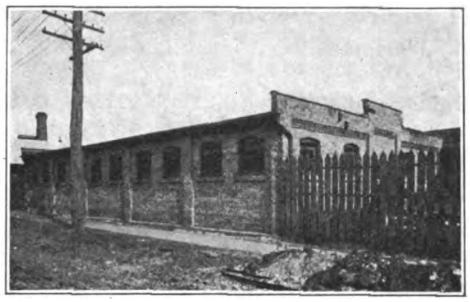


Fig. 4.—Battery House of the Elmira Water, Light and Railroad Company, Elmira, N. Y.

Association of Car-Lighting Engineers.

A meeting was held in Chicago, Ill., on August 24 and 25, to form the Association of Car-Lighting Engineers. The date for the first annual meeting was fixed for November 18, in Chicago. Committees were appointed to report on the subjects of illumination, wiring, connectors, lamps, organization, history of electric lighting on steam railroads, axle lighting, straight electric lighting, storage batteries, straight storage-lighted cars, head-end systems and entertainment.

The following officers were elected: President, A. J. Farrelly, Chicago & Northwestern Railway; first vice-president, E. M. Cutting, Southern Pacific; second vice-president, A. J. Collett, Union Pacific; secretary, G. B. Colegrove, of the Illinois Central.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

WESTERN UNION TELEGRAPH COMPANY.

The preliminary estimated statement of the Western Union Telegraph Company for the quarter ended September 30 gives net revenue of $1,700,000; bond interest, $433,062; balance, $1,266,938; dividends, $497,789; surplus, $769,149.

UNITED ELECTRIC SECURITIES COMPANY.

The United Electric Securities Company has issued a statement of earnings for the six months ended July 31, as follows: Bond interest received and accrued, $160,817; interest on notes, bank deposits, etc., $9,435; dividends received, $1,352; total earnings, $171,604; collateral trust bond interest, $99,065; expenses, $16,225; total charges, $115,290; net profit from income, $56,314; profit from sale of securities, less adjustments for discount on collateral trust bonds bought and sold, $17,691; six months' surplus, $74,005; profit and loss surplus, $1,291,677; preferred stock dividend, $35,000; surplus, August 1, $1,256,677.

EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.

The annual report of the Edison Electric Illuminating Company, of Boston, Mass., for the year ended June 30 shows gross of $4,229,239; expenses, $2,690,419; net, $1,538,820; miscellaneous income, $38,442; total income, $1,577,262; interest, etc., $54,989; balance, $1,522,273; miscellaneous charges, $125,368; balance, $1,396,905; dividends, $1,390,796; surplus, $6,109; total surplus, $247,219.

UNITED TRACTION COMPANY.

The United Traction Company, of Albany, N. Y., for the quarter ended June 30 reports gross of $498,245; expenses, $305,027; other income, $29,341; charges, $91,884; surplus, $130,675.

HUDSON VALLEY RAILWAY COMPANY.

The report of the Hudson Valley Railway Company, of Glens Falls, N. Y., for the quarter ended June 30 shows gross of $145,547; expenses, $113,252; other income, $1,149; charges, $55,886; deficit, $22,442.

KEYSTONE TELEPHONE COMPANY.

The report of the Keystone Telephone Company for the year ended June 30 shows gross earnings of $1,051,071; expenses and taxes, $539,123; balance, $511,-948; reserve for renewal and interest charges, $413,112; surplus, $98,836; previous surplus, $503,436. The surplus is equal to 5.06 per cent on the $1,936,850 preferred stock.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

The report of the associated Bell Telephone operating companies, not including the long-distance lines of the American Telephone and Telegraph Company, for the month of July and seven months ended July 31, shows a further growth in the company's business. The figures for the month of July are as follows: Telephone revenue, $10,014,300; general operating and maintenance expenses, $7,175,-100; net income, $2,839,200; sundry earnings, $453,600; total net earnings, $3,292,800; interest, $627,200; available for dividends, $2,165,600. The figures for the period from January 1 to July 31 are as follows: Telephone revenue, $68,-841,700; general operating and maintenance expenses, $50,599,800; net, $18,-241,900; sundry earnings, $2,963,000; total net earnings, $21,204,900; interest, $4,529,800; available for dividends, $16,-675,100.

LETTERS TO THE EDITOR.

"The Gasolene-Electric Drive for Vehicles."

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In your issue of August 29, 1908, page 300, I note an editorial comment on "The Gasolene-Electric Drive for Vehicles."

Some eight or ten years ago a United States Consul's report from, I believe it was Belgium, gave an extended account of an automobile made by a Belgium firm, the essential features of which were a longitudinal shaft direct geared to the rear axle and arranged for direct coupling to a gasolene engine and an electric motor; that is, just ahead of the rear-axle gearing was a friction clutch, next ahead was an electric motor with brushes so arranged for running in either direction, and so wound as to act as a generator when running at excess speed. Ahead of this motor on same shaft was a friction clutch; ahead of this clutch a single-cylinder gasolene engine. The equipment carried a small-capacity storage battery.

The principle of operation was that the pushing of a lever forward connected the storage battery to the electric motor; that when sufficient speed was attained by the machine, automatically the gasolene engine would come into action.

The gasolene engine's normal arrangement was such as to have a speed slightly in excess of the motor, which would cause the motor to charge the storage battery; that is, at a normal running speed under ordinary conditions, the machine was driven by a single-cylinder gasolene engine direct, the excess power of same being taken up through the generator into storage battery. The slower speed was handled entirely by electric motor. In case of long, heavy roads, the rear clutch could be disconnected and generator charged from time to time.

It appeared to me at the time I saw this report that if this principle was developed by a progressive American firm, it would have decided advantages over the then used automobile devices, and I believe could be developed into a better device than is now used.

J. F. NOBLE.

Oklahoma City, September 2.

Brusio Hydroelectric Plant.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In my article entitled "The Brusio Hydroelectric Plant and Its 50,000-Volt Swiss-Italian Transmission System," published in the ELECTRICAL REVIEW for August 8 and August 15, there appeared the following inaccuracies": "There are at present installed six main units and four exciters; two main and two exciter units are of the impulse type, by Escher, Wyss & Company; four main and two exciters are of the Girard type by Picard, Pictet & Company."

The statement should read: "There are at present installed ten main units of 3,500 kilowatts' capacity each, and four exciters of 250 kilowatts' capacity each. Two main units and two exciters are of the Girard type with partial admission, by Picard, Pictet & Company, and eight main units and two exciters are of the impulse type, by Escher, Wyss & Company, Zürich, who also supplied the entire penstock equipment."

It might also be of interest to state that the further equipment of the Brusio plant will be impulse wheels, which proved more efficient. It will be remembered that the plant is operating under a head of 1,300 feet.

FRANK KOESTER.

New York, September 14.

Cost of Subways.

The subway systems now in service in Greater New York have already cost the city the sum of $54,802,944, as shown by a statement prepared by the Public Service Commission to be submitted to the Tax Department. The Manhattan tubes have required over $48,000,000 of this sum, over $3,500,000 has been expended on the Brooklyn extension, and over $3,000,000 has been used in building the Manhattan section of the bridge loop now in course of construction.

PENNSYLVANIA ELECTRIC ASSOCIATION.

FIRST ANNUAL CONVENTION HELD SEPTEMBER 8-9.

The Pennsylvania Electric Association held its first annual convention at Eagles Mere, Pa., on September 8 and 9. There were represented forty companies, including most of the principal electric lighting companies in the state, and at the time the convention was called to order there were about one hundred delegates and guests present.

After the reports of the officers and the address of the president were presented the association discussed the advisability of reorganizing on the basis of a state branch of the National Electric Light Association. The discussion was opened by W. C. L. Eglin, president of the National Electric Light Association, who outlined the scope of the association's work and the amendments made to the constitution and by-laws to allow of the organization of state and territorial branches. The subject was discussed very thoroughly by the various members present and practically all of the features of association work were treated. The unanimous opinion was expressed that there were no disadvantages in a state association immediately becoming a state branch of the National Electric Light Association, and that advantages were to be gained along all of the lines of association work. When, later, the question was voted upon it was unanimously carried that the state association should reorganize as a state branch of the National Electric Light Association, and a committee was appointed to carry out the details. L. H. Conklin, Connellsville, was elected president; E. F. McCabe, Lewiston, vice-president, and E. L. Smith, Towanda, secretary and treasurer.

There were also in attendance at this convention a number of representatives of manufacturing companies and supply dealers, and the state branch of the association has arranged for their attendance at the state conventions.

The programme arranged for embraced most of the questions that are of importance at this time, and all of the subjects were freely discussed.

The various details of the handling of the convention were excellently managed and all of those in attendance appreciated the efforts that had been made in their behalf by the officers and committees.

THE CONVENTION OF THE PENNSYLVANIA ELECTRIC ASSOCIATION, EAGLES MERE, PA., SEPTEMBER 8 AND 9.

The opinion was universally expressed that state conventions are beneficial to the companies and fill a field that can not properly be covered in any other way.

The meetings were well attended. The paper on "The Day of Distribution," by T. Commerford Martin, was well received and opened up an interesting line of discussion, particularly on overhead-line distribution, a committee being appointed to prepare specifications and instructions regarding proper construction, and to give particular attention to foreign attachments and railroad crossings. A vote of thanks was extended to Mr. Martin.

F. W. Willcox, of the General Electric Company, Harrison, N. J., presented an interesting paper on incandescent lamps, which opened up a wide discussion on this subject.

Amusements and entertainment were provided for the ladies accompanying the members. One of the enjoyable features in which all took part was a corn roast and camp fire on the shore of the lake. An informal glee club rendered college songs and a generally pleasant evening was spent, the success of which was largely due to the entertainment committee.

Water Power in France.

The Journal of the Royal Society of Arts contains an interesting report on this subject. According to this the total water power utilized in the Alps is nearly 300,000 horse-power, while the yearly average obtainable is estimated by various experts at between 2,300,000 horse-power and 15,000,000 horse-power. Power is supplied to undertakings of two kinds. The first consists of factories engaged in the electrometallurgical and electrochemical industries, and utilizing water power obtained by them on the spot for the manufacture of aluminum, calcium carbide and ferro-silicon. These at present utilize over 100,000 horse-power in Dauphiné alone. The other kind consists of enormous power stations, pure and simple, for supplying current, not only to various works in the neighborhood, but within an ever-growing area. Lyons is lighted by power from the Volta Works at Moutiers, belonging to the Grenoble Power and Light Company, which transmits 6,000 horse-power over a distance of 112 miles under a pressure of 57,000 volts, while from Lyons to Valence the whole Rhône Valley is fed by power stations situated in the departments of the Savoy and Isère. Even St. Etienne and Roanne, in the department of the Loire, will, before long, be using electricity generated far away on the other side of the Rhône, in the valley of the Drac, a tributary of the Isère. As is well known, proposals have also been made to supply Paris from the Rhône, and schemes have been got out whereby 100,000 horse-power could be thus transmitted. These are, however, merely suggestions so far, but if the present rate of progress be maintained, in a few years the whole of France will be supplied with hydroelectric power from a few distributing centres. The industrial importance of such a development would necessarily be very great.—*Electrician* (*London*).

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Purchase of Coal on a Scientific Basis.

Several articles have appeared recently, in the main having been criticisms of the English coal industry, and seeming to place this industry in a somewhat unfavorable light. The present article, on the question of buying coal for industrial purposes, is from the coal-seller's point of view. In the first place, the assumption that British coal merchants are averse to modern methods of coal selection is considerably wide of the mark. The rule which must apply to all contract work in engineering—that the vendor must know as much about the article on sale as the buyer—holds good in coal dealing. A coal factor is very often in the position of actually having to advise a buyer as to the quality of coal to be selected, having regard not merely to the intrinsic quality of the fuel, but also in relation to furnaces or other purposes for which it is to be used. For this reason, if for no other, every British coal factor who takes his position seriously welcomes any scientific test which will help him to predetermine the performance of the coal for which it is his duty to find a market. The rock upon which the discussion appears to split is the undue prominence given to calorific value pure and simple. The chemical test of fuel is a very useful step to take, and the results of analyses should be carefully studied in selecting coal. It must be remembered, however, that what is ultimately aimed at is working performance, of which the only conclusive test is the trial of a sample ton, under ordinary working conditions, by a skilled fireman free from bias. It is pointed out that in a certain test of two samples of steam coal, the calorific value of one sample, as judged by the pounds of water raised to steam, was 13.76 pounds, while that of the latter was 13.7 pounds, both at a temperature of 212 degrees Fahrenheit. When, however, these two classes of coal were tried under working conditions, the second sample turned out, in a particular case, so much superior in result to the first that it was unhesitatingly adopted and retained. This might be explained by the difference in nature of the two coals and the particular requirements of the furnaces in which they were used. To require that all the coal should come from the same seam of a colliery is unreasonable. If a colliery is working one seam only, it is quite reasonable to stipulate that coal alone from that seam is secured. If, however, it is getting its output from two or three seams at different levels, it is nearly always found that the coal from these seams is mixed at the pit mouth, and the various qualities sent out are products of various seams.—*Abstracted from the Electrical Review (London), August 28.*

Telegraphy and Telephony Over Electric Light and Power Circuits.

An arrangement permitting the use of electric light and power circuits for telegraphy and telephony has been invented by Professor R. B. Goldschmidt, of Brussels. Results obtained by him over 110 or 220-volt lines are said to be equally good. The circuits may at the same time supply any number of electric lights and motors without the slightest disturbance. The transmitting device comprises a sensitive and powerful microphone, capable of withstanding currents of great intensity, which is connected in the circuit of an accumulator, a coil of thick wire and an adjustable resistance for regulating the intensity of the currents through the microphone. The coil forms the primary of a transformer, the secondary of which contains a great number of turns of fine wire of sufficiently high resistance to make the insertion of additional resistances unnecessary, when the secondary is connected to the electric light or power line. When the microphone is spoken into, the voice produces in the secondary circuit of the transformer alternating-current oscillations, which superpose themselves on the direct current flowing through the conductors and, the direct current being scarcely influenced by alternating currents, as is well known, the latter act on the telephone at the receiving end through another transformer, similar to that at the transmitting end. The calling apparatus consists essentially of a toothed-wheel interrupter placed in the circuit, which, when rotated, produces electric currents in the transformer at the receiving end. A sensitive relay connected in the secondary of this transformer serves to establish a local circuit through a battery and bell. A condenser is connected around the interrupter for the prevention of heavy sparks. When the telephone receiver is hung on a hook, the secondary circuit is closed by the relay; when the receiver is removed, the hook rises and the telephone is automatically connected in the secondary circuit of the coil. In order to telegraph it is only necessary to substitute a Morse key for the calling device, and a Morse apparatus or sounder at the receiving end for the bell. Experiments made by Professor Goldschmidt have shown that during the day the transmission is effected as perfectly as over ordinary telegraph and telephone lines, but in the evening, when many local circuits are simultaneously opened and closed, the transmission is a little more difficult. Among the practical applications of the invention are the sending of telegraphic or telephonic messages simultaneously from a central station to a number of subscribers, and communication between central stations and electric railway cars. On account of the high resistance of the transformers the current consumed is almost negligible and the devices are not much more expensive than those ordinarily used.—*Translated and abstracted from L'Electricien (Paris), August 22.*

The Utilization of Electric Power in Salt Mines.

H. R. Speyer describes in this article the generating station which has been built for the joint use of the salt mines owned by the Nordhauser Kali Company, the Immenrode Carnallit Company, and the Ludwigshall Carnallit Company. This group of mines is situated in the midst of the Harz Mountains. The raw material is brought to the surface by electrical main winding engines, and is transmitted to the factory, a distance of some three or four miles, over an electrically driven aerial steel roadway, and is shot from the incoming trucks automatically by electrical tippers into the mills. Issuing from these in a pulverized form, it is taken by conveyers to the top of the building, where it is dropped into the live-steam-heated boilers containing a solution of calcium chloride. Here the original salt, consisting of carnallite and sodium chloride, undergoes the first chemical change. The carnallite dissolves and the sodium chloride remains in its solid state. The liquid is drawn off and pumped into large open tanks, where the potassium chloride crystallizes out. This is afterwards taken to revolving drying pans fitted with spiral blades, which discharge it in its dry state into hoppers for transmission to the stores. The remaining filtrate is put through various processes for further utilization. The final output is for commercial salts, namely, potassium chloride, magnesium chloride, potassium sulphate and magnesium sulphate. The requirements for producing the commercial salts from the raw material are such that with the exception of live-steam heating for the dissolving boilers, electricity can be used exclusively. The boring operations are carried out electrically; the pit gear, including the underground haulage and winding engines, is driven by electric motors; the transmitting aerial roadway, the tippers, the mills, the hoppers, elevators, pumps, mixing and storing gear, drying plant and cranes for loading, are in each case driven electrically. The power station, when completed, will contain five steam generating sets having an aggregate horse-power of 3,500. The output of the generating machines is controlled from a low-tension control board, while all the high-tension service is in a separate inclosed chamber. The method of control from the low-tension switchboard, including the paralleling of the generators, is by relays actuated by push-buttons mounted on the front of the board. The high-tension switches of the generator cables and of the outgoing feeder cables are all actuated by solenoid coils energized from the low-voltage continuous-current circuit, and controlled from the low-tension board. In order to minimize the risk of a breakdown, the main high-tension distributing cables are laid in pairs. These are at present, however, worked in parallel, and are controlled from one switch panel. Arrangements are to be carried out to enable each feeding cable to be dealt with separately. There are in all five pairs of outgoing main high-tension cables. The transmitting pressure is 5,000 volts. Two substations have been erected, equipped with high and low-tension feeding and distributing switch panels and with static transformers for reducing the transmission voltage to 500 and 110 volts. The former is for small power work, and the latter for the lighting circuits. The electrical equipment at the several pits is described, and an analysis made of the working costs and the excellent results which have thus far been secured.—*Abstracted from Electrical Engineering (London), August 27.*

Some Contact Rectifiers of Electric Currents.

It is not generally known, says L. W. Austin, that there is a large number of solid conductors of electricity, metallic and non-metallic, in which, when brought together so as to form a contact of not too low resistance, electricity appears to pass more easily in one direction than in the other. Most cases of this kind are too uncertain and capricious in their action to allow definite study, but silicon in contact with almost any of the ordinary metals, carbon-steel and tellurium-aluminum, all show a well-marked and fairly regular unilateral conductivity. In the investigation of these contacts the author has used two main methods of experiment. In one a direct electromotive force is applied to a contact, first in one direction and then in the other, and the resulting currents measured on a galvanometer or ammeters having resistances small in comparison with that of the contact. In the second method a known alternating current of sixty cycles is sent through a fall-of-potential wire, and the required voltages taken from sliding contacts and applied to the rectifying contact, which is in series with the direct-current meter. G. W. Packard in 1906 first announced the fact that a piece of silicon, when properly brought in contact with brass or copper, or, in fact, almost any of the common metals, is capable of acting as a detector for electrical oscillations without the use of external electromotive force. The rectifiers used in the experiments were made by embedding a piece of silicon in solder and bringing a bit of brass or steel wire soldered to the end of a flat spring in contact with it. The contact pressure was adjusted by means of a micrometer pressing on the spring from above. As some points on the silicon are more sensitive than others, the contact point is also made adjustable. For the determination of the absolute sensitiveness of the silicon-steel rectifier at high frequencies, a rectifier of rather low sensibility was compared with an extremely sensitive thermo element at a frequency of 140,000. They were connected in turn in series with a one-microfarad paper condenser for stopping the direct current, and with an inductance of 0.0331 microhenry, coupled very loosely to a second tuned circuit in which oscillations were excited. For a set of nine observations, after taking account of the reactance of the coupling coil, the readings on the galvanometer, with the thermo element, indicated a mean alternating electromotive force of 0.0336 volt. The deflection due to the silicon indicated a mean electromotive force of 0.0350 volt, according to the calibration of the rectifier for low-frequency currents. The experiment shows that there is no change in sensitiveness with frequency within the limits of accuracy of the observations. While, in general, the rectified current with silicon rectifiers flows from steel to silicon, an exception was found in a certain sample which was probably less pure in its composition than the rest of the silicon specimens used. In addition to the rectifying effect of tellurium-aluminum contacts, which appears to be thermoelectric, or at least in the same direction as the thermoelectric action, and which becomes irregular above low voltages, there is a second rectifying effect in opposition to the first, which, in general, becomes prominent only at the higher voltages. This second effect seems entirely analogous to the rectification of silicon, and is of the same order of magnitude. The author concludes that in all the cases noticed, the contact has a resistance of several ohms, as though there were a resisting film between the conductors. In all the cases, too, there is a comparatively poor conductor in contact with a good conductor, but the rectification in the cases of carbon-steel and of silicon-steel is from the good to the poor, while in tellurium-aluminum it is in the opposite direction, except for very low voltages, where another phenomenon — perhaps thermoelectric — predominates. It may be worth noting that the first effect is in the same direction as the rectified current in the aluminum electrolytic rectifier. When these surfaces are sufficiently large and the contact sufficiently close, the rectification entirely disappears. Even if the rectified currents were not opposed in direction to the ordinary thermoelectric currents, their magnitude would seem to preclude the possibility of a thermoelectric explanation. Nevertheless, the fact that the direct currents are, in general, roughly proportional to the square of the alternating currents suggests heat action. It may be that there is something of the nature of polarization and a counter-electromotive force at the contact, but if this exists no evidence of it has thus far been found. It is possible that we are dealing with the still obscure question of the escape of electrons from a conductor, and that our rectifying contacts furnish us with conditions under which the electrons pass more readily in one direction than the other; that is, that it is a case of direct, and not secondary, rectification.—*Abstracted from the Bulletin of the Bureau of Standards (Washington), August.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Westinghouse Manhole Transformers.

The accompanying illustrations show the transformers supplied by the Westinghouse Electric and Manufacturing Company to one of the largest electrical companies in the country employing underground distribution. The many advantages of this type of construction have led to its adoption for the entire line of

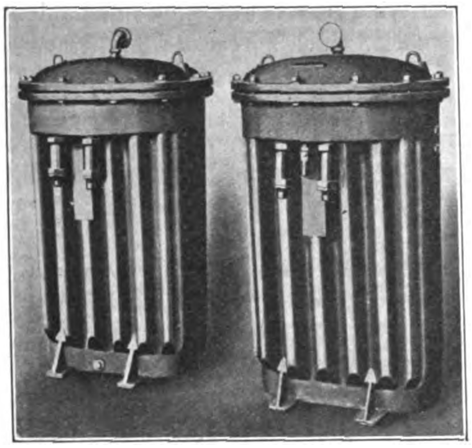


Fig. 1.—Westinghouse Manhole Transformers.

transformers designed for manhole service. These transformers are installed in subway manholes which are liable to flooding from heavy rains or overflow water, and, in addition, these underground chambers are rarely well ventilated. For this reason it is necessary to enclose the transformer in a hermetically sealed case, and design it for an exceedingly low temperature rise.

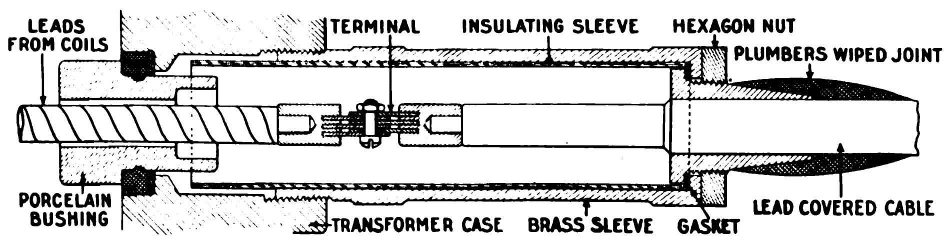


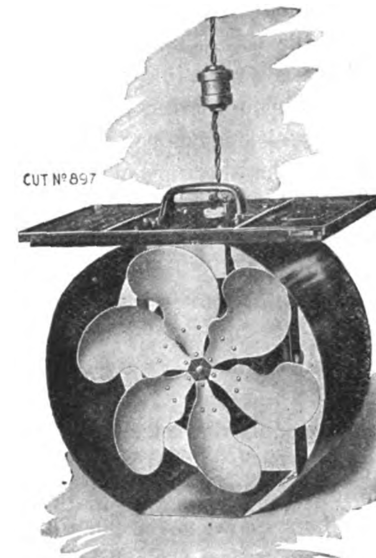
Fig. 2.—Diagram Showing Construction of Terminal Bushing.

The transformers are of the oil-insulated type, and a large air space is left at the top of the case to take care of any expansion of the oil under a rising temperature. Necessarily, this compresses the air in the upper portion of the case and causes a slight rise in pressure. Under abnormal operating conditions, such as a short-circuit, a considerable rise in this pressure may occur, and the transformer case may be seriously injured. In order to avoid any danger from such occurrences a horn-shaped brass casting is used for the oil plug in the cover. The mouth of the horn is closed by a thin sheet of copper which will rupture, acting as a safety or relief valve for any excess pressures. Each case is tested with an air pressure of about ten pounds per square inch and carefully inspected for leakage before shipment.

An improved bushing is used for the leads of these manhole transformers which permits them to be connected to, or disconnected from, the line without removing the cover or otherwise opening the transformer case. This design of bushing eliminates any necessity for breaking the joints of the transformer case and eliminates the danger of water leaking into the transformer through a joint made under difficulties in the confined space available in a manhole. A further advantage of this joint, which is shown in the illustration (Fig. 2), is that it permits transformers of the next larger or smaller size to be substituted in any manhole. Three sizes of bushings cover the full line. The joint is made without any solder except that in the plumber's wiped joint required to connect the lead covering of the cable to the brass sleeve. This is a permanent connection and made when the first transformer is installed. A number of transformers of this design have been arranged to operate on a three-wire, low-tension circuit with a grounded neutral. When this method of operation is used the neutral tap on the low-tension side of the transformer is grounded directly on the transformer case through a stud terminal, as shown in the right-hand view in Fig. 1. The high-tension side of the single-phase transformer, as shown on the left of this figure, is only provided with two outlet bushings.

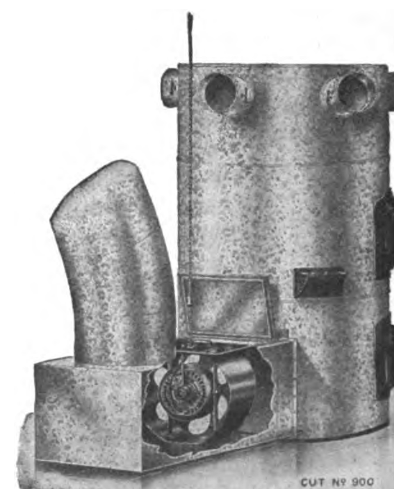
Electric Blowers for Furnaces.

The Emerson Electric Manufacturing Company, St. Louis, Mo., has developed an electric blower for use with ventilating and heating systems, adapted to either al-



Electric Blowing Unit for Furnaces.

ternating or direct current. The need is apparent for some aid to natural draft in hot-air furnaces used for heating residences, as the natural air currents from the furnace fail to properly heat one or more rooms in almost every house. Even



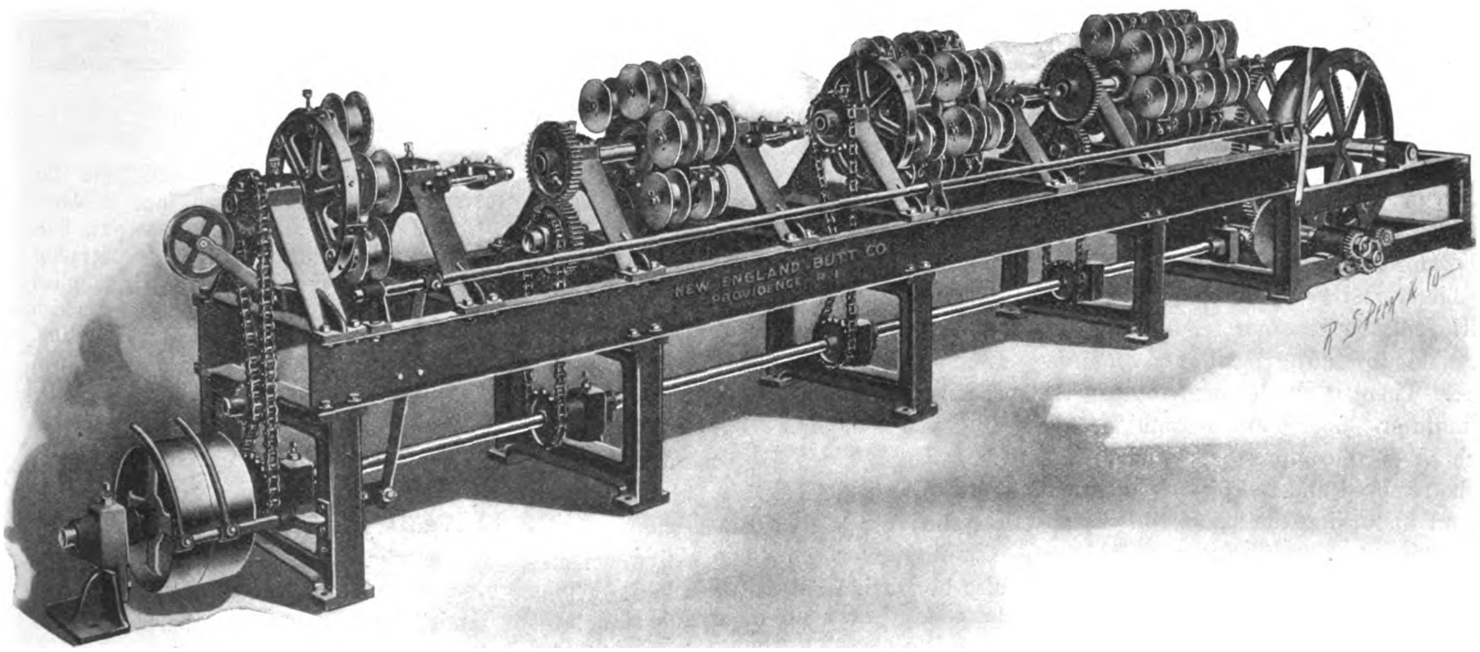
Electric Blowing Unit Adapted to Residence Furnace.

when the maximum heating power of the ordinary furnace is secured, it is almost certain that some rooms can not be kept comfortably warm. The use of the furnace blower secures a substantial increase in heat from a given quantity of fuel, forcing heated air to the rooms further from the furnace and providing greatly improved ventilation for the entire house.

In the special furnace blower shown in the accompanying illustration there has been developed a fan blower which meets all the requirements of residence service. The blower outfit is placed in the cold-air chamber of the furnace at the back of the furnace. To accommodate the motor an opening of eight and one-half inches by fourteen and three-quarters inches is cut in the top of the cold-air box and provided with a hinged lid or door. The blower outfit is complete, and may be connected by attachment plugs to any convenient electric light socket or receptacle in the cellar.

A Four-Head Tandem Stranding Machine.

The accompanying illustration shows one of the latest products of the New England Butt Company, of Providence, R. I. This is a four-head tandem stranding machine consisting of six, twelve, eighteen and twenty-four spool heads. The machine is used for making concentric cables of small sizes up to sixty-one wires. The spools, which are six inches in diameter, with a three-inch traverse, are carried on pins in such a way as to be easily removable.



FOUR-HEAD TANDEM STRANDING MACHINE.

The tension device enables the spools to be removed and inserted again without readjustment. The heads are driven by chains from the main shaft, and the alternate heads run in opposite directions. Each head is provided with die holders, adjustable longitudinally, and three sets of dies are furnished with the machine. The take-up sheave is thirty-two inches in diameter and is driven through change gearing which provides for four different lays from two to eight inches. A cross shaft on the front of the machine has a flanged pulley for driving a reel fixture.

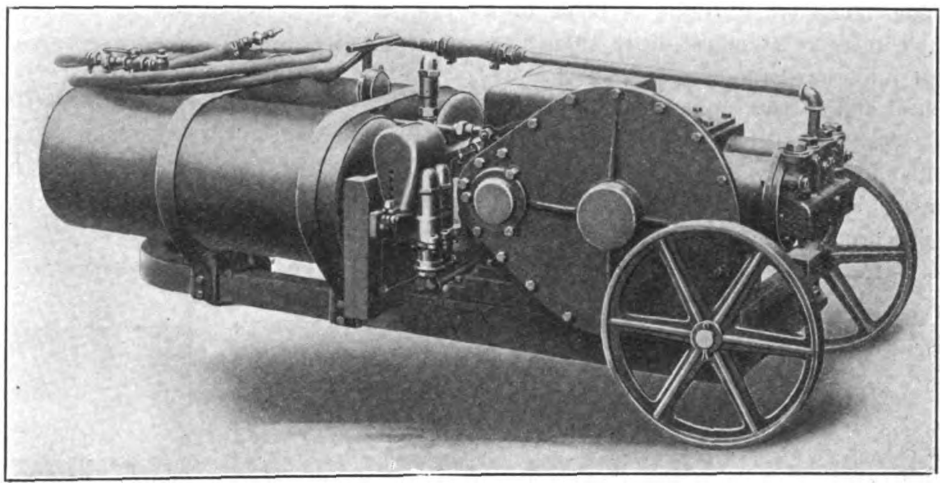
The tight and loose driving pulleys at the rear of the machine are twelve inches in diameter by three and one-half inches wide, and are run at 150 revolutions per minute. This gives the following speeds to the different heads: six-head, 175; twelve-head, 150; eighteen-head, 125; twenty-four-head, 100 revolutions per minute.

A belt-shifter is connected to a rod which runs the entire length of the machine, within easy reach of the operator.

The net weight of the machine is 23,000 pounds, and it takes up a floor space seventeen feet ten and one-half inches by two feet six inches.

A New Horizontal Blowing Outfit.

In response to the demand for a horizontal blowing outfit embracing the same general principles as the standard vertical plant, which has been in successful operation for several years, the Westinghouse Air Brake Company has designed the outfit shown in the illustration. It differs from the vertical plant chiefly in arrangement and more compact construction and is intended for use where conditions do



A NEW HORIZONTAL MOTOR-DRIVEN BLOWING OUTFIT.

not permit convenient movement of the vertical apparatus.

Portable plants are now in wide demand for cleaning electrical and other machinery, and for many services for which compressed air is the most convenient and economical agent.

The new horizontal plant consists of a motor-driven air-compressor with one or two brazed reservoirs, an electric pump governor and the usual accessories, such as switch, fuse blocks, gauge, safety valve, insulating hose connection, and hose with nozzle. The truck frame is made of a single piece of standard-shape angle iron bent into the shape of a U, and is cross-braced at the back under the compressor. The rear axle is a piece of square steel bolted directly to the frame. The compressor bed-plate bolts to the frame at each corner. The reservoirs rest upon angle-iron supports and are held firmly in place by means of wrought-iron straps bolted to the frame. A very simple switchboard is placed between reservoirs and compressor, upon which the governor, fuse blocks and switch are mounted. The position of the governor renders it easily accessible for adjustment and maintenance. There is ample room to open the commutator door and examine the brushes. The compressor cylinder head can be removed and the pistons taken out without disturbing the balance of the apparatus.

If it is ever necessary the gear-case cover can be removed by first removing one of the rear wheels, which is easily accomplished. All oil fittings are easily accessible. The rear wheels are eighteen inches in diameter, and the front wheel eight inches in diameter, and the latter can be turned through an angle somewhat greater than 180 degrees. The handle is bent so that when it lies back between the reservoirs the end of it will not protrude above the other apparatus on the truck. When the reservoirs are used they are drilled symmetrically, so that if removed either one can be put back on either side. The width of the outfit is such that it can be run through aisles thirty-one inches wide, and its height is such that it can be stored under a bench if desired. The disposal of the apparatus on the truck brings about two-thirds of the weight on the rear axle.

The type shown in the illustration can be varied in arrangement to suit conditions, and the truck furnished with roller bearings if preferred.

A Contractor's Electric Motor.

The adaptability of electric motors to all sorts of service is well illustrated in the two views herewith of a direct-current motor with a circular saw on the extended shaft. The motor only differs from a type "S" motor of standard Westinghouse design in that the shaft is somewhat larger and longer on the pulley end and that a commutator end bracket is supplied on this end to provide a bearing nearer the saw. The motor speed may be varied from 1,125 to 1,800 revolutions per minute to provide for various classes of work, with saws of different diameters. This motor is rated at ten horse-power.

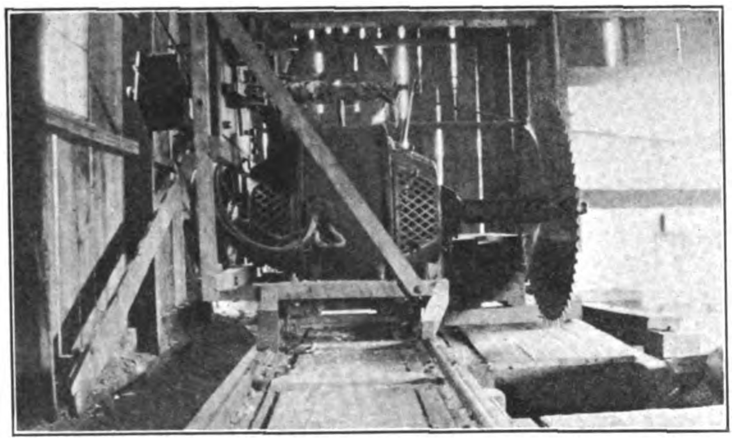


Fig. 1.—Motor Driving Rip Saw.

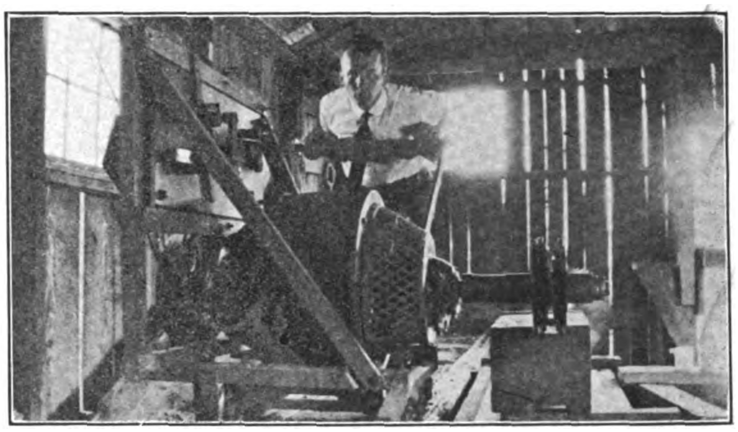


Fig. 2.—Motor Driving Groove Cutter.

It will be noted that a pulley has been installed on the extended shaft at the commutator end to act as a flywheel and also to provide a place for a brake. This latter is thrown on by means of a lever near the operator whenever it is desired to stop the saw quickly. The contractor has also installed a bladed fan on the pulley to blow air over the motor and throw the chips and sawdust away from the track and the motor. These can not be seen in the illustrations.

In Fig. 1 a large circular rip-saw is shown for taking a cut in heavy oak timber to be used in dam wickets on the Ohio River. The material must finish ten by twelve. In Fig. 2 a groove cutter is shown in place. A cross-cut saw is also used by the contractor who owns the outfit.

The motor is mounted on a frame with wheels which run on a short piece of track that the saw may be fed through the work. Attention is called to the method adopted by the contractor to keep the track clear of sawdust. In front of all four wheels a flap of leather is arranged to rub on the track which effectually clears away all material and allows the groove cutter to make a cut of even depth at all times.

Mounted on the frame which carries the motor is the switchboard panel with a field rheostat for adjusting the speed, a starting rheostat and a circuit-breaker. As the motor must move back and forth the current is supplied through two short stretches of trolley wire on which the trolley wheels run, similar to the method used in a traveling crane.

From the illustrations it is apparent that the motor is not installed under ideal conditions as the protection from the weather is none too good, but it shows to what purposes motors may be put. The entire outfit is intended by the contractor for portable service as current is supplied from a gas-engine-driven generator which is also mounted for ready handling. There is also a small air-compressor which supplies a pneumatic drill.

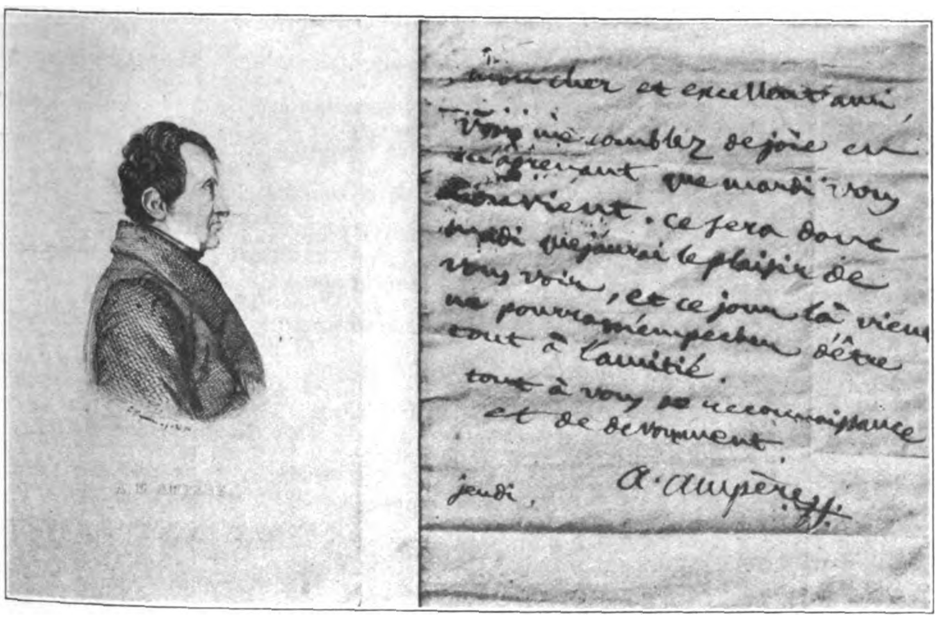
Tungsten in California.

The representative of a foreign steel corporation, says a correspondent in the *Engineering and Mining Journal,* has been some little time in the region of Randsburg and Johannesburg, in Kern County, California, examining various tungsten deposits which have been found there. Some of them, notably the Atolia, have been pretty well developed into productive mines, but most of the claims have not had any extensive work done upon them as yet. It is expected that upon the report of the expert some of the more prominent tungsten mines may be purchased by the foreigners.

Crocker-Wheeler Company Post-Office.

In order to facilitate handling the increasing volume of mail at the Ampere, N. J., post-office, the Crocker-Wheeler Company, manufacturer of electrical machinery, has built a brick and cement post-office building on its grounds. The architecture is of a modern classical style which might be termed "Federal." Upon the pediment above the main entrance is an eagle and United States shield in high relief. The interior of the building is finished in quartered oak and the floor is of mosaic tile. Upon the walls hang a fac-simile of the Declaration of Independence, with the coats of arms of the various states, a Constitution of the United States and an autograph letter and portrait of A. M. Ampere (1775-1836), after whom Ampere is named. The new post-office will still further beautify the grounds of the Crocker-Wheeler Company.

THE NEW POST-OFFICE AT AMPERE, N. J.



mon cher et excellent ami
Vous me comblez de joie en
m'apprenant que mardi vous
convient. ce sera donc
mardi que j'aurai le plaisir de
vous voir, et ce jour là rien
ne pourra m'empêcher d'être
tout à l'amitié.
tout à vous de reconnaissance
et de dévouement.
jeudi, A. Ampère

PORTRAIT AND AUTOGRAPH LETTER OF AMPERE IN THE NEW AMPERE, N. J., POST-OFFICE.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on September 22 for 8,000 feet of telephone cable, two starting panels, six engine telegraphs, for delivery at Mare Island, Cal.; 10,000 feet of fibre conduit, miscellaneous conduit and fittings, and five engine telegraphs, for delivery at Puget Sound, Wash.; miscellaneous arc lamps and miscellaneous wire and sheet platinum for delivery at Brooklyn, N. Y.; miscellaneous electrical supplies and 1,200 steel enameled nipples for delivery at Boston, Mass.

Bids will be opened on September 29 for miscellaneous electrical supplies for delivery at Boston, Mass.; Charleston, S. C., and Brooklyn, N. Y., and for furnishing and installing three transformers at Brooklyn, N. Y.

It is announced that the Bureau of Supplies and Accounts will hereafter accept an annual bond to cover all contracts which may be awarded to one bidder during a fiscal year, instead of requiring a separate bond with each contract, provided such annual bond is executed by a corporate surety company, duly authorized under the act of Congress approved August 13, 1894, to do business as sole surety in United States matters. Blank forms and all necessary information for filing an annual bond will be furnished upon application to the Bureau of Supplies and Accounts.

The Golden West and American Industries Exhibition.

An American exposition, for which all the exhibits will be taken from this country, will be held in the grounds and buildings of Earl's Court, London, England, next year from May to October, under the title of "The Golden West and American Industries Exhibition." A distinguished committee has been organized, headed by the Lord Mayor of London. Representatives have been appointed to visit the leading cities, and all manufacturing districts of the United States, the commissioner in charge of the work being John W. Ryckman. The temporary headquarters of the commission have been established at the Ansonia, Broadway and Seventy-third street, New York city.

The exhibition will typify the great development of the states of the "Golden West" since the discovery of gold in California in 1849, and will also commemorate the bicentennial of the completion of the first Atlantic cable.

The New York Electrical Show.

The New York Electrical Show will be held in Madison Square Garden, New York city, from October 3 to October 14. Plans have been developed to create a number of startling features in the way of exhibit decoration and decorative lighting. The popular application of power will be made a feature of the coming exhibition. It is announced, also, that a series of lectures, twice daily, will be given free of charge in the concert hall.

Thomas A. Edison has signified his willingness to act as president of the exhibition, and on the opening night will be present at Madison Square Garden.

During the show the jubilee of the first Atlantic submarine cable will be celebrated, and the receipts for the evening of Thursday, October 8, will be given to the Loomis Annex.

Current Electrical News

DOMESTIC AND EXPORT.

MONTREAL LIGHT, HEAT AND POWER—A New York syndicate, headed by Leslie Shaw, ex-Secretary of the United States Treasury, has made an offer to the directors of the Montreal Light, Heat and Power Company to purchase the company. The offer is in the shape of a ninety-nine-year lease, the New York syndicate to have the right to purchase the stock at 110.

MONTANA INTERURBAN—The Billings & Cooke City Electric is being organized with $3,000,000 capital to build a line from Absarokee, Mont., northeast to Billings. Surveys are now being made and grading will begin as soon as the right of way is secured. J. B. Clayberg, Helena, Mont.; George E. Savage, Butte; A. L. Babcock, Theodore Martin and Bert G. Shorey, Billings; M. E. Estep, Chicago; Thomas Harney, Galena, Ill., and E. M. Hosky, of Helena, are interested.

NEW JERSEY RAPID TRANSIT COMPANY, INCORPORATED—The New Jersey Rapid Transit Company, with a capital of $1,000,000, has been incorporated at Trenton, N. J., for the purpose of constructing a railroad from the city of Paterson to Suffern, N. Y., a distance of fourteen miles. The incorporators are Thomas J. Maloney, of Jersey City; Henry M. Parmalee, Herbert Bogart, Charles D. Cook and Guy H. Pierce, all of Paterson; M. R. McAdoo, Montclair, and George M. Dunlap, Spring Valley, N. Y.

NOOKSACK VALLEY ROAD FILES INCORPORATION PAPERS—Articles of incorporation have been filed at Bellingham, Wash., for the Nooksack Valley Traction Railway Company, which is surveying a route for the Bellingham-Ferndale Interurban. The incorporation papers state that the purpose of the company is to run lines from Bellingham to Sumas, thus providing for both the Ferndale and Lynden branches. The incorporators are W. P. Alward, J. S. Wheeler, J. E. Morrison and W. H. Jarrett, of Seattle; Edward Brown, of Custer, and Joseph Morrison and J. William Welch, of Ferndale. The capital stock of the company is listed at $1,250,000.

WISCONSIN TRACTION PROPERTY IN HANDS OF NEW COMPANY—With a capitalization of $850,000 the Wisconsin Electric Company has taken over the property of the Winnebago Traction Company, recently sold under foreclosure proceedings. The new company has been authorized to issue $1,500,000 in bonds. The officers of the Wisconsin Electric Company are: President, O. C. Fuller; secretary, Fred C. Best; treasurer, R. C. Smith; manager, C. C. Smith. The company will operate the Oshkosh city lines and the interurban lines in conjunction with the Eastern Wisconsin Electric Railway Company between Oshkosh and Fond du Lac formerly operated by rival interests.

$10,000,000 COMPANY TO BUILD KANSAS INTERURBANS—The organization of the Interstate Railway and Power Company, which will build and operate a network of trolley lines covering eastern and southern Kansas, with a main interurban line between Kansas City and Topeka by the way of Lawrence, has been completed. With this has been organized the Kansas City Union Trust Company, a $10,000,000 corporation, which is to finance the deal. Headquarters of both companies are to be in Kansas City, and men of that city are the most active promoters of the proposition. It is announced that $8,000,000 of the proposed capital of the Kansas City Union Trust Company has been arranged by financiers of Liverpool. The remainder has been subscribed or is to be subscribed in the district where the new lines are to be operated.

KANSAS-COLORADO ELECTRIC LINE—The Kansas-Colorado Railroad Company, organized recently at Pueblo, Col., to build a trolley system in the Arkansas Valley from Pueblo as far east as Dodge City, Kas., has applied to the Kansas Charter Board for authority to engage in business in the state. The original company was chartered under the laws of Colorado and its headquarters are at Pueblo. The company says its object is to construct and operate either a standard-gauge steam or electric road from Pueblo east to Dodge City, taking in these Kansas towns: Coolidge, Syracuse, Lakin, Deerfield, Garden City, Pierceville, Ingalls, Cimarron and Dodge City. Branch lines are provided for to Scott City and other towns in that section of the state. It wants authority to build the road, electric plants and telegraph and telephone systems. Its capital is placed at $5,000,000. Most of the men interested in the concern live in Colorado. The Kansas men on the board of directors are W. P. Humphrey, Syracuse; A. C. Campbell, Lakin; Andrew Russell, Dodge City, and A. H. Warner, Garden City.

PROPOSED EXTENSION OF TRANSIT FACILITIES IN PHILADELPHIA—An ordinance providing for an increase of the city of Philadelphia's indebtedness $4,000,000, with which to build an elevated railroad from Front and Market streets to the Torresdale Boulevard, has been introduced in select council by James Emery Byram. The bill was referred to the street railway committee. The ordinance authorizes the mayor to enter into a contract for the construction of the railway from Front and Market streets to the terminal at the Torresdale Boulevard. It is provided that the city shall lease the road to the highest bidder. Funds with which the city is to build the road are to be obtained by increasing the indebtedness by $4,000,000, the loan proposition to be submitted to a vote of the people. Such a railroad would tap a territory embracing more than forty-three square miles and containing a population of more than 324,000. It would afford quick transit facilities to residents of Frankford, Kensington, Richmond, Bridesburg and the eastern side of old Coopersville, which is now the thirty-third ward.

DATES AHEAD.

American Institute of Mining Engineers. Annual meeting, Chattanooga, Tenn., week of September 29.

American Electrotherapeutic Association. Annual meeting, New York city, September 22-24.

Central Electric Railway Association. Next bi-monthly meeting, Indianapolis, Ind., September 24.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 5-6.

Empire State Gas and Electric Association. Annual meeting, New York city, October 7.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Pittsburg, Kan., October 8-9.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

Railway Signal Association. Annual meeting, Washington, D. C., October 13-15.

Order of the Rejuvenated Sons of Jove. Annual meeting, Buffalo, N. Y., October 15-16.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Association of Car-Lighting Engineers. First annual meeting, Chicago, Ill., November 18.

NEW MANUFACTURING COMPANIES.

BOSTON, MASS.—The Universal Electric Light, Power and Machine Company has been incorporated to deal in electrical supplies. The capital stock is $100,000. Albert L. Farr, of Stonington, Me., is president and treasurer.

WILMINGTON, DEL.—The Automatic Cashier Machine Company has been incorporated to manufacture electrical apparatus. The incorporators are J. Charles Righter, Samuel Vance, Jr., both of Philadelphia, and Harry W. Davies, of Wilmington. The capital stock is $300,000.

ELECTRIC LIGHTING.

BELLEFONTAINE, OHIO—The West Liberty electric plant has been sold to R. M. Keller, of Washington, for $10,000.

SIOUX FALLS, S. D.—The business men and other residents of Scotland have decided in favor of an electric lighting system.

ROCKFORD, ILL.—Improvements to cost in the neighborhood of $40,000 to $50,000 are contemplated by the Rockford Electric Company.

DAYTONA, FLA.—The Daytona electric light plant, which was recently destroyed by fire, will be rebuilt. Bonds have also been voted for a city waterworks plant.

BASTROP, TEX.—The Bastrop Water and Light Plant, including fixtures for the ice factory, was sold at public sale to T. A. Hasler for $12,281.40, one dollar more than the indebtedness on the plant.

CLINTON, MASS.—The Marlboro Electric Lighting Company has entered into an agreement with the Connecticut River Power Company to secure a portion of its electric power from the plant at Vernon, Vt.

NORTH PLATTE, NEB.—The electric light company has greatly enlarged its plant within recent months, the latest improvement being the installation of a new 250-horse-power boiler and a 150-kilowatt dynamo.

LEXINGTON, KY.—The Kentucky Water, Heating and Illuminating Company, John A. Gary, president, has bought for $6,100 the franchise for a new electric lighting plant in this city, auctioned by Mayor Skain.

ARVADA, COL.—A special election has been called for September 22 at which the citizens will vote upon the matter of granting a franchise to a newly organized company which purposes to light the town with electricity.

LOGANSPORT, IND.—The contract for the new equipment to be installed in the Logansport municipal electric and power plant has been awarded to the Westinghouse Electric and Manufacturing Company at its bid of $27,907.94.

CORPUS CHRISTI, TEX.—A charter has been granted to the People's Light Company, of this city, which will at once begin the installation of a $30,000 electric power and ice plant. This will be the second plant of the kind to be installed in Corpus Christi.

SALISBURY, N. C.—The Southern Power Company is now supplying current to the Salisbury & Spencer Street Railway Company, in this city. The current is conveyed a distance of 104 miles and its use increases the capacity of the Salisbury electric plant from 600 to 4,000 horse-power.

BUFFALO, N. Y.—The Buffalo General Electric Company has built a transformer station for the purpose of delivering power and lights, both arc and incandescent, to the Lackawanna district of West Seneca. The company will tap the wires of the Niagara, Lockport & Ontario Power Company.

NORFOLK, CT.—Excavations have been begun for the foundation of a building on the site of the Southern New England Telephone Company office, which was destroyed by fire several years ago. When completed the new building will be used as a substation by the Berkshire Power Company.

BANGOR, ME.—The Bar Harbor & Union River Power Company has its line completed from the power plant in Ellsworth to Bar Harbor, a distance of about twenty-three miles. Light and power are now being transmitted from Ellsworth to Bar Harbor, and a line is being built to Bangor.

LIVE OAK, CAL.—The Live Oak & Encinal Lighting Corporation is being formed by Live Oak business men. It is proposed to run wires from the substation at Encinal along the public road to Live Oak and place lights on about every third pole that carries the wires of the Bay Counties Power Company.

BOYSEN, WYO.—Work on the dam of the Big Horn Power Company, which was suspended several months ago when a controversy as to the height of the dam arose, has been resumed. The dam will be thirty-five feet in height and will make possible the generation of 10,000 electrical horse-power from the flow of the Big Horn River.

NIAGARA FALLS, N. Y.—The Ontario Power Company is constructing an entirely new transmission line to Welland, Ontario. At the river, west of Niagara Falls, Ontario, the poles are seventy-five feet high. Three cables have been strung and three more are to be added. From the river the company has its own right of way paralleling the line of the Michigan Central Railway.

MACUNGIE, PA.—At a meeting of citizens the Macungie Electric Light, Heat and Power Company was organized. Charles H. Neumoyer was elected president of the company; Postmaster H. L. Hertzog, treasurer; W. N. Decker, secretary; Charles Boettger, H. B. Weaver, C. O. Shimer, Adam B. Neumoyer and Charles H. Neumoyer, directors. The capital stock was placed at $5,000.

TABOR, IOWA—On September 21 the people of Tabor will vote on the granting of a franchise to the Malvern Light and Power Company. This company proposes to run a wire from its plant at Malvern to supply the necessary current. It will cost the Malvern concern $15,000 to enlarge its plant for this purpose. To aid in the enterprise thirty-five citizens of Tabor have subscribed for $7,500 of the bonds.

BUFFALO, N. Y.—Plans for the proposed electric lighting system at the city hall will soon be completed by J. J. O'Leary, the electrical expert engaged by the board of trustees for that work. Mr. O'Leary and Trustees Bisgood, Zittel and Steul have returned from a trip of inspection to Harrisburg, Pa.; Philadelphia, Pa.; Washington, D. C.; Baltimore, Md.; Trenton, N. J.; New York city and Syracuse, where they examined the lighting systems of the public buildings.

WAUWATOSA, WIS.—The common council has entered into a five-year contract with the Milwaukee Electric Railway and Light Company under which the company will at once install a system of Nernst lamps. A total of 112 of these lights will be placed, with possibly twenty-seven more within a short time. The contract is for an all-night service, the city to pay $21 per lamp per year. In order to operate these lights it will be necessary for the company to rewire a part of its system.

SANTA ROSA, CAL.—At the annual meeting of the Cloverdale Light and Power Company A. Sbarboro was chosen president, P. C. Rossi vice-president, and A. E. Sbarboro secretary and manager. C. A. Feldmeyer was reappointed superintendent of the company. The work of the past year was found to be very satisfactory and it was planned to extend the lines of the company north and south of Cloverdale, and also to cross the Russian River and supply light and power for the many residences in the rural section there.

ASHEVILLE, N. C.—Extensive improvements are to be made by the Asheville Electric Company. The expenditure will amount to between $25,000 and $30,000 for new transformers, switchboards and other apparatus for utilizing the current obtained from the Weaver Power Company as well as the reserve of the steam plant. On account of the increased business of the company the new equipment will be more extensive than that which it will replace and, to accommodate it, an addition to the power-house, costing about $5,000, will be required.

FALL RIVER, MASS.—At the annual meeting of the Tiverton Electric Light Company officers were re-elected as follows: President, John R. Hicks; clerk, George R. Lawton; treasurer, Owen Durfee. Directors: Edward L. Anthony, Rufus W. Bassett, Robert S. Goff, Albert F. Dow, Frederick O. Dodge, Fall River; John R. Hicks, George R. Lawton, Tiverton. It was reported at the meeting that the work of constructing the lines in Tiverton would probably be begun at an early date. The power will probably be furnished by the Fall River Electric Light Company.

NEW PUBLICATION.

"THE FUTURE OF ELECTRICITY"—The New York Electrical Trade School has reprinted a lecture entitled "The Future of Electricity," which was delivered to the students of the school by Professor Charles P. Steinmetz in the lecture hall of the American Institute of Electrical Engineers last fall. This lecture is full of helpful and hopeful information for the younger man, and its reading will prove a decided stimulus to the student who is ambitious to succeed and become a factor of importance in his chosen profession.

ELECTRIC RAILWAYS.

KANSAS CITY, MO.—The Kansas City & Olathe Electric Railway has been completed between Rosedale and Shawnee.

MACON, GA.—The Macon Railway and Light Company is installing new machinery in its power plant in Macon. More than $50,000 will be expended.

ROCHESTER, N. Y.—The Buffalo, Lockport & Rochester electric line is now in operation as far as Albion. It is hoped to have the system completed to Buffalo by November 1.

STERLING, ILL.—The people of Tampico Township have raised the sum of $15,000 for the purchase of bonds of the new interurban line that is being proposed between Tampico and Hooppole.

LITTLE ROCK, ARK.—A 1,500-horse-power turbine engine is being installed in the power house of the Little Rock Railway and Electric Company. The new engine is one of the largest in use in the South.

MARSHALL, TEX.—Marin Turney has made application for a franchise to build an electric car line in the city. He guarantees to build one and three-quarters miles of track and to operate the same within the first thirteen months.

CAIRO, ILL.—Announcement is made that the Cairo Electric Traction Company and Cairo City Gas Company have been bought by the McKinley traction system, which will control all the public lighting and traction facilities of this city.

NEW CASTLE, PA.—James Strawhecker, of Zelienople, president of the proposed Wampum-New Castle street railway, states that he expects to begin active work in a short time. The line is to come through West Pittsburg and South New Castle borough.

DULUTH, MINN.—The Duluth Street Railway Company, now operating under a franchise which still has twenty-three years to run, has applied to the secretary of state for new articles of incorporation to extend fifty years from date, with a capital of $1,500,000.

LAPORTE, IND.—Electric cars will run direct between Michigan City and Louisville within eight weeks. The recent completion of the Laporte extension of the Murdock lines leaves but one small gap, that between Peru and Warsaw. Three cars will make the trip each day.

OKLAHOMA CITY, OKLA.—Information has been received from G. B. Stone, the president of the Chamber of Commerce, who is now traveling in Europe, to the effect that a company made up of Vienna capitalists is being organized for the construction of a trolley line from Oklahoma City to Wichita Falls, Tex.

HASTINGS, PA.—The Barnesboro Construction Company has been awarded a contract by the Northern Cambria Street Railway Company for the construction of an extension of the system from Barnesboro to Hastings. The street railway company has already invested $400,000 in its line from Patton to Barnesboro.

REDWOOD CITY, CAL.—Supposedly representing the interests of the Southern Pacific Company in its plans to spread a network of electric railways throughout the peninsula, S. M. Snyder, a realty promoter and agent for North Fair Oaks, has secured the consideration of the trustees to his plan for an electric road through the city.

CHESTER, PA.—A movement has been begun to establish a trolley line between this city and West Chester, the route of the proposed road to pass through Village Green, Concord, Thornton and Westtown. All the property owners in that section are in favor of the project. It is expected that the road will be staked out at an early date.

OKLAHOMA CITY, OKLA.—Surveys on an interurban electric line from El Reno to Oklahoma City by way of Yukon have been started. The road will parallel the Rock Island tracks between Yukon and El Reno, touch the Oklahoma City street railway system at Belle Isle and enter Oklahoma City over the local company's tracks. Maney Brothers and Henry Schafer, promoters, have applied for an increase in capital stock from $25,000 to $1,000,000. The line will be known as the El Reno Cable and Trolley Company.

GOUVERNEUR, N. Y.—A trolley road is proposed for this section of the state. A. A. Potter, in behalf of the parties interested, has circulated a petition among the business men of this village asking them to agree to give the company their freight business. The petition receives the signature of practically every firm. The right of way of the entire distance of 100 miles has been secured, and as soon as the franchise is granted a survey of the proposed route will be made and active operations on the construction of the road begun.

HAMILTON, OHIO—Stockholders of the Cincinnati Northern Traction Company have elected the following directors: George B. Cox, Bensom Fodaker, Charles Richardson, N. S. Keith and L. A. Ireton, of Cincinnati; O. V. Parrish, Peter Schwab and W. C. Shepherd, of Hamilton. The directors elected George B. Cox president, W. C. Shepherd vice-president, and F. R. Williams, of Cincinnati, secretary and treasurer.

DES MOINES, IOWA—George W. Adams, president of the Iowa & Omaha Short Line Railway Company, states that the preliminary work is well under way and actual construction on the new line will begin the coming spring. Most of the right of way has been taken and the surveyors are in the field. The line as proposed will run from Des Moines to Omaha by way of Dallas Center, Panora, North Branch, Exira, Elkhorn, Walnut, Oakland, Carson, Treynor and Council Bluffs.

ASHEVILLE, N. C.—On application of the Asheville Electric Company and other creditors, the Asheville Rapid Transit Company, on its admitted inability to meet its liabilities, has been placed in the hands of a receiver, Judge Ward appointing John P. Arthur to take charge of the property. Under order of the court the receiver will operate the railway, as at present, from the Golf Links station to Craggy station, a distance of five miles, but no effort will be made to operate the Overlook Park line from the Golf station to the top of Sunset Mountain.

BATH, N. Y.—There is a possibility that the Sodus Bay Railroad which was abandoned thirty years ago, when it was finished and ready for the rolling stock, may be constructed. Former Congressman Haines, with several capitalists and railway promoters, has been looking over the roadbed. The promoters entertain the idea that it would be feasible to build the road as an electric line. The Sodus Bay road was abandoned because several of its principal promoters yielded to the interests of the Fall Brook road, which paralleled the Sodus Bay line from Corning to Lyons.

ASHEVILLE, N. C.—Work on the construction of the electric line from Weaverville to Asheville, a distance of nine miles, is now well under way, and it is expected that the grading and trestle work will all be completed within sixty days. It is the purpose of the Weaverville Electric Company, the corporation building the road, to have cars in operation by late fall. It is learned that the promoters of the Weaverville-Asheville electric line purpose extending the line further into North Buncombe and make it penetrate the Barnardsville section and on to the Yancey county line. It is believed that the line will ultimately be extended to Burnsville, in Yancey County.

HUNTSVILLE, ALA.—A controlling interest in the Huntsville Railway, Light and Power Company is said to have been acquired by Ed. L. Pulley and his associates, who have incorporated the Huntsville, Chattanooga & Birmingham Railway, Light and Power Company. The incorporators are Mrs. Jimmie V. Lowry, of Huntsville; Dr. William J. Pulley, of New York; N. O. Wallace, of Fayetteville; Charles H. Pulley and Ed. L. Pulley, of Huntsville. Officers have been elected as follows Mrs. Jimmie Lowry, president; Dr. Wm. J. Pulley, vice-president; N. O. Wallace, secretary; Charles H. Pulley, treasurer, and Ed. L. Pulley, general manager. The authorized capital stock is $50,000, of which $31,000 has been paid in.

GALESBURG, ILL.—The Galesburg, Aledo & Northwestern Railroad Company has been organized with a capital of $10,000 to run through the counties of Knox, Warren and Mercer to the city of Aledo. The road will then proceed through Rock Island County to Rock Island, and thence to Muscatine, Iowa. The articles of incorporation call for a charter of fifty years' duration, the government of the company to be in the hands of a board of directors and such executive officers as may be provided for in the by-laws. The prospects for the line are growing brighter each day and at present practically all doubt as to the building of the road has disappeared. The subscription books will be opened and work on the line commenced in a few weeks.

PERSONAL MENTION.

MR. H. A. GRANT has assumed the position of general manager of the Orlando Water and Light Company, of Orlando, Fla. Mr. Grant has had a wide experience in the electrical field, having been identified with the Florida Electric Company, of Jacksonville, Fla., for the past seven years.

MR. C. M. NININGER has been appointed district commercial manager of the Southern Bell Telephone and Telegraph Company, with headquarters at Montgomery, Ala., succeeding Edward Lyle, who has been promoted to the position of general right of way agent, with headquarters at Atlanta, Ga.

MR. WALTER P. SCHWABE has been appointed manager of the Northern Connecticut Light and Power Company, succeeding Parker H. Kemble, who has hitherto acted as both president and manager of the company. Mr. Schwabe for fifteen years was in charge of the Rutherford (N. J.) plant of the Public Service Corporation of New Jersey.

MR. CLARENCE GIBSON, formerly manager of the Uniontown (Pa.) district of the Bell Telephone Company, has been placed in charge of the Washington, Pa., district, succeeding J. H. Clune, who has been made superintendent of the Butler exchange. Ernest Ritter, district manager of the company at Easton, Pa., has been transferred to Allentown in order to keep in closer touch with the plant and traffic department which is located at that place. The Easton office is now under the management of R. D. Frame.

OBITUARY NOTES.

DR. HENRI BECQUEREL died in Paris, France, last month, at the age of fifty-six. Although it is to his pupils, the Curies, that the discovery of radium is due, this discovery was made in carrying out a systematic research to investigate the cause of the invisible rays which Becquerel had found to be emitted by certain compounds of uranium. His announcement that photographic plates enclosed in a light-tight box with uranium salts were acted upon actinically was at first received with a considerable amount of skepticism, but this, on the whole, formed the basis of the field of research which since that time has opened up.

PROFESSOR E. E. N. MASCART died at Paris, France, on Tuesday, August 25, at the age of seventy-one. After graduating from the College of Valenciennes at the age of nineteen, Mascart became a teacher at the Lycées of Lille and Douai. In 1858 he entered the Ecole Normale Superieure, where, after completing his course, he remained until 1864 as assistant on the teaching staff. After filling chairs of physics at Metz and Marseilles he was called in 1868 to Paris to take the position at the College of France of adjunct professor to Renault. On the death of the latter he succeeded to the full professorship. During the Franco-Prussian war he served as assistant director of the cartridge and arms factory at Bayonne. In 1878 he was appointed director of the Central Meteorological Bureau of France, from which position he retired only recently on account of ill-health. In 1878 he published his "Treatise on Static Electricity," in two volumes, and between 1882 and 1886 his work entitled "Lessons in Electricity and Magnetism," which he prepared with Professor Joubert as collaborator, appeared. In 1892 he published his "Treatise on Optics," and in 1900 his "Treatise on Terrestrial Magnetism." During the greater part of his life he was one of the most active figures in the scientific circles of Paris. He was a member of the Academy of Sciences, and served as president of the Physical Society, the International Society of Electricians, the Meteorological Society and the Association for the Advancement of Science. He served also as president of the Committee on Commerce and Manufactures attached to the French Ministry of Commerce and as president of the Commission of Inventions for the Army and Navy. He took a leading part in the several international electrical congresses held in Paris, namely, those of 1881, 1889 and 1900, and was a delegate of the French Government to the International Electrical Congress of Chicago in 1893. He was a Grand Commander of the Legion of Honor.

ELECTRICAL SECURITIES.

The course of the market was generally downward and irregular all last week, some of the declines assuming considerable proportions. A feature of the selling was the aggressive bear pressure and the liquidation of stock which had been held for some time. The adverse factors appear to be the inclination toward a firmer money market, with advance in foreign exchange, and the passing of dividends by several prominent industrials. The government crop report was not considered especially satisfactory, but, on the other hand, a very favorable development was the court decision declaring the commodity clause of the Hepburn act unconstitutional. Developments indicate that the return to industrial activity is to continue comparatively slow. A compilation of railroad earnings for the first six months of this year shows a gross decrease of $235,000,000, while the net loss appears to be about $65,000,000. For the month of August the gross decreased 13.8 per cent, while for July the gross loss was 17.2 per cent, the net decreasing 8.1 per cent.

Dividends have been declared upon the following electrical securities: United Gas Improvement Company; regular quarterly dividend of 2 per cent, payable October 15 to stock of record September 30. Chicago Telephone Company; regular quarterly dividend of 2½ per cent, payable September 30; books close September 26, reopen October 1. Quarterly dividend of 1¾ per cent on the stock of the Manhattan Railway Company, guaranteed by the Interborough Rapid Transit Company, payable October 1 to stock of record September 11. United Traction and Electric Company; regular quarterly dividend of 1¼ per cent, payable October 1. Cumberland Telephone and Telegraph Company; have declared a quarterly dividend of 2 per cent, payable to stock of record September 20; this is an increase of ¼ per cent quarterly, the rate heretofore having been 1¾ per cent quarterly. West End Street Railway Company; regular semiannual dividend of $1.75 on the common stock, payable October 1; books close September 21 and reopen October 2. Portland Railway, Light and Power Company of Oregon; regular quarterly dividend of 1¼ per cent on the preferred stock, payable October 1 to stock of record September 15. Houghton County Street Railway Company; regular semiannual dividend of 3 per cent on the preferred stock, payable October 1 to stock of record September 15. Toronto Railway Company; regular quarterly dividend of 1½ per cent, payable October 1 to stock of record September 15. Union Traction Company, of Indiana; regular semiannual dividend of 2½ per cent on the preferred stock, payable October 1 to stock of record September 25. Western Union Telegraph Company; quarterly dividend of ½ per cent, payable October 15. Halifax Electric Tramway, Limited; quarterly dividend of 1½ per cent, payable October 1. Ridge Avenue Passenger Railway; quarterly dividend of $3 per share; guaranteed by Philadelphia Traction Company, lessee.

ELECTRICAL SECURITIES FOR THE WEEK ENDED SEPTEMBER 12.

New York:	*Closing.*
Allis-Chalmers common	10½
Allis-Chalmers preferred	34¼
Brooklyn Rapid Transit	52¾
Consolidated Gas	151¼
General Electric	143
Interborough-Metropolitan common	11⅝
Interborough-Metropolitan preferred	32½
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	67¼
Mackay Companies (Postal Telegraph and Cables) preferred	69
Manhattan Elevated	135
Metropolitan Street Railway	29½
New York & New Jersey Telephone	113½
Western Union	60¼
Westinghouse Manufacturing Company	74½
Boston:	*Closing.*
American Telephone and Telegraph	129
Edison Electric Illuminating	230
Massachusetts Electric	47
New England Telephone	118
Western Telephone and Telegraph preferred	75
Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	38
Electric Storage Battery preferred	38
Philadelphia Electric	9¾
Philadelphia Rapid Transit	20¾
United Gas Improvement	87¾
Chicago:	*Closing.*
Chicago Telephone	151
Commonwealth Edison	107
Metropolitan Elevated preferred	44
National Carbon common	70
National Carbon preferred	109

NEW INCORPORATIONS.

STAUNTON, VA.—Shenandoah Electric Company. $10,000.

AU SABLE, MICH.—Eastern Michigan Power Company. $10,000.

HARRISBURG, PA.—Portersville Telephone Company, Portersville. $12,000.

SPRINGFIELD, ILL.—Chatsworth Electric Company. To furnish light, heat and power. $25,000. Incorporators: L. A. Walter, J. B. Grotevant, G. W. McCabe, Chatsworth.

INDIANAPOLIS, IND.—Morgantown Light and Power Company, Morgantown. $5,000. Directors: William T. Gibson, Jesse H. Deer, James A. Collett, Joseph H. Enos and William W. Davis.

INDIANAPOLIS, IND.—Public Service Telephone Company, Leesburg. $20,000. Directors: Abraham H. Brown, Frank Bortz, Henry E. Kinsey, John E. Armstrong and Walter H. Stanley.

HARRISBURG, PA.—Carrick & Baldwin Street Railway Company. $6,000. Officers: F. K. Martin, Pittsburg, president; J. C. Bily, F. K. Martin, J. G. Evans, S. T. Tone and W. B. Carson, directors.

COLUMBUS, OHIO—Perry Electric Company, of Crooksville. $10,000. To establish and maintain an electric power plant at Crooksville. Incorporators. J. Edward Horn, J. C. Horn, Charles W. Runk, W. M. Runk and W. W. Hardy.

INDIANAPOLIS, IND.—Logansport, Frankfort & Indianapolis Traction Company. To build an interurban line from Frankfort to Logansport. $25,000. Samuel H. Blakeslee and Allen G. Barone, of Cleveland, and Fred Cook, of Indianapolis.

FAIRMONT, W. VA.—Independent Power and Light Company, of Fairmont. $150,000. To erect electric plants and perform all the functions to which such a plant can be applied. Incorporators: A. H. Donnally, L. C. Wyer, J. R. Linn, J. T. Hill, C. E. Mayers, all of Fairmont.

JOHNSON CITY, TENN.—Unaka Traction Company. To build a street railway from Erwin to Johnson City, through Unaka Springs, to be operated by horse, steam or electric power. $10,000. Incorporators: Isaac Love, W. B. McNabb, A. M. White, F. B. Vines and J. A. Wilson.

CHICAGO, ILL.—Chicago, Wheaton & Western Railway. To tap the region north of Wheaton, Ill., and connect with the Aurora, Elgin & Chicago electric line. $10,000. Incorporators: J. Sidney Condit, J. Percy Strickland, D. W. Peters, R. B. Tabor and H. C. Wood, all of Chicago.

INDIANAPOLIS, IND.—Valparaiso & Northern Railway Company. To construct, maintain and operate street and interurban railroads in Indiana. Its lines will run from Valparaiso, in Porter County, to and in the town of Chesterton. The concern is capitalized at $10,000. Chicago capitalists are named as the incorporators.

WHEELING, W. VA.—Wheeling, Cadiz & Tuscarawas Traction Company, Cadiz. To build a road connecting Bridgeport and Uhrichsville, and passing through Belmont, Jefferson, Harrison and Tuscarawas counties. $10,000. Incorporators: Barclay W. Rowland, Charles L. Scott, Charles F. Branson, William T. Perry, John F. Kennedy and G. W. Grissinger.

EVANSVILLE, IND.—Evansville & Eastern Railway Company, of Evansville. To construct and operate street railway and interurban companies in Indiana and to furnish lighting facilities to Indiana cities and elsewhere. $10,000. Incorporators: John C. Lake, of Lake, Ind.; Marcus S. Sonntag, W. H. McCurdy, Albert F. Karges, William A. Koch and C. H. Battin, of Evansville.

OMAHA, NEB.—Independent Transportation Company, of Council Bluffs. $30,000, consisting of 6,000 shares at a par value of $5. Incorporators: William Leahy, J. R. McPherson, Henry Sperling, J. R. Reed and A. T. Flickinger, of Council Bluffs. To carry on a general transportation business, including the carrying of persons and property in this city and adjacent territory. Officers: William Leahy, president; J. R. McPherson, vice-president; Henry Sperling, secretary; J. R. Reed, treasurer.

TELEPHONE AND TELEGRAPH.

ANAHUAC, TEX.—A telephone line has been constructed between Stowell and Anahuac.

MIDDLETOWN, OHIO—The consolidation of the Bell and the independent telephone companies at West Elkton was effected recently, when the subscribers of the Bell company were transferred to the independent company.

BOSTON, MASS.—The New England Telephone and Telegraph Company has secured control of the Northeastern Telephone Company, the Lewiston-Auburn Telephone Company and the Cumberland Telephone Company, three independents, operating in some twenty-five towns and cities in Maine.

WINSTON-SALEM, N. C.—Manager E. H. Wilson, of the Southern Bell Telephone Company, reports that the company will be in its new quarters by the middle of October. A new switchboard is being installed and the old equipment in the present office in the municipal building will be discarded.

MAUCH CHUNK, PA.—At a meeting of the stockholders of the Carbon Telephone Company, an independent line between Coal Dale and Summit Hill, it was decided to improve the service by extending the line to Tamaqua on the west and Nesquehoning on the east, and connect at both places with the United Telephone and Telegraph Company's lines.

ST. JOSEPH, MO.—The Agency Telephone Company's exchange, including all of the wires, instruments and reserve stock, has been sold to the Clinton County Mutual Telephone Company, of Plattsburg, by Dr. F. C. Owens, of Big Horn, Mont. Three considerations entered into the transaction. The purchaser paid Dr. Owens $1,000, released a debt of $300 due from Owens, and paid to E. W. Miller, of Agency, $4,532.56, secured by a mortgage on the plant. Suit against Dr. Owens for $300 was instituted in circuit court July 16 by the Plattsburg company, which alleged that it had been engaged to repair the Agency lines, and that it had performed services in March, April, May, June and July without recompense. The suit now will be dismissed.

INDUSTRIAL ITEMS.

THE ANDRESEN-EVANS COMPANY, Monadnock Building, Chicago, Ill., has published a handsome catalogue devoted to ore and coal-handling plants and grab buckets.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., in bulletin No. 1,111, describes and illustrates electric motor drives applied to machine tools. This is a very interesting bulletin and should be in the hands of all those interested in this phase of motor application.

THE MINNEAPOLIS STEEL AND MACHINERY COMPANY, Minneapolis, Minn., announces that the Clarkfield Roller Mills and Electric Light Company, of Clarkfield, Minn., has placed an order for an eighty-horse-power Muenzel producer gas engine and suction gas producer for running its mill and electric light plant.

THE HARVARD ELECTRIC COMPANY, 66 West Van Buren street, Chicago, Ill., announces that although its main factory and stock were seriously damaged by fire on August 28, it is in a position to take care of all orders. The eastern territory will continue to be supplied from the New York city office, and the Chicago factory has recommenced work with sufficient force to fill all orders promptly.

THE COLONIAL SIGN AND INSULATOR COMPANY, Akron, Ohio, has issued an attractive booklet devoted to special porcelain for special purposes. This booklet describes a number of interesting types of fuse-box porcelains, lightning arresters, combination cutouts, pendent signs, condulet covers, attachment plugs, panel terminals, switches, telephone accessories, third-rail insulators, cable supports, strain insulators, gas-mantle products, solid porcelain reflectors, raised sign letters, cutout bases, rosettes and resistance tube.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued an attractive pamphlet giving a brief history of the material used in transformer construction and calling attention to the improved Type H transformer in the manufacture of which the described steel is used. This publication is No. 3,687. Bulletin No. 4,611 is devoted to sewing-machine motors; bulletin No. 4,612 describes the combination ammeter and voltmeter for automobile service, and bulletin No. 4,615 the Thomson direct-current test meter, Type CB-2.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a circular announcing a ten per cent reduction in the price of Columbia tungsten lamps. Transportation on standard packages of Columbia tungstens will be allowed east of the Mississippi River, and a small additional charge will be made for delivery to other points. The company's record of breakage for six months amounts to approximately two per cent upon the actual value of the lamps shipped. The company is carrying a complete stock of all sizes and styles of Columbia tungsten lamps.

THE MOLONEY ELECTRIC COMPANY, St. Louis, Mo., has published a very handsome catalogue devoted to its high-efficiency transformers. These transformers are made with great care from material of the highest grade procurable. The design of the transformer permits of the most economical distribution of copper, as well as the use of a sufficient cross-section to carry the current with a minimum loss. The all-day efficiencies of these transformers are very high, and some remarkable qualities have been demonstrated after numerous tests covering every characteristic of transformer performance.

THE JENNEY ELECTRIC MANUFACTURING COMPANY, Indianapolis, Ind., it is announced, will break ground in the near future for a factory at Anderson, Ind., which will, when completed, be four times the size of the present establishment in Indianapolis. This company has been in business for many years, and during the last few years has devoted itself largely to the manufacture of electric motors for printing-press operation. When in its new quarters the company will enlarge its present line of alternating and direct-current motors and dynamos, and will become a more conspicuous factor in the manufacture of electrical machinery.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has issued "Hand Book IP," which is a publication of special interest to dealers and contractors. It treats of the application of the "Chloride Accumulator" to small isolated electric lighting and power plants for factories, residences, etc., where electric service from central stations is not available. It shows how the advantages of a twenty-four-hour electric service are made possible by the use of a battery of "Chloride Accumulators," entering fully into the subject and giving illustrations of the types of batteries and switchboards required for installations of different capacities. Specifications and prices for complete installations are given.

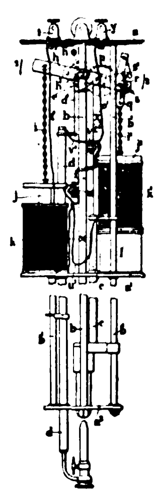
THE STANDARD GAUGE MANUFACTURING COMPANY, Syracuse, N. Y., announces that the Schaeffer & Budenberg Company, of Germany, has sold its plant at Foxboro, Mass., to the Industrial Instrument Company, which was lately organized with Bennett B. Bristol, formerly of the Bristol Company, Waterbury, Ct., as its head. The Standard Gauge Manufacturing Company will operate the plant for the manufacture of gauges, recording instruments, etc., and the property will be deeded to it by the Industrial Instrument Company, as the same interests control both concerns. Watson E. Goodyear, of Naugatuck, Ct., will be president of the Standard Gauge Manufacturing Company; Bennett B. Bristol, treasurer, and Arthur F. Mundy, secretary.

Record of Electrical Patents.

Week of September 8.

897,866. SIGNALING APPARATUS. George F. Atwood, East Orange, N. J., assignor to Western Electric Company, Chicago, Ill. Filed February 26, 1906. The instrument case contains the induction coil, condenser, relays, battery, magneto, switch, springs and ringing system.

897,868. ELECTRIC IGNITION DEVICE OR SPARKING PLUG FOR INTERNAL-COMBUSTION MOTORS. Charles O. Bastian and George Calvert, London, England. Filed June 27, 1906. The ignition device is contained in a removable, renewable glass tube.



897,960.—Electric Arc Lamp.

897,906. LIGHTNING ARRESTER. Frank P. H. Knight, Keokuk, Iowa, assignor to Electric Service Supplies Company, Camden, N. J. Filed June 28, 1907. Separate paths are provided for the circuit-breaker and the discharge. The circuit-breaker is adapted to open the circuit and close the circuit by the normal current.

897,947. LIGHT FIXTURE. Arthur B. Wilson, St. Louis, Mo., assignor of one-half to George T. Breen, St. Louis, Mo. Filed September 27, 1907. The hollow body is adapted to receive hollow lamp-supporting arms, and is fitted with a flanged brace ring.

897,950. SYSTEM OF ELECTRICAL DISTRIBUTION. Joseph L. Woodbridge, Philadelphia, Pa. Filed January 20, 1908. A rotary converter is connected between the alternating-current circuit and the transforming apparatus, and means are provided for responding to changes of electrical condition in the alternating-current circuit.

897,960. ELECTRIC ARC LAMP. Pierre M. Capitaine, Les Lilas, France. Filed November 11, 1907. Means are provided for varying the adjustment of both carbon-holders by means of series and shunt magnets.

897,965. SYSTEM FOR TRANSMITTING ELECTRIC CURRENTS TO CARS. John J. Eagan, San Francisco, Cal. Filed October 18, 1905. The train is electrically connected by means of mutually engaging rods curving downwardly at their ends to contact with side arms.

898,030. SYSTEM OF REGULATION. Joseph Bijur, New York, N. Y., assignor to the General Storage Battery Company, New York. Filed April 4, 1906. A storage battery is used for compensating variations in the working circuit.

898,052. ELECTRIC ARC LAMP. Robert E. Leve, New York, N. Y. Filed January 22, 1908. The winding drum, brake-shoe and escapement wheel are mounted concentrically upon a single rotatable shaft.

898,055. ELECTRIC BATTERY. William MacMillan, New York, N. Y., assignor of one-half to Egbert Winkler and one-half to John J. Walsh, New York, N. Y. Filed August 18, 1902. The battery comprises a plurality of concentric elements located within a cloth-lined insulating exterior cylinder.

898,058. MEANS FOR REGULATING DYNAMOELECTRIC MACHINES. Wilbur L. Merrill, Schenectady, N. Y., assignor to General Electric Company. Filed February 20, 1906. Means are provided to modify the voltage of the generator of the motor-generator set so as to maintain the speed of the motor constant independent of its load.

898,061. FUSE BOX. Harry P. Moore, Newburyport, Mass., assignor to Chase-Shawmut Company, Boston, Mass. Filed April 8, 1907. The terminals are out of line with the fuse support.

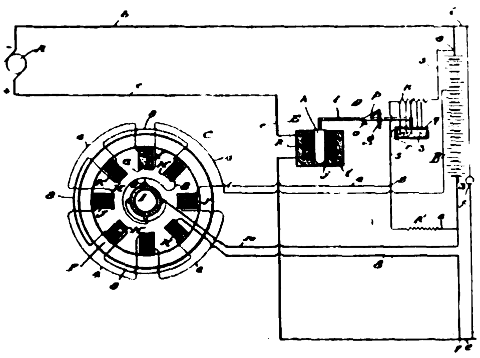
898,073. APPARATUS FOR SPEECH TRANSMISSION. Herbert E. Shreeve, Wyoming, N. J., assignor to American Telephone and Telegraph Company. Filed October 15, 1907. Means are provided for varying the magnetic flux traversing the induction coil.

898,083. ELECTRIC LIGHT FIXTURE. William Amstalden, Amador City, Cal., assignor of one-half to Aaron Weil, Amador City, Cal. Filed December 31, 1907. The lamp cord is contained in a casing provided with a spring-controlled winding drum.

898,086. MULTIPLE ELECTRIC FUSE CUT-OUT. Wilhelm Boehm, Berlin-Charlottenburg, Germany. Filed June 8, 1907. A fuse comprising a plurality of independent sections is contained in an annular chamber and fed as may be necessary through a fuse-containing passageway.

898,095. SIGNAL BOX. Frederick W. Cole, Newton, Mass., assignor to the Gamewell Fire-Alarm Telegraph Company, New York, N. Y. Filed June 10, 1906. Means are provided for the transmission of selected different signals.

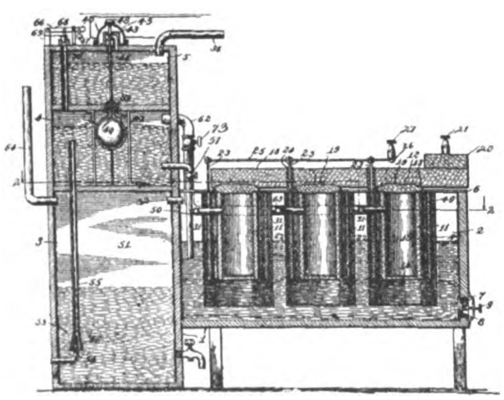
898,097. TERMINAL FOR ELECTRIC CABLES. Charles W. Davis, Edgeworth, Pa., assignor to Standard Underground Cable Company, Pittsburg, Pa. Filed December 23, 1907. A combination multiple petticoat insulator having a conducting core and means for insulating a plurality of separate conductors.



898,030.—System of Regulation.

898,104. CIRCUIT-CLOSER FOR CALL BELLS. Robert Henderson, U. S. Navy. Filed June 4, 1906. The weighted knob or handle contains a helical spring adapted to effect the closure of a circuit upon any increase of pressure.

898,133. APPARATUS FOR PRODUCING VOLTAIC HIGH-CURRENT ARCS. Harry Pauling, Gelsenkirchen, Germany, assignor to the firm of Salpetersäure-Industrie-Gesellschaft, G. M. B. H., Gelsenkirchen, Germany. Filed July 29, 1907. The arc is formed between a pair of curved electrodes, and means are provided for spreading out the arc in a strong magnetic field.



898,055.—Electric Battery.

898,189. ELECTRODEPOSITION OF ALLOYS. Sherard O. Cowper-Coles, London, England. Filed August 2, 1907. The method consists in employing an anode of the alloy to be deposited, and an anode of each of the metals composing the alloy, and independently varying the current passing through the anodes of the metals of the alloy as desired.

898,195. SUPERVISORY SYSTEM FOR TELEPHONE LINES. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed October 31, 1903. Means are provided in connection with a supervisory relay to deprive the signal system of operating current.

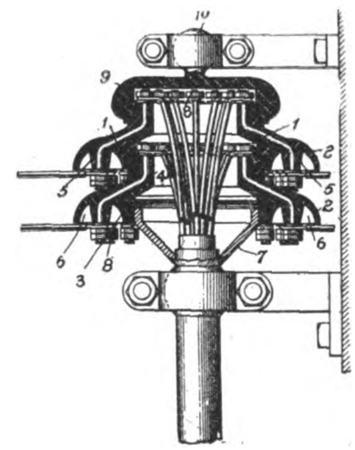
898,197. WIRELESS TELEGRAPH APPARATUS. Halsey Dunwoody, U. S. Army. Filed May 21, 1907. A portable, self-contained radioelectric circuit.

898,216. ELECTRIC RAILWAY CONDUIT. Elmer E. Granger, Chicago, Ill. Filed August 4, 1906. A flexible strip or connector in the conduit is capable of an undulatory movement throughout its length under the influence of polar magnets carried upon the car.

898,218. ELECTRICAL PIANO-PLAYING INSTRUMENT. Alvan L. Hart, Burlington, Iowa. Filed November 29, 1902. The armature operates directly upon its magnets and transmits motion to the hammer.

898,219. RAILWAY ELECTRIC SIGNALING. Job Hutchinson, New York, N. Y. Filed May 10, 1905. This signal is biased to danger, and is normally electromagnetically restrained when its section is unoccupied by a car or train.

898,220. CONTACT RAIL FOR ELECTRIC RAILWAYS. Job Hutchinson, New York, N. Y. Filed May 10, 1905. The rail proper and its flexible cover both afford metal contact with the contact shoe.



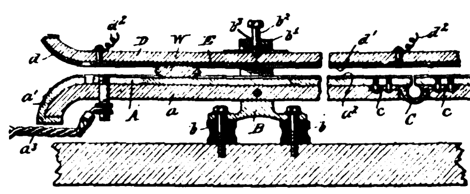
898,097.—Terminal for Electric Cables.

898,221. RAILWAY ELECTRIC SIGNALING SYSTEM. Job Hutchinson, New York, N. Y. Filed January 2, 1906. Means are provided for controlling the signals when the section is occupied by a car.

898,283. TELEGRAPHONE. Harve R. Stuart, Wheeling, W. Va. Filed September 24, 1907. Means are provided for making the telegraphone instrument unresponsive.

898,296. SYSTEM FOR CONTROLLING TRAINS. Paul Winsor, Weston, Mass., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed August 12, 1905. A double-circuit, relay-control block-section signal system.

898,313. ELECTRIC RECORDER FOR ICE PLANTS. William D. Cain and Wade H. Williams, Durant, Okla. Filed May 9, 1908. A detent closes the circuit upon the passage of a block of ice, and causes an index to be made on a dial system.



898,220.—Contact Rail for Electric Railways.

898,324. ELECTRIC SIGNALING SYSTEM. Elmer R. Coe, Wilkinsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed May 11, 1908. The track rails are provided with a signaling current from a high-potential system with a transformer interpolated.

898,370. HIGH-TENSION MAGNETO. Edward B. Jacobson, Pittsfield, Mass., assignor to Pittsfield Spark Coil Company, Pittsfield, Mass. Filed January 16, 1907. The potential is built up by inductive windings and compound field magnets, with a condenser in the primary.

898,404. PROCESS OF MAKING ARTICLES BY ELECTROPLATING. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. A coating of copper is electroplated on a former, a film of nickel electroplated on the copper coating, and a film of iron electroplated on the nickel film.

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CONTENTS

THE EVOLUTION OF THE LAWS OF THERMODYNAMICS.

For his presidential address before the engineering section of the British Association for the Advancement of Science, which held forth recently in Dublin, Ireland, Mr. Dugald Clerk took the subject of the discovery and evolution of the laws of thermodynamics. The address is entirely historical in nature, but there runs all through it a philosophical interlude which adds to the recapitulation the charm of easy reading and affords a most satisfactory method of reviewing our knowledge of a subject dear to the heart and mind of all engineers. The story is romantic, too, and we can live over some of the struggles and gratifications which came to those sturdy workers who have done so much to place our scientific knowledge on a firm footing.

It seems almost absurd, however, in the light of our present knowledge and our superficial scanning of text-book information, that these discoveries were made only at such an expenditure of mental and physical effort. Notwithstanding the fact that steam-engine development had reached a very satisfactory stage, it was not until 1849 that Carnot evolved his famous theory of the functions of a perfect heat medium; and, even at that time, Carnot was very much in the wrong in not a few of his assumptions. With Dugald Clerk we go over the ponderings of Joule and Thomson, and we can see the latter, a young man of mighty intellect, becoming impressed with Joule's announcement and calling to the attention of those who very coolly received these statements their importance and the great field of opportunity that they opened up. We can almost realize a psychological emotion at the joining together of these two intellectual forces, and we can only wonder, in the light of the subsequent achievements of these great minds, that they did not arrive earlier at their splendid conclusions. And, reading further, we are struck with amazement at the tenacity with which other brilliant minds clung to opinions which were finally overcome and rendered obsolete by later investigations and discoveries.

This brings to mind at the present day the thought of the work which is now engaging the attention of some of our greatest intellects in the fields of wireless communication and the various phenomena connected with the study of radioactive forces. Surely it seems that the study of these forces requires a knowledge and an intellect and an ability for abstract reasoning the like of which did not exist in the problems connected with the laws of thermodynamics. Will culture have advanced to such an extent fifty years hence that students, poring over their text-books, will wonder why Becquerel and Hertz, the Curies and Kelvin, Fessenden and Stone, Roos and Pickard, Marconi and De Forest, did not arrive at definite conclusions concerning the phenomena with which they were dealing with less expenditure of effort? Will it then seem that these things should have been more readily understood, or are we becoming bankrupt of intellectual and scientific resources, as was pointed out a decade ago—before Hertz and others of his scientific stature enunciated their wonderful theories concerning the ion and the atom of electricity?

When we realize the marvelous accumulation of information with which we have garnished our intellectual storehouses and read the history of this advance, we are impressed with the fact that for each problem there has been developed a mind sufficiently great to solve it, and we must feel that, even though at times the riddle of the universe seems imponderable, we shall still ascend peak after peak of learning and some day arrive, not at the stars, but sufficiently near to realize that they and we are made of the same clay.

A NEW DEPARTURE IN ILLUMINATING ENGINEERING.

Within the last few years many central stations have realized that a field exists for the better use of illumination on the premises of certain customers, and in an informal way some of the more progressive companies have from time to time gone out of their way to offer suggestions leading to improvement. The most notable step in this direction that has thus far been taken is the action of the Boston Edison Company in opening a special department of illuminating engineering on September 1 at its main offices. This new branch of the company's work will afford free consultation on the application of electricity to lighting problems for any of its customers who will take the trouble to call upon or send for the expert advice which is now at their disposal. The company believes that in helping its customers to use electricity most efficiently it is creating a satisfied clientele which is a most valuable asset, and while in many cases the recommendations of the department will mean a reduction in the monthly bills of customers applying for advice, the fact that the prosperity of the company is intimately related to the prosperity of its clients will in the long run work out to the general advantage of all concerned.

For any public-service corporation to voluntarily take steps which may reduce a portion of its immediate income requires a broad and courageous view of the business situation, and not a little faith in the intelligent appreciation of its customers of efforts to serve them well. In the last twenty-two years the average cost of electricity to Boston Edison customers has been reduced seventy-five per cent. The average dwelling and office cost has been cut fifty-eight per cent; stores, eighty-three per cent, and long-hour burners, eighty-seven per cent. Within the last two years the average cost has been reduced forty per cent. The company has taken from the first an advanced and progressive position regarding the tungsten lamp and other high-efficiency units, and in starting the new department it is expected that the immediate effect of the recommendations will be to create general satisfaction with the policy of showing customers how to get the most and the best light for their money. The numerous inquiries immediately received after the opening of the department was announced show conclusively that the Edison company's customers in Boston and its vicinity are thoroughly alive to the merits of a proposition of this character, and it is expected that some remarkably interesting data will be accumulated within the next few months. We do not know whether the company formally intends to handle the power business in a similar way, but if the work of the illuminating division should be of a permanent character, it would be a logical step to carry the same idea into the motor field. To a large extent, of course, all progressive companies are glad to advise their customers as to the use of power, but the handling of such problems by a special branch of the central station organization affords a more systematic method of dealing with these semi-technical questions.

That there is room for a great deal of improvement in both electric lighting and power applications can not be doubted by any one whose opportunities for observation cover a large part of this country. One of the reasons for this condition is the lack of the proper advice when the original installation is made, and another is the inadequate handling of the statistical end of the power and lighting problem by some of the central station organizations. All new and revised electrical installations call for more or less real engineering skill, and in many instances the purchaser has been entirely unwilling to pay for the advice of an experienced engineer in selecting his apparatus and its method of application to his peculiar conditions. The result has been that while many electric power installations are more efficient than the steam or other mechanical transmissions that preceded them, the bills are actually higher than would be the case if a skilled engineer had been given the chance in the first place to carefully study the conditions. Again, central stations are notoriously deficient in the filing of complete data of their power and lighting installations, so that when the commercial departments undertake to secure new business, many problems have to be figured without the advantage of referring quickly to the detailed facts. The costs of the installation may be filed with some care, but the particulars of the mechanical drive, speed ranges, normal and overload capacities are apt to be lacking. In the lighting field the same paucity of accurate data is notable. A company may have a complete list of all the mercantile houses, for instance, which have adopted the tungsten lamp in place of the gas arc, but it will be unusual if its files contain any particulars of the installation in the line of room sizes, wall colors and height of installed lamps above the floor. It is not enough to tabulate the number of lamps replaced in each case. In a recent trip through about a dozen states in search of central station power data, only one company was found which had the details of the pulley sizes in its possession, in connection with its applications of motor driving.

These conditions will inevitably be remedied if the central stations find it profitable to take up and continue the advising of their customers along the lines started in Boston, and in cases where an outside engineer would clearly never be called in there is no doubt that much good may be expected from such a policy. Experience alone will tell just where the central station should cease to advise its customers and where the consulting engineer should step in. Presumably the time is scarcely ripe as yet for highly successful independent practice in the minor problems of illuminating engineering, and in the smaller power applications the cost of expert consulting advice from other sources than the central station or manufacturer's staff is clearly prohibitive. In a general way it would seem that when the work is of sufficient magnitude to require the making of plans and specifications by an outside party, the central station should stand aside, furnishing its advice freely as before, but refraining from entering distinctly upon the consulting field through the preparation of costly drawings, the writing of specifications and the supervision of construction. There is clearly a limit to the wise expenditures of a central station for advising its customers, but time alone will show where this limit falls.

DESTRUCTION OF THE PARIS CENTRAL TELEPHONE EXCHANGE.

Despatches from Paris state that on September 20 a disastrous fire destroyed the central telephone building and a portion of the post-office at the French capital. It is estimated that the loss will approximate $6,000,000. This is, however, the estimate for only the material loss, as no approximation can be made of the loss incident to the prostration of business and the anxiety and mishaps which ensued from the tying-up for even a short time of the arteries of communication of a great cosmopolitan centre. Not only was telephonic communication suspended, but the outbound telegraph systems were also put temporarily out of commission. Heroic work under the direction of the under secretary of posts and telegraphs soon re-established telephonic communication with London and Brussels from the Bourse and the post-office. Arrangements are being made to set up a provisional exchange to take care of commercial communication.

For a long time the telephonic situation in Paris has been anything but satisfactory. Only recently we had occasion to review an article by the president of the Paris association for the improvement of the telephone service, in which it was emphatically deplored that the government was entirely incompetent to cope with the necessities of the situation, and advocating the turning over of the system to a private concern. Many leading business men of Paris hold the opinion that it is only by enlisting private capital in the enterprise that the vast amount of money needed to rehabilitate the system can be procured, as the government appropriation is entirely too small, and the inertia of the government organization will not allow the present generation of business men in Paris to secure the advantages of a modern system. It is deplorable indeed that Paris is thus so suddenly deprived of its telephonic communication, because, bad as the service may have been, it certainly was a great improvement over no service at all. Now, however, that an accident has made it necessary for actual and material rehabilitation, it would be well for the government to give ear to the protests of those who need and use the telephone, and encourage the installation of a modern system built and operated, if need be, entirely by private capital.

COMMERCIALISM.

The convention of the Vermont Electrical Association, held at Bennington last week, was devoted mainly to a discussion of the commercial side of public utility work, the technical, or engineering, features of central station service being referred to only incidentally. The keynote of the situation was sounded in the presidential address, when it was declared that the technical problems had been pretty well solved, and that there was nothing essentially new to be discussed at the present time. Matters of public policy, of increasing the number of new customers and retaining those already on the books of the company, were to-day of prime importance to the central station manager. One of the speakers, a copious abstract of whose remarks appears on another page, made the bold statement that five years hence the engineering features would be incidental to what will then be regarded as a purely commercial proposition of manufacturing and selling a necessary commodity. Mr. Rae's remarks in some directions are radical, and the sting will go deep and possibly hurt a good deal; but they should not be taken so much as an attempt to teach one one's business as they should be regarded as the effort of the specialist to indicate possible lines along which special work may be conducted. The men who are to-day foremost in developing plans for increasing the sale of current are not claiming to know much, if anything, about the engineering features of central station work, but they do believe that they know how to sell a product once it is available for the market.

Now, we must realize that there is plenty of opportunity for each to help the other. The engineer will devote his attention to making his station safe, his transmission system reliable, and to producing electricity at the lowest possible cost consistent with reliability. On the other hand, the executive department will unceasingly direct its efforts toward increasing the market for its product by, first of all, insisting that the public shall know that it is in business the same as any other manufacturer, that its product is tangible and is subject to the same laws as any other manufactured product, and, while encouraging a monopoly of this service, indicate the same regard for its patrons as exists when there is the most open-handed and free-for-all competition.

Vermont Electrical Association.

Seventh Annual Convention, Held at Bennington, Vt., September 16 and 17.

THE seventh annual convention of the Vermont Electrical Association, held in Bennington, Vt., September 16 and 17, was unique in several respects. There were only three numbers on the programme, and all of these were purely commercial. The fact is significant. "We feel that the technical problems are pretty well solved and not especially new," said President E. E. Larrabee in opening the meetings, "but the commercial questions are always new and we never tire of talking of how to get more new business without losing any of the old, how to create demands for current-consuming devices and how to make the use of electricity a necessity instead of a luxury."

The programme as announced was made up of papers by H. C. Rice, of Cleveland, Ohio, on "The Tungsten Lamp and Its Effect Upon the Smaller Central Station"; by Frank B. Rae, Jr., and George Williams, of New York, on "Commercialism"; by Henry L. Doherty, of New York, on "Public Service Corporations." Owing to a misunderstanding Mr. Doherty was unable to be present, but the association was fortunate in filling his place with an address on "State and National Electric Light Associations," by T. Commerford Martin, of New York. Glenn Marston, of New York, also spoke on "Public Policy."

About 100 members and guests were present in the meeting room when President Larrabee called the convention to order.

Harry C. Rice followed with his paper on tungsten lamps, which combined a brief sketch of the technicalities of lamp making with much practical advice on the commercial aspects of high-efficiency units. In describing tungsten lamps, Mr. Rice showed specimens of the ore from which the metal tungsten is reduced, together with samples of crude and refined tungstic oxid, pure tungsten in powdered form and finished filaments. He then launched into the commercial questions involved in the selling and renewing of these lamps, covering the subject at length.

Comparisons were made between the tungsten lamp and the flaming arc, gas arc, gas burner, Nernst lamp and various incandescent units, and arguments adduced to prove that there is no reason to fear the tungsten; rather that central station men should take the initiative and offer the new lamps rather than wait until they are driven into this field of lighting.

In the discussion that followed many valuable points were brought out. H. W. Brown, of the General Electric Company, pointed out the difficulties and percentage of loss in manufacture and stated that as the lamps come into more general use the price will gradually decrease. Their present high cost, he said, precluded free renewals, but this was really an advantage as it served to educate the public away from the free renewal and made them appreciate the economy of high-efficiency units. Mr. Brown also talked at some length on the monthly rental plan which is being tried in various localities. At Lowell, Mass., a flat rate of twenty-five cents per lamp per month is charged for tungsten renewals; at Elkhart, Ind., the rate is twenty-four cents for a forty-watt lamp, twenty-seven cents for a sixty-watt lamp and thirty cents for a 100-watt lamp. The plan, he said, was proving successful.

Samples of the twenty-five-watt tungsten lamp were exhibited and led to considerable discussion as to their effect. The feeling was expressed by several of those present that both this and the 250-watt size can hardly be considered as commercially available, though numbers have been installed in practical service with satisfactory results. The city of Hartford, Ct., Mr. Brown said, is about to install 250-watt tungstens for street lighting in order to secure data on results. Mr. Larrabee stated that where a plant is loaded to its capacity, the tungsten lamp offers a means of saving investment in new generators and enables the lighting man to secure the same income from customers with longer hours of burning.

The discussion of Mr. Rice's paper occupied the entire afternoon session.

The evening session was held in the rooms of the Bennington Club and was attended by a number of the leading business and professional men of the city. The first item on the programme was Mr. Rae's paper on "Commercialism," in part as follows:

Five years ago commercial engineering in the central station field was the doubtful side line of a technical business. Five years hence electrical engineering will be only incidental to what will then be an almost purely commercial enterprise.

Five years ago, also, the lighting company was—in the public mind—a monopoly, a slimy serpent of graft and grab, proceeding by devious and subterranean ways, debauching city officials, pre-empting public lands and franchises and robbing the widow and orphan. Five years hence it will be recognized generally that the central station is nothing more or less than a manufacturer and retailer of a necessary commodity.

The reason for these changes may be summed up in one word—commercialism.

DEFINITION.

Central station commercialism is even yet vaguely understood. To many managers of lighting plants it means little more than a spasm of hysterical advertising. To others it means such advertising plus a season of brazen solicitation by underpaid canvassers. But to a few, perhaps one per cent of the central station managers of the country, it means the wise conduct of business along business lines, unhampered on the one side by too narrow engineering ethics or upon the other by political intrigue or financial jugglery.

It embraces—I name them in the order of their importance—public policy, general management, soliciting, advertising.

Let me define these briefly.

PUBLIC POLICY.

Public policy means the company's attitude and policy toward the public. One point may well be remembered, however: public policy is not something to resolve about in board meetings and spread upon the records; it is the mainspring of daily routine. It applies not only to public officials, newspapers and important customers, but to the ignorant foreigner who kicks about his minimum bill. It applies whether you have indigestion or not; it must be maintained unchanged in the face of any accident to plant or lines; it must be followed by every man in the organization every hour of the day.

GENERAL MANAGEMENT.

General management means what it says—general management. It is part of commercialism—the most important part.

The organization of a central station personnel parallels closely the layout of the plant and system. The board of directors is the prime mover. The general manager is the generator; the engineers, linemen, office force and solicitors are the apparatus energized, all doing a variety of work over a large or small territory.

but all getting their impetus from one source. And just as the generator in your plant does not actually perform the work of the motors on the lines, so the real general manager does not do the work of his employés. It is commendable to be able to strap on a pair of climbers, shin up a pole and demonstrate to some mutton-headed lineman the right way to do his work—but it is poor management. A good manager would not have that kind of a lineman.

This holds in all departments. The manager draws his pay for managing, not for being every employé's superior in every branch of central station work. Successful management requires a certain amount of physical and mental leisure in which to ponder and plan. The man who clutters his brain with the detail of non-essentials will be unable to give clear-sighted, unhurried consideration to those larger problems which daily confront him. Of these problems nine out of ten are commercial.

THE COMMERCIAL CAMPAIGN.

First of these problems is the main plan of the commercial campaign; there must be one, whether or not a company employs solicitors and advertises. Just as one would not build a power-house without first sketching it out on paper, so there can be no commercial success without some sort of prearrangement. Without it you would only putter.

Right here too many managers err. They confound a business-getting scheme with a commercial plan. They hit upon some such detail as the installing of signs on flat rates or of loaning tungsten fixtures and renewing the lamps for a set sum per month. Those are schemes, not plans.

A commercial plan is a broad policy of commercial advancement based upon the daily load-curve, the condition of the company treasury, the status of the company's securities, local business and political conditions and the manager's ability as an organizer and executive. Such a plan has its foundation on the bed rock and its purpose is a commercial structure which shall endure indefinitely. (And here let me say parenthetically that makeshifts are the curse of America, and the manager who knowingly is content with a makeshift commercial plan writes himself down as a sloven or a fool. Happily, most such mistakes are the result of shortened perspective.)

The petty detail of the day is so close to the eye and looms so large that one can scarcely see it in its true relationship to the larger scheme of things. Like the boy in the fable, there are so many trees we can not see the forest. But if we recognize the difficulty its correction is easy.

Having sketched your main commercial plan—one that is broad, solidly grounded, yet flexible enough to allow for technical, political or business developments—it will be found that the various business-getting schemes, devices and methods will take their proper places. There is an abundance of such schemes, all good when adapted to local conditions. Their danger lies in the tendency to *adopt* rather than to *adapt*. No two sets of local conditions are identical, and no two central station organizations are the same. The electrical fraternity is fortunate in that it is common practice to interchange ideas and experiences, but when this intercourse results in the method of one manager being copied exactly and slavishly by another, without regard to the dozens of peculiar conditions surrounding each, it is a decided disadvantage. Do not think from this that I advocate nothing but new and original schemes. The company that relies wholly upon the brains within its organization will have a hard time. Gather ideas where you will—from the trade press, the manufacturer's salesman, the experience of other industries, from your fellow managers—take them where you find them, but make them your own. Fit them to your needs—adapt them to your organization—trim and cut or expand and enlarge them to meet your local conditions.

SOLICITING.

When it comes to the actual soliciting of a contract, adapt again your scheme to the specific case in hand. Make it fit not only your own requirements, organization and local conditions, but the particular needs and individual characteristics of the man whom you solicit. This is important. Too many companies adopt an idea and then try to force it, willy-nilly, down the throats of their clients. It is a vain and saddening experience. Despite your best arguments to the contrary, the average business man will persist in believing that he knows something about his own affairs. Nine men in ten will rebel at the cut-and-dry scheme, the standard and uniform "free sign," the ready-to-wear window lighting or store equipment. By all means have a general scheme, but make it flexible; allow for the idiosyncrasy (or idiocy, if you prefer) of the individual customer.

And give your solicitors a chance to use that flexibility. At the risk of being guilty of bragging, I may say that I sell sixty per cent of the men I call on. This is not the result of crafty salesmanship or superior intellect. It is because I never see a man with a sales proposition that has not been carefully adjusted to fit his needs and give him results. All his objections are provided for and refuted in advance. Not only that; the made-to-measure proposition is something which he can and will endorse immediately, enthuse over and insist upon with the least possible delay. The central station salesman can do the same. He knows—or should know—every customer in advance. He knows that man's business, rating, character, possibilities, prejudices. What easier, then, than to fit the scheme to the man, instead of trying to stretch or compress every man to a stock scheme?

A trouble experienced by too many lighting companies is that they get results from only a very small percentage of their salesmen's calls. This is not always the salesman's fault; generally it is because they either insist upon too many calls or seem to the salesman to demand too great immediate results. And the salesman, hurrying from door to door like a book agent the last week before Christmas, neither prepares his way in advance nor leaves a friendly opening for a call back.

In guiding salesmen, give them a little head, counsel them to patience and careful preparation, rehearse with them the day's campaign. Then, when a critical moment comes, swing every ounce of weight, every breath of influence, to the aid of the man with the order book. And when he has won, be free with the praise that heartens him for the next conquest. The great mistake in this field consists in dubbing our salesmen "solicitors" and in looking upon them as a species of business-getter but one removed from the book agent—poorly paid, delegated with no authority, supported only when convenient. If you hire salesmen, hire good ones. Give them your confidence and support. Treat them like men. Cultivate and permit them to use their brains, tact, discretion. It pays.

ADVERTISING.

Advertising, as it is generally understood, has at best but a minor place in the central station commercial plan. The most effective printed advertising in the world will only carry a short way. It is simply a manifestation of the company's public policy and to be effective must be reinforced by fair, liberal and tactful management, and followed up by clean, businesslike and earnest solicitation.

But if we take the better and broader

meaning of the word, advertising is of next importance to management. As now understood by the most thorough advertising men, the word embraces whatsoever influences the public mind as related to the company. Thus, the neat appearance of your office boy is good advertising. A sweet-voiced, tactful telephone operator; a well-dusted window display; an attentive receiving teller; a good-natured, likable meter-reader; a well-timed contribution to charity; a good cigar and a warm handclasp offered in unison with sincerity to a newspaper man; quick, courteous attention to complaints; prompt apology for errors; earnest endeavor to serve any one anywhere at any time in matters electric —these are forms of advertising, and the best advertising. They cost nothing. They mark the successful manager. They are so intangible that one notes only their absence; their presence I have known to ward off municipal ownership and double dividends.

A certain amount of printed advertising is of course necessary and profitable, but it must be prepared with skill and care. If you have not the skill or lack time to bestow the care, hire it done. It is of the same importance and should have the same particular attention which your lawyer gives to a franchise or a contract. As a matter of fact, an advertisement is a contract and in some states can be enforced in court of law.

The most successful printed advertising for a central station is that which reflects most broadly to the advantage of the city. Be an enthusiast for the town. Find the opportunities for bragging, and whoop it up. Next in importance is educational advertising—the A B C's of electricity presented in words of one syllable. Such advertising lightens the work of your solicitor and brings voluntary inquiries for exact figures. Finally, there is the general publicity—interviews, personals, news of the company, write-ups of notable installations which gratify the merchant, stories of the wonders of electricity which make folk appreciate your service. These are all advertising, all easy to secure, all profitable when published.

Mr. Rae was followed by George Williams, who exhibited a large number of lantern slides showing interesting and spectacular examples of street, sign and outline lighting. Mr. Williams's remarks were brief comments on the installations shown, but he took pains to point out that the brilliant illumination of business streets serves the city as the best possible municipal advertising and greatly increases all local business. The policy of the lighting company, he said, should be to do whatever it can for the city in which it operates; to arouse public spirit, institute and encourage movements toward municipal betterments and make the people realize what a great and important part electricity plays in their prosperity. The views and remarks of Mr. Williams were received with enthusiasm, not only by members of the association, but by the business men present.

Glenn Marston was then introduced and gave a short talk on "Public Policy," saying, in part, "No farsighted public utilities man objects to reasonable state regulation; it is the unreasonable and municipal regulation that harms. Nor do we object to municipal ownership as such, but to the false showings made by municipally owned plants which make the public believe that such plants operate more cheaply than those owned by individuals or corporations." He then stated that reasonable control, which should include municipal with private plants, would show that business men can conduct their business better than politicians can conduct similar business for a city and, if the truth were known, no city would ever want municipal ownership. In dealing with the work of public utilities commissions, Mr. Marston pointed out that they were as beneficial to the small company as to the large and said unreservedly that no public service law, honestly drawn for the mutual protection of public and company, but would prove of immense benefit to the lighting industry.

T. Commerford Martin made an able address on the purposes of associations and the advantage of joining with the National Electric Light Association. After sketching briefly the history of the industry and quoting figures to show its huge importance to-day, Mr. Martin said that the future lies wholly with the central station managers. Touching the subject of state control, he pointed out that the public service commission is not a menace but a dam which will, in future, hold back any tide of socialism or worse evil which may arise, and predicted that within ten years every state in the Union will have such a commission. Mr. Martin's words in praise of the work done by utilities commissions in New York, Massachusetts and Wisconsin created a profound impression.

The purpose of Mr. Martin's address, however, was to urge the Vermont Electrical Association to co-operate with the national association, and in this he was successful.

The executive session was held just prior to the regular meeting on Wednesday afternoon. The question of co-operating with the state legislature in drafting a fair and equitable public-utilities bill was discussed at some length and steps taken toward this end. The matter of closer relationship with the National Electric Light Association was also favorably considered. The following officers were elected:

President, F. H. Parker, Burlington Light and Power Company, Burlington.

First vice-president, James E. Davidson, Consolidated Lighting Company, Montpelier.

Second vice-president, C. E. Parker, Vergennes.

Secretary-treasurer, A. B. Marsden, Manchester.

Members of executive committee: Three years, C. C. Wells, Middlebury, and George S. Haley, Rutland.

On Wednesday evening President Larrabee gave an informal dinner at the Bennington Club in honor of F. H. Parker, the incoming president of the association. The guests were:

F. H. Parker, Burlington, president-elect Vermont Electrical Association.

Hon. F. E. Howe, Bennington, representative to legislature and publisher of the Bennington *Banner*.

Hon. C. H. Dailey, Bennington, collector of customs.

I. E. Gibson, Bennington, president Bennington Club.

O. M. Barber, Bennington, attorney.

Colonel F. S. Richardson, Bennington.

A. B. Marsden, Manchester, secretary-elect Vermont Electrical Association.

George S. Haley, Rutland.

T. C. Martin, New York, editor *Electrical World*.

Harry C. Rice, Cleveland, vice-president G. I. Lamp Company.

George Williams, New York, Henry L. Doherty & Company.

Glenn Marston, New York.

Frank B. Rae, Jr., New York, editor *Selling Electricity*.

The clambake on Thursday was particularly enjoyable. The members of the association and their guests left the headquarters in the Putnam House at about 10.30 for the picnic grounds and amused themselves with various sports until the bake, which was ready shortly after one. The bake was pronounced "the best ever."

E. D. Strickland came down from Buffalo to direct a rejuvenation of the Sons of Jove. The ceremony was performed with much pomp and circumstance—and now nearly everybody in Vermont is a Jovian.

The Association of Edison Illuminating Companies.

The annual convention of the Association of Edison Illuminating Companies was held at the Hotel Aspinwall, Lenox, Mass., September 15, 16 and 17. The convention was called to order on Tuesday morning, September 15, at 9.30 o'clock, and the presidential address delivered by Alex Dow, of Detroit, Mich. The report of the executive committee was presented by W. W. Freeman, Brooklyn, N. Y., secretary, and the report of the treasurer by Louis A. Ferguson, of Chicago. J. W. Cowles, of Boston, presented the report of the Committee on Meters. A paper entitled "Measurements with Portable Testing Instruments" was read by F. P. Cox, of Lynn, Mass. The report of the Committee on Electric Heating was presented by John F. Gilchrist, chairman. This was followed by a paper entitled "A Study of Residence Lighting." The report of the Committee on Storage Batteries was presented by Louis A. Ferguson, Chicago, chairman, followed by a paper by P. S. Millar, of New York, entitled "A Review of the Policies Pursued by Edison Companies in Handling Incandescent Lamps." The report of the Committee on National Code was presented by William C. L. Eglin, Philadelphia, chairman.

The second session was held on Tuesday evening. The report of the Committee on Incandescent Lamps was presented by John W. Lieb, Jr., New York, chairman. John W. Howell, of the incandescent lamp department of the General Electric Company, Harrison, N. J., delivered a talk on "Recent Developments in Metal-Filament Lamps." A paper entitled "Probable Effects of the Higher-Efficiency Lamp on Central Station Income" was read by E. F. Tweedy, New York. A paper entitled "A Self-Supporting Tungsten Lamp Campaign" was read by M. S. Seelman, Jr., of Brooklyn.

The third session was held on Wednesday morning, when the report of the Committee on Steam Turbines was read by Charles N. Parker, Boston, chairman. A paper entitled "Operation of the Boiler Plant and Cost of Making Steam" was read by J. P. Sparrow, New York. A paper entitled "Supplementary to 1907 Paper, 'Steam Heating from Central Stations,'" was read by B. R. Fales, Detroit. A paper entitled "Modern Substation Apparatus" was read by E. M. Allen, Schenectady. A paper entitled "Single *Versus* Three-Phase Transformers for Distribution Purposes" was read by L. L. Elden, Boston. A paper entitled "Short-Circuits on Alternators" was read by E. J. Berg.

The fourth session was held on Wednesday evening. The report of the Committee on High-Potential Disturbances was presented by W. F. Wells, Brooklyn, chairman. Dr. Charles P. Steinmetz delivered a lecture entitled "Electrical Engineering Problems of the Future."

The fifth session was held on Thursday morning. The first paper was entitled "Some Advertising Notes, with Particular Reference to the Advertising Value of the Display Room," by Howard K. Mohr, Philadelphia. A paper entitled "The Status of the Special Customer" was read by James V. Oxtoby, Detroit. A paper entitled "Compensation to Injured Employés—Plan of the New York Edison Company" was read by E. M. Atkin, New York. The technical session was closed with a talk by Dr. Louis Bell, entitled "Lighting in Europe."

The following officers were elected for the ensuing year:

President—W. W. Freeman, Brooklyn, N. Y.

Vice-president — George H. Harries, Washington, D. C.

Secretary—D. L. Huntington, Spokane, Wash.

Treasurer—L. A. Ferguson, Chicago, Ill.

Executive committee—Samuel Insull, Chicago; Charles L. Edgar, Boston; John W. Lieb, Jr., New York; Joseph B. McCall, Philadelphia; Thomas E. Murray, New York.

Meeting of Railway Commissioners.

The annual meeting of the National Association of Railway Commissioners will be held at Washington, D. C., on October 6. This is the twentieth annual convention of the association. It is expected that the Interstate Commerce commissioners, the various commissioners who have been appointed by states throughout the Union, and prominent legislators, railroad men and financiers will be in attendance.

The committee to report on construction and operating expenses of electric railways is composed of James S. Harlan, Interstate Commerce Commission; Milo R. Maltbie, Public Service Commission, First District, New York; J. C. Morris, Ohio; William J. Wood, Indiana; William Kilpatrick, Illinois; Hartford Erickson, Wisconsin; Orasmus R. Fyler, Connecticut.

Pittsburg Section, American Institute of Electrical Engineers.

The September meeting of the Pittsburg (Pa.) section of the American Institute of Electrical Engineers was held in the lecture hall of the Carnegie Institute. The following officers were elected for the ensuing year: Chairman, W. Edgar Reed; secretary, B. P. Rowe; executive committee, C. B. Auel, B. Rutherfoord, F. Uhlenhaut, Jr., C. W. Davis, E. B. Tuttle, Ludwig Hommel.

Mr. Reed has had a broad experience in electrical engineering both in France and in America.

F. D. Newbury abstracted J. L. Woodbridge's paper on "The Application of Storage Batteries to the Regulation of Alternating-Current Systems." He explained how batteries were used in connection with rotary converters having two-part split pole-pieces and also rotary converters having three-part pole-pieces.

R. L. Flanders read a paper on the "Relay Type of Load Regulators for Storage-Battery Systems." He explained by diagrams how beautifully a relay can be used together with a battery to regulate the supply of alternating current through a rotary converter to produce a satisfactory supply of direct current.

P. M. Lincoln said that the idea carried in all electrical engineers' minds was that the ratio of the direct current to alternating current in a rotary converter was fixed; being for two-phase 1 to 0.7 and for three-phase 1 to 0.6. These ratios do not hold exactly and it has been known that by trimming the pole-pieces and giving the proper back charge, the ratios could be modified. The idea of changing the field form in order to change the alternating-current and direct-current ratio is believed to be original with Mr. Woodbridge. The two-part pole-piece rotary has the advantage of combining the functions of a rotary and regulator. The disadvantages are that it will probably be more expensive, have a distorted wave-form, the power-factor can not be made unity, and the conditions are favorable for resonance with large cable systems, and also for hunting.

J. L. Davis discussed Mr. Fessenden's paper on "Wireless Telephony." He explained how the energy began to flow out into space from the antenna harp when the frequency became 85,000 and from that figure on to 100,000 the energy radiated increased from zero to nearly 100 per cent. He also explained the design of a high-frequency generator, the arrangement of Poulsen's arc, and the marginal method of tuning invented by Fessenden.

E. B. Tuttle spoke of the method of relaying telephone messages from wire lines to wireless transmitters, and *vice versa*.

S. P. Grace, in the discussion, spoke of the progress made in telephony. He started with the first form of telephone, that of iron rods driven into the ground outside of forts to indicate to the defenders any attempt of an enemy to tunnel into the fort, and showed what rapid progress had been made in the art. He referred to some early letters on the invention of the telephone written by T. A. Edison to T. B. A. David.

American Society of Mechanical Engineers.

The season of professional meetings of the American Society of Mechanical Engineers will be opened on Tuesday evening, October 13, by a meeting of the Gas Power Section in the Engineering Societies Building at 29 West Thirty-ninth street, New York city.

H. L. Doherty, chairman of the Meetings Committee of the section, will present a report for discussion outlining plans for future work, and there will also be a discussion of standards to be used in gas-power work.

Two papers will be read, one by D. A. Harvev on gas-producer plants, with data upon costs, performance, etc.; and one by N. T. Harrington, giving the results of tests to determine the loss of fuel weight in a freshly charged producer, due to increase of ash contents in the fuel bed. The first paper will be illustrated by lantern slides, showing actual plants and plans for the arrangement of apparatus.

Large Water-Power Development on the Mississippi River.

A 300,000-kilowatt water-power plant is to be erected by Cooper & Powelson at Keokuk, Iowa. The plans contemplate damming the Mississippi River in the rapids at Keokuk. Current for electric light and power is to be supplied to Keokuk, Davenport, Burlington, Rock Island and other manufacturing cities and towns in that district, and eventually to St. Louis, Mo. Mr. Cooper owns the government franchise to build a dam across the Mississippi River at Keokuk.

The Convention of the American Street and Interurban Railway Association.

The annual convention of the American Street and Interurban Railway Association and its affiliated and allied associations will be held at Atlantic City, N. J., October 12, 13, 14, 15 and 16. The American Street and Interurban Railway Manufacturers' Association is making great preparations for a magnificent exhibit, which will cover the entire area of Young's million-dollar pier. One hundred and fifty different companies have already been assigned exhibit space. The association booth for the registration and information of delegates and guests to all of the associations will be located at the Boardwalk entrance to the pier. The manufacturers' association will also have a booth at the same place, which will take care of similar matters relating to the exhibitors and the members of that organization.

All of the meetings of the American association and of the Transportation and Traffic association will be held in the Greek Temple, near the outer end of the convention pier. The Accountants will hold their two sessions on Wednesday, at the Chalfonte Hotel, and their Thursday and Friday sessions in the Aquarium Court Hall, near the Boardwalk end of the convention pier. The Engineers will hold their Tuesday and Wednesday sessions in the Aquarium Court Hall, and their Friday session in the Greek Temple. The Claim Agents will hold all of their sessions at the Traymore Hotel.

The following programme has been announced:

ACCOUNTANTS' ASSOCIATION.

Tuesday, October 13—2 to 5 P. M.—Registration and badges.

Wednesday, October 14—9.30 A. M. to 12.30 P. M.—Convention called to order. Annual address of president. Annual report of executive committee. Annual report of secretary-treasurer. Paper—"Organization of the Accounting Department of an Electric Railway and Light Company," by A. R. Patterson, general auditor Savannah Electric Railway Company, Savannah, Ga. Report of Committee on Collection of Blanks and Forms, by Elmer M. White, secretary Accountants' Association, Brooklyn, N. Y. Appointment of Convention Committee. New business.

Wednesday, October 14—1 P. M.—"Get together luncheon."

Thursday, October 15—9.30 A. M. to 12.30 P. M.—Paper—"Interline Accounting of Interurban Railways," by W. H. Forse, Jr., secretary and treasurer Indiana Union Traction Company, Anderson, Ind. Paper—"Accounting Methods of a Holding Company," by P. S. Young, comptroller Public Service Railway Company, Newark, N. J. Report of Committee on Standard Classification of Accounts and Form of Report. Report of Committee on International Standard Form of Report. Appointment of Nominating Committee.

Friday, October 16—9.30 A. M. to 12.30 P. M.—"The Effect of Electrification on the Accounting Methods of Steam Railways," by A. B. Bierck, general auditor Long Island Consolidated Electrical Companies, Long Island City, N. Y. Reports of Convention Committees. Report of Nominating Committee. Election of officers. Installation of officers. Adjournment.

ENGINEERING ASSOCIATION.

Tuesday, October 13—9.30 A. M. to 12.30 P. M.—Registration and badges.

Tuesday, October 13—2 P. M. to 5 P. M.—Convention called to order. Annual address of president. Annual report of executive committee. Annual report of secretary-treasurer. Appointment of Convention Committees. Report of Committee on Maintenance and Inspection of Electrical Equipment.

Wednesday, October 14—9.30 A. M. to 12.30 P. M.—Report of Committee on Standardization. Report of Committee on Power Generation.

Wednesday, October 14—2 P. M. to 5 P. M.—Report of Committee on Control. Appointment of Nominating Committee. Report of Committee on Power Distribution.

Thursday, October 15—9.30 A. M. to 12.30 P. M.—Inspection of exhibits.

Thursday, October 15—2 P. M. to 5 P. M.—Inspection of exhibits.

Friday, October 16—9.30 A. M. to 12.30 P. M.—Report of Committee on Car and Car-House Wiring. Report of Committee on Operating and Storage Car-House Designs. Question box.

Friday, October 16—2 P. M. to 5 P. M.—Report of Committee on Way Matters. Report of Committee on Economical Maintenance. General business. Report of Nominating Committee. Election of officers. Installation of officers. Adjournment.

CLAIM AGENTS' ASSOCIATION.

Monday, October 12—9.30 A. M. to 12.30 P. M.—Registration and badges.

Monday, October 12—2 P. M. to 5 P. M.—Convention called to order. Annual address of the president. Annual report of the executive committee. Annual report of the secretary-treasurer. Appointment of Convention Committees.

Tuesday, October 13—9.30 A. M. to 12.30 P. M.—Paper—"The Organization of a Claim Department for a Small or Moderately Large Company, Including a School of Instruction as a Means of Preventing Accidents," by Francis J. Ryan, M.D., Syracuse Rapid Transit Railway Company, Syracuse, N. Y. Paper—"The Claim and Its Disposition," by Peter C. Nickel, claim agent New York City Railway Company, New York, N. Y.

Tuesday, October 13—2 P. M. to 5 P. M.—Paper—"Uniformity in Claim Department Records and Accounts," by John J. Reynolds, claim agent, Boston Elevated Railway Company, Boston, Mass. Paper —"The Duties of Claim Agents and Other Officials of Quasi-Public Corporations to the Public," by Eugene R. Roberts, attorney Knoxville Railway and Light Company, Knoxville, Tenn. Appointment of Nominating Committee.

Tuesday, October 13—8 P. M.—Social smoker and entertainment. (Place to be announced later.)

Wednesday, October 14—9.30 A. M. to 12.30 P. M.—Question box. Discussion—"The Medical Side of the Prevention of Accidents." General business. Reports of Convention Committees. Report of Nominating Committee. Election of officers. Installation of officers. Adjournment.

TRANSPORTATION AND TRAFFIC ASSOCIATION.

Monday, October 12—9.30 A. M. to 12.30 P. M.—Registration and badges.

Monday, October 12—2 P. M. to 5 P. M. —Convention called to order. Congratulatory address by Hon. W. Caryl Ely. Annual address of the president. Report of organization meeting. Annual report of the executive committee. Annual report of the secretary-treasurer. Appointment of Convention Committees. Reports of special committees. Paper—"How Can a Small Road Best Promote Traffic and Increase Its Revenue?" by Ernest Gonzenbach, general manager Sheboygan Light, Power and Railway Company, Sheboygan, Wis. Report of Committee on Training of Employés.

Tuesday, October 13—9.30 A. M. to 12.30 P. M.—Paper—"Carrying of United States Mail on Electric Railways, Its Advantages and Disadvantages, and the Compensation Therefor," by C. H. Hile, assistant to vice-president Boston Elevated Railway Company, Boston, Mass. Report of Committee on Freight and Express. Paper—"Progress to Date in Carrying Freight and Express Matter by Electric Roads—Some Mistakes That Have Been Made and Their Remedy," by C. V. Wood, general freight and passenger agent New England Investment and Security Company, Boston, Mass.

Wednesday, October 14—9.30 A. M. to 12.30 P. M.—Appointment of Committee on Nominations. Symposium—"The Possibilities of a Well-Conducted Publicity Department," by George Sabin Brush, clerk Transportation Department Boston Elevated Railway Company, Boston, Mass. B. R. Stephens, general traffic manager Illinois Traction System, Springfield, Ill. Charles E. Flagg, department of publicity Inland Empire System, Spokane, Wash. George H. Gall, publicity manager Washington, Baltimore & Annapolis Electric Railway Company, Baltimore, Md. Charles W. Lamb, advertising expert, Milwaukee, Wis. Report of Committee on Interurban Rules.

Thursday, October 15—9.30 A. M. to 12.30 P. M.—Paper—"The Operation of Multiple-Car Trains on Interurban Roads," by D. F. Carver, receiver Trenton & New Brunswick Railroad Company, Trenton, N. J. Report of Committee on Passenger Traffic. Report of Committee on Rules for City Operation. General business. Report of Nominating Committee. Election of officers. Installation of officers. Adjournment.

Canadian Bell Telephone Company Extending Its System.

It is announced at Montreal, Quebec, that the Bell Telephone Company will spend $1,000,000 in improving the company's service in Ontario and Quebec. The company is building through lines from Toronto to North Bay, a distance of 230 miles, to connect at the latter point with the Ontario Government system to the new districts of Ontario. Another line from Toronto to Parry Sound will be constructed to embrace a number of summer resorts in the Muskoka lakes district. An additional telephone line direct between Montreal and Quebec has been completed.

In Montreal the Bell Telephone Company is erecting a new exchange building in the north end to be known as the St. Louis exchange. In Toronto the company will put up a building, five stories high, sufficient to accommodate 20,000 subscribers. All long-distance work will be centred in this building. At Quebec a large addition is being built to the present exchange, which will be ready for occupation in about three months.

Modern Science Club.

The Modern Science Club will open its winter season at the club house, 125 South Elliott Place, Brooklyn, N. Y., with a smoker and entertainment on Tuesday evening, September 29.

The following announcements are made for the first month of the lecture course: October 6, Almet R. Latson, president of the Union League Club, of Brooklyn, will deliver an address entitled "The Sources of Our Law"; October 13, quarterly meeting of the club; October 20, Emil F. Jennert, superintendent of the Manhattan Brass Company, will deliver an address entitled "Voting Machines"; October 28, George A. Orrock, mechanical engineer of the New York Edison Company, will deliver an address entitled "Central Station Design."

Memorial to Alexander Graham Bell.

The people of Brantford, Ontario, have raised the sum of $40,000 for a memorial to Professor Alexander Graham Bell. It was just outside of the city that Professor Bell made his first successful experiments with the telephone, and Brantford has since been known as the "Telephone City." With the money subscribed several blocks of land in the centre of the city have been purchased and will be turned into public parks.

The October Meeting of the American Institute of Electrical Engineers.

The October meeting of the American Institute of Electrical Engineers will be held in the Auditorium of the Engineering Societies Building, 33 West Thirty-ninth street, New York city, on Friday, October 9, at 8 P. M. At this meeting a paper entitled "High-Potential Underground Transmission," by P. Junkersfeld and E. O. Schweitzer, of the Commonwealth Edison Company, Chicago, will be presented and discussed.

National Electric Lamp Association to Establish a Department of Physical Research.

The engineering department of the National Electric Lamp Association, Cleveland, Ohio, announces that Dr. Edward P. Hyde, now of the Bureau of Standards, Washington, D. C., after October 1 will organize and direct a department of physical research under the auspices of, and at the expense of, the association. Dr. Hyde will operate his department with entire freedom from commercial suggestion, and with the same frank publicity which has characterized his work at the Bureau of Standards.

The British Association Meeting.

The annual meeting of the British Association for the Advancement of Science was opened in Dublin, Ireland, on Wednesday, September 2, at the reception given to the council and delegates by the Lord Mayor and Lady Mayoress. The formal sessions began on Wednesday evening with the address of Francis Darwin, president of the association, in the course of which Mr. Darwin paid a touching tribute to the late Lord Kelvin, and stated that all kinds and classes of people alike lamented his recent death.

On the morning of Thursday, September 3, Dr. W. N. Shaw delivered his presidential address to Section A (mathematical and physical science). This address dealt almost entirely with meteorology. The remainder of this section's proceedings was of little interest to electrical engineers, with the exception of the report presented by Dr. R. T. Glazebrook, of the Electrical Standards Committee.

Section G (engineering) listened to the address by Dugald Clerk, its president. This dealt with the discovery and development of the laws of thermodynamics. A portion of the address is printed elsewhere in this issue. Gerald Stoney read a paper entitled "Recent Advances in Steam Turbines." The great progress which had been made in the building of turbines was called attention to. The largest steam turbine made in 1900 had a rated output of 1,000 kilowatts, while to-day there are quite a number of turbines installed with outputs ranging from 5,000 to 8,000 kilowatts.

On the morning of Friday, September 4, a joint meeting of Sections A, B and G was held, the topic for discussion being entitled "Gaseous Explosions." During the discussion of this subject Mr. Clerk stated that he had made some experiments with a view to ascertaining how completely combustion was effected when the gaseous mixture was exploded. With a mixture of one part of gas to seven of air he found that two and one-half per cent of the gas had not undergone combustion, and that the same figure applied to a one-in-ten mixture. He was of the opinion, however, that if a higher degree of accuracy could have been obtained, the percentage of unconsumed gas would have been five or six.

Sir William Ramsay read a paper entitled "Do the Radioactive Gases (Emanations) Belong to the Argon Series?" A paper entitled "On the Number and Absorption of the Beta Particles Emitted by Radium" was read by W. Makower. A paper entitled "The Rate of Production of Helium from Radium" was read by Sir J. Dewar.

On the morning of Monday, September 7, Section A opened its session by a discussion of the topic "Theory of Wave Motion," introduced by Professor Horace Lamb. A paper entitled "On the Measurement of Large Inductances Containing Iron" was presented by Sir Oliver Lodge and Benjamin Davies.

Section G listened to the reading of three papers concerning gas production and use. These papers are as follows: "The Utilization of Peat for Making Gas or Charcoal with Recovery of By-Products," by Captain H. R. Sankey; "Producer Gas," by J. Emerson Dowson, and "Suction Gas Producers," by P. W. Robson. This session was concluded by the reading of a paper entitled "The Study of Breakages," by R. Rosenhain, and a paper entitled "The Electrical Conductivity of Certain Light Aluminum Alloys, as Affected by Exposure to London Atmosphere," by Professor E. Wilson.

On Tuesday, September 8, Professor E. Rutherford read a paper entitled "The Scintillations of Zinc Sulphide," before Section A. This was followed by a paper by Horace H. Poole, entitled "A Determination of the Rate of Evolution of Heat by Pitchblende."

Section G listened to a paper entitled "The Laws of Flight," by F. W. Lanchester, and a paper entitled "The Causes of Wear in Motor Vehicle Machinery," by F. H. Royce.

The session of Section A on Wednesday, September 9, was devoted to meteorological subjects, and Section G listened to the reading of a paper by J. Brown and M. F. Fitzgerald, entitled "Experiments on Rotating Discs." This paper was followed by the closing paper, entitled "Urban and Suburban Transit and Methods of Railless Traction," by F. Douglas Fox.

The informal sessions were concluded on the afternoon of Wednesday, September 9, by a garden party given to the members of the association by the Lord Lieutenant at the vice-regal lodge.

New Wireless Test.

It is stated that Lee De Forest has arranged with the British Admiralty for exhaustive tests of his wireless telephone system. The experiments are expected to occupy several weeks.

Electrification Plans of the Delaware, Lackawanna & Western.

It is announced that electrification of the Delaware, Lackawanna & Western system from Hoboken to Morristown, N. J., will take place shortly after January 1. Plans are in readiness for making the change in motive power over the stretch of thirty-two miles, and actual work will begin as soon as the new tunnel through Bergen Hill is finished. This tunnel, which has been building for two years, will open for traffic on November 15. All grade crossings along the line will be abolished first and the tracks through the Oranges will be depressed. Motor-cars will be ordered which will be of a different type from the electric locomotives on the New York Central. These will draw the regular trains from Hoboken to Morristown, where the change to steam will be made on the trains running to Buffalo.

All told the cost of the various operations, including the tunnel, electrification, new cut-off at Lake Hopatcong and additional track laying, will total more than $25,000,000. This amount will be spent in three years' time.

New York Edison-Philadelphia Electric Outing.

Arrangements have been completed for a baseball game between the employés of the New York Edison Company and the Philadelphia Electric Company, to be held at the American League Grounds in Philadelphia, Pa., on Saturday, September 26.

A special train will leave West Twenty-third street, New York city, at 11.55 A. M.; Cortlandt and Desbrosses streets at 12 M., arriving at Broad Street Station, Philadelphia, at 2 P. M. Transportation to the grounds will be arranged for by the Philadelphia Electric Company, who will also furnish a collation and music at the finish of the game.

Illinois Central Electrification.

An exhaustive report, about completed, by the chiefs of various city departments of Chicago, Ill., on railroad electrification estimates the cost to the Illinois Central at $5,000,000. J. T. Harahan, president of the Illinois Central, says he will study every phase of the electrification problem and reach a decision as soon as possible. Louis C. Fritch, assistant to Mr. Harahan, is inspecting the operating conditions of the terminals electrified by the New York Central.

A UNIQUE WATER-POWER PLANT.

BY H. LESTER HAMILTON.

Probably at no other time in the history of the world has the subject of power and its efficient utilization been given so much attention as at the present. Scientists tell us that in a comparatively short time the rapid depletion of our coal deposits will necessitate the adoption of more efficient methods of transforming this latent energy. Mighty rivers, on whose bosoms could float the largest battleships, have been dammed to furnish power for hydroelectric plants, and countless Niagaras the world over are being enlisted in the same cause. Projects for utilizing the mighty power of the ocean waves are daily launched, and we occasionally read of some scientist who proposes to harness the potential energy of the thunder cloud in order that we may have a perpetual supply of electricity.

But how many of us, while listening to the murmur of the rippling brook, think of it as a power producer? Yet in the small streams of our country the energy of thousands of horse-power is daily going to waste, and all for the want of proper development. The cost of developing a water power of this nature is comparatively small, yet those who are in a position to reap the benefits which would be derived therefrom rarely take advantage of the opportunity. This condition of affairs may be attributed to one of two things: ignorance of the real value of the water power or lack of initiative.

This spirit of lethargy has, however, been shaken off in some parts of the country and enterprising persons have awakened to the latent power possibilities existing in nearby streams. Among this class the farmers are in the van, and not a few have harnessed their meadow brooks and are now enjoying luxuries which were not possible before.

Where the natural features are such that it is practicable to secure a considerable pondage and a fair head of water, a comparatively small stream can be made very valuable to the farmer. A water turbine can be installed to run a gristmill or sawmill during the daytime, the belt being shifted over at night to run a small dynamo for lighting the house and outbuildings. If the pond has sufficient capacity, the dynamo could also be run during the daytime to supply power for operating cream separators, cutting feed, elevating ensilage and hay, and for performing various other farm duties. During the winter months the surplus energy could be used for heating the house. Carrying it a little further, the laundry irons could be electrically heated, the sewing machine and ice-cream freezer motor-driven; chickens could be hatched in the electric incubator, the cows milked by a motor-driven automatic milker, and instead of carrying produce to town in the slow, creaky farm wagon, the swift, noiseless electric automobile could cover the distance in a third of the time. Ideal! Yes, but entirely possible to the fortunate possessor of a suitable water power.

A General View of the Mill Pond, Looking Up from the Dam.

An excellent example of the profitable utilization of a small water power, and one unique in some features, is found in the power plant of Christ School. This model school, nestled away among the hills of western North Carolina, commonly known as the "Land of the Sky," and not far from the city of Asheville, is almost a village in itself. There are several dormitories, an assembly hall, a chapel containing a miniature pipe organ, several workshops, and neat little cottages for the instructors. Not only is the mind trained, but the pupils are instructed in farm work, wood-working and domestic work as well. The making of beds and the sweeping of floors are as important a part of the daily routine as the memorizing of rules for extracting the cube root of a number. "The Galax Leaf," a little magazine published and printed by the students, is widely read by those interested

Looking Toward the Top of the Dam, and Showing the Building Containing the Grist Mill, Saw Mill and Dynamo Room.

A View Taken Below the Dam, Showing a Part of the Power-House on the Right.

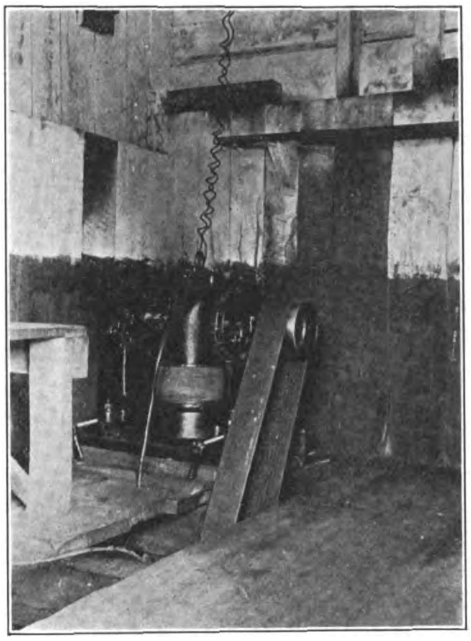
in the progress of the school. Not far from the school and down in the valley runs a little brook, rushing and tumbling through the fields, as is typical of most mountain streams. For years it had merrily gurgled its way over the pebbly bottom, occasionally bestirring itself to wash away the corn planted on its banks or to hollow out inviting swimming holes for the boys, but several years ago a progressive principal who was placed in charge of the school saw that by building a suitable dam across the brook enough water could be impounded to run a sawmill and a gristmill. The services of a local engineer were accordingly enlisted and a twenty-foot dam of rubble masonry was built, forming a pond some five acres in area.

An eight-horse-power water turbine of the horizontal type, together with the machinery for the gristmill and sawmill, was installed in a frame building just below the dam, the upper side of the structure forming part of the retaining wall. This building was later extended to make room for a small dynamo. During the daytime either the sawmill or the gristmill is operated, provision being made so that the belt can be shifted from one line shafting to the other. At night the belt is transferred to the pulley of the dynamo.

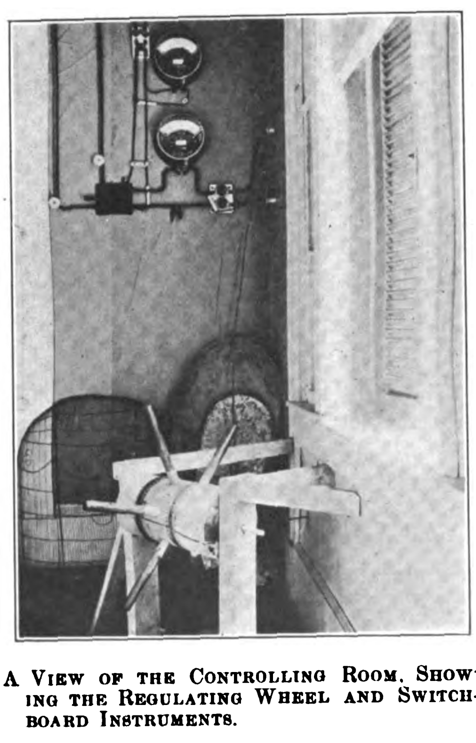
The sawmill, while not very complicated or of the latest design, manages to turn out very creditable work. The machines in use consist of a circular saw for ripping out rough boards from the logs as they are skidded into the mill, a cutoff saw for reducing them to a uniform length, and a combination planer and molder which converts them into flooring or plain boards, as the case may be.

In the gristmill the corn and wheat, which are planted, cultivated and harvested by the pupils of the school, are ground and sacked ready for the market. A small proportion of the total grain crop is made up into bread and baked by these same students, the remainder being sold at a neat profit to Asheville merchants, who are always glad to buy the product of the Christ School mill.

The electrical end of the installation presents several interesting features. The dynamo, which is five kilowatts, or a little over six horse-power in capacity, is a two-pole direct-current machine giving forty amperes at 125 volts when driven at a speed of 1,100 revolutions per minute. Running under normal load it supplies current to some eighty-five sixteen-candle-power incandescent lamps in the various buildings on the hill. Owing to the character of the load, which is always steady, and the constant supply of water, due to the large area of the pond, no governor is needed other than a simple hand-wheel connected by a short iron rod to the gate valve of the turbine. The forward or backward turning of this hand-wheel varies the amount of water supplied to the turbine and enables quite a range of speed to be obtained. It is sometimes necessary to change the speed in the mill, especially when sawing different kinds of timber.



A View of the Dynamo Room.



A View of the Controlling Room, Showing the Regulating Wheel and Switchboard Instruments.

As the power plant is about one-third of a mile from the school, it was out of the question to go there at night to start and stop the machinery, and the expense of keeping an attendant did not seem justified. Neither did it seem advisable to allow the dynamo to run all night, as something might happen to stop the flow of oil to the bearings, in which case the machine might be seriously damaged. For this reason the following method of "remote control" was adopted:

On top of the hand-wheel regulating the water supply of the turbine, and securely fastened to it, is placed perpendicularly a wooden cylinder, about eight inches in diameter and a foot long. A small chain is wrapped several times around the cylinder, the ends of the chain being carried out through the side of the house, where they are fastened to two small iron wires, telephone wires, in fact. These wires extend along the transmission line to the principal's house, terminating in a room which might appropriately be called "the controlling room." At each pole the wires are strung through small pulleys in order to keep the friction down, the pulleys also serving as guides for the wires.

In the controlling room is placed a capstan or windlass, in appearance similar to the steering wheel of a ship, and around which the wires are fastened in the same manner as in the power-house. In other words, the controlling system consists of an endless chain fastened at each end to a movable cylinder, the cylinder fastened to the valve rod of the turbine moving in response to a movement of the cylinder in the principal's house, 1,700 feet away. Contrary to all expectations, this system of control has never caused the slightest trouble, not even during the trying winter months when the wires were covered with sleet and snow.

The controlling room is also the switchboard and distribution room, as here the transmission line from the power-house, after passing through a main switch, branches off to the various dormitories. An ammeter and voltmeter are the only indicating instruments, the switchboard equipment being completed by the necessary protective fuses and distributing switches.

The method of procedure in starting up is very simple. The wheel in the controlling room is turned until the voltmeter indicates that the dynamo has begun to generate. The different switches are then closed and further turning of the wheel, as soon as the ammeter shows that the dynamo has "picked up" its load, speeds the machine up until the voltmeter registers 110 volts. To allow for drop in voltage on the various lines running to the dormitories, the needle of the voltmeter is generally held a little higher than this value.

It is very seldom that the voltage varies enough to be noticeable in the lamps, but should it do so, only a turn of the regulating wheel is required to bring it back to normal. At half-past ten, when the "lights-out" bell is rung, a few turns of the wheel quickly slow the dynamo down, and darkness reigns.

The remarkable success that has attended the operation of this little plant leads those in authority to believe that a much larger turbine and dynamo could be installed to advantage, and plans are being made to utilize this extra energy in heating the dormitories, furnishing power for a motor-driven fire pump and for various other operations around the school and on the farm. When these plans mature the Christ School power plant will stand as a monument to the energy and farsightedness of the man who first realized the true value of the little meadow brook, and it should act as an incentive to less enterprising owners of equally valuable water power. Even in its present condition it is an excellent example of what is possible to be accomplished by the proper development of small water powers.

Electrical Equipment for Santos Dock Company, Brazil.

The Santos Dock Company through whose docks most of the coffee exported from Brazil passes, has recently received from the General Electric Company complete generating station equipment—five revolving field, 3,000-kilowatt, 2,300-volt, three-phase, sixty-cycle, alternating-current generators; 350-kilowatt exciters; fifteen 1,000-kilowatt, step-up transformers, transforming generator voltage to 44,000 volts, with complete switchboard of most modern construction.

Some time ago a comprehensive order, including complete substation equipment, wiring and lighting supplies, and a large number of induction motors for operating air-compressors, hoists, cranes, etc., was received from the Santos Dock Company. This apparatus is now being shipped to Brazil.

The hydroelectric plant is located some thirty-five miles from the substation and, besides furnishing power for operating all the machinery at the docks, will also supply energy for light and power to various other industrial enterprises near the city.

THE KOKOMO, MARION & WESTERN TRACTION COMPANY.

BY C. A. TUPPER.

As an illustration of what may be accomplished in building up an existing electric railway, lighting and power distributing system, and at the same time strengthening the industrial position of an entire community, the management of the Kokomo, Marion & Western Traction Company furnishes one of the most striking and instructive examples to be met with anywhere in the country. At the time ownership of the system was assumed by the interests now in control, less than four years ago, there was a small street railway and electric lighting plant, having no greater output than 500 kilowatts, a few miles of trackage wholly within the city of Kokomo, and circuits containing several hundred arc and incandescent lamps. To-day 22,000 incandescent and 395 arc lamps in and about Kokomo are supplied with electric current and more than one-half of the company's customers have various electric household devices; factories in the vicinity take upward of 1,000 horse-power daily in current for operating motors; the street railway system has been extended to a trackage of ten miles, and a finely equipped interurban line of twenty-eight miles in length extends from Kokomo, a city of about 18,000 inhabitants, to Marion, having a population of 26,000, through several large towns situated in a rich, closely tilled agricultural country. Further extensions are projected to Terre Haute and Lafayette on the west, distant respectively, 130 and seventy-nine miles from the eastern terminus of the road. Among the principal places on the line now in operation are: Georgetown and Swayzee, each of about 2,000 people; Sycamore, Sims, Herbst and Roseberg.

Among outward signs of progress, however, the most prominent is the development of the new power station, which has recently been equipped with two Allis-Chalmers steam turbines and generators having an aggregate normal capacity of 2,000 kilowatts and delivering two-phase, sixty-cycle current at a terminal pressure of 2,300 volts. The first of these machines, put in operation February 21, 1907, was found so satisfactory that a second unit of identical construction was ordered, the latter being placed on the line December 7 of the same year.

Coal, consisting of a comparatively low grade of Indiana screenings, is brought in on a spur from the Lake Erie & Western Railway and unloaded through a trestle extending the entire length of the firing room, so that it is heaped up in front of iron doors opening upon the several furnaces. From these piles it is shoveled directly into the furnaces, which are so arranged as to obtain a relatively high heat value from the fuel—with the exercise of good management. Removal of ashes is accomplished by an inexpensive device. Instead of the customary ash pit with tracks and cars, there has been installed a tunnel and screw conveyer through which the ashes are constantly transferred to a pit outside the building. There, by means of a bucket elevator and inclined conveyer, the material is discharged to storage bins at one side of the building and unloaded into cars, which take it to points along the line where it can be used as ballast.

The boiler equipment, set on concrete foundations reaching to bed rock, consists of three batteries, two of which include four Stirling boilers, each having a capacity of 235 horse-power, and the third comprising one Atlas water-tube boiler with a capacity of 400 horse-power. Two of the Stirling boilers discharge into one stack six feet by eighty feet, constructed entirely of steel, and the remaining two, with the Atlas boiler, into a stack six feet by 125 feet, also of steel. The shorter of these stacks is equipped with an engine-driven blower, made by the B. F. Sturtevant Company, by means of which enough draft can be induced to give large temporary overload capacity to the two boilers with which it is connected. The boiler room has ventilators at the top and is very commodious with room for considerable additional capacity.

A main header, twelve inches in diameter, located above the pump compartment in the steam-turbine room, is in the form of a loop, from which each turbine unit is fed by a seven-inch pipe. Gate valves are placed between each battery of boilers and between each turbine inlet, these valves being of the Crane type with rising stems. There is also a four-and-one-half-inch auxiliary header. A proper arrangement of valves enables any part of the plant to be supplied from any boiler at will. All of the piping is made as short and direct as possible and heat insulation is provided in the shape of heavy covering of the pattern furnished by the H. W. Johns-Manville Company. Long bends to provide for expansion have, of course, been used wherever necessary, and the system includes Cochrane steam separators.

The condensers and all of the other

auxiliaries exhaust into a Cochrane heater (with Sorge water purifier) where a temperature of from 200 degrees to 212 degrees Fahrenheit—never less than 200 degrees—is maintained constantly. Water may be drawn from either the condenser suction or discharge pipes, from a deep well or from the city mains, and discharged into an elevated tank which feeds by gravity into the heater and from there by gravity into the boiler feed pumps; or the water may be by-passed directly to the boiler.

Two Worthington pumps are used for supplying the tank over the heater and two Dean pumps for boiler feed. Either one of any of these two is, however, of sufficient capacity to take care of the water system of the entire plant. The former are now being displaced by a centrifugal pump with two-and-one-half-inch discharge, driven by an induction motor supplied with current directly from the main generator buses through a step-down transformer; but the steam pumps will be held in reserve.

Water for condensation and boiler feed is taken from a creek, about 350 feet distant, through a sixteen-inch cast-iron pipe. and discharged back to the stream through twenty-inch tile. The water is drawn from a concrete basin in the creek, seven feet square inside and extending six feet below low-water mark, with walls extending to high-water mark and a gate on the down-stream side where the water enters. This gate can readily be closed down tight when desired and the water exhausted by pumps in the power plant, so as to facilitate cleaning the basin of sand and mud.

The turbine-operating floor is five and one-half feet above the boiler and pump-room floor, eleven feet above the basement floor and thirty feet below the roof trusses, the foundation of each generating unit being kept entirely separate from the steel frame of the concrete flooring. Overhead is a ten-ton crane, hand operated. In this room are placed two horizontal steam turbines and generators of 1,000 kilowatts capacity each, a 330-kilowatt engine-driven alternator operated in parallel with them, the exciters for these units, and substation apparatus, transformers, switchboard, etc.

Incorporated in these turbines are the various patented features controlled by the builders, the Allis-Chalmers Company, among which may be mentioned channel-shaped shrouds protecting the ends of the blading from injury; machine-cut slots in the foundation rings insuring accurate spacing of the blades; a method of fastening the latter which effectually prevents them from working loose, and improved balance pistons.

The turbines operate at 1,800 revolutions per minute, with a steam pressure of 140 pounds at the throttle, dry saturated, and a vacuum of twenty-eight inches of mercury referred to thirty inches barometer at the exhaust nozzle. Large temporary overload capacity has been provided for in the design of these machines; high efficiency is maintained, and close regulation secured under unfavorable operating conditions as a result both of good design and efficient station management. They are frequently run six weeks at a time without taking the load off and then only to make inspection.

The bedplate is divided into two parts, one carrying the low-pressure end of the turbines and the bearings of the generator, and the other the high-pressure end of the turbine. The turbine is secured to the former, while the latter is provided with guides which permit the turbine to slide back and forth with differences of expansion caused by varying temperature, at the same time maintaining the alignment. This arrangement permits of the utilization of the entire space between the foundation piers and below the turbine for the condensing apparatus. A grating is provided in the engine-room floor, directly over the condenser pumps and engines, so that operators above and below can watch each other's movements and signals, and the auxiliary engines can ordinarily be watched from above.

The condensers for the steam turbines are of the jet type built by Allis-Chalmers Company, each capable of giving the best possible service when its unit is operating at full rated load. Cycloidal air-pumps, direct-connected to enclosed, self-oiling, high-speed engines, and duplex, double-acting circulating pumps are installed with this apparatus, as is also a third condenser to take the exhaust from the remainder of the plant.

The speed of each turbine is regulated within close limits by a governor driven from the shaft through cut gears working in an oil bath. This governor, by means of a relay, operates a balanced throttle valve.

The lubrication of the four bearings, two for the turbine and two for the generator, is effected by supplying an abundance of oil to the middle of each bearing by means of a small cycloidal pump driven from the turbine shaft, and allowing it to flow out at the ends.

TURBO-GENERATORS.

The revolving-field alternators driven by these turbines are of Allis-Chalmers Company's standard type, designed for high efficiency and safe operation at high peripheral speeds. The field core is built up of steel discs, each in one piece, giving high magnetic permeability and great strength. Coils are placed in radial slots, avoiding side pressure on slot insulation and the complex stresses resulting from centrifugal force, which, in these rotors, acts normal to the flat surface of the strip windings. Bronze wedges hold the coils firmly in the slots, making the surface of the rotor a smooth cylinder, reducing windage losses and insuring quick operation; and the end connections are securely held by chrome nickel-steel rings. The stator is completely inclosed. Coils were wound and insulated before being placed on the core. Stator windings are placed in open slots and end connections are firmly braced.

Excitation of the two turbo-generators is accomplished by means of exciters of thirty-five kilowatts and thirty kilowatts, the former being driven by an Allis-Chalmers induction motor and the latter by an Erie Ball engine. The engine-driven unit has a five-kilowatt belted exciter. Turbo-generator excitation at full load is at 120 volts, 160 amperes. The exciters do not take care of the station lighting. Current for this is derived directly from the main bus-bars, or from a storage battery.

The character of the load put upon this station is railway, lighting and power combined. At present there is a normal consumption of current somewhat under the rated capacity of the turbines, so that one can be held constantly in reserve, and this drops to a minimum during the early morning hours of about 300 kilowatts.

A feature to be particularly commended is the thorough keeping of station records and the frequent checking of efficiencies of different parts of the plant. On the company's log sheet the daily load curve is plotted, thereby enabling it to be easily comprehended, for the twenty-four hours, at a glance. All costs and station performances are also recorded on the daily log. In addition to this records are kept in the office of the outside distributing circuits, and two Wright demand meters are constantly used to check the loads on lighting and power transformers over the town.

Alternating current is generated at two-phase, 2,300 volts, and transformed to three-phase, 11,000 volts, for transmission over the line of the interurban railway. In the main station there are used for this purpose three 150-kilowatt, oil-filled, self-cooled transformers, Scott connected, and in the substation (seventeen miles distant) there are three 150-kilowatt step-down transformers, delta connected. These transformers have one-and-one-half-inch outlet pipes run directly through the floor, so that in case of fire oil can be emptied into barrels in the basement where the oil supplied is stored.

Direct current for the city railway system and ten miles of the interurban line is supplied through motor generator sets in the main station, delivering power at an operating pressure of 600 volts; and the substation at Swayzee, eighteen miles east of Kokomo, contains three rotary converters for the purpose of transforming the alternating to direct current. One of these, having a capacity of 200 kilowatts, is equipped with an induction starting motor, and two of seventy-five kilowatts each are started through a storage battery from the direct-current end.

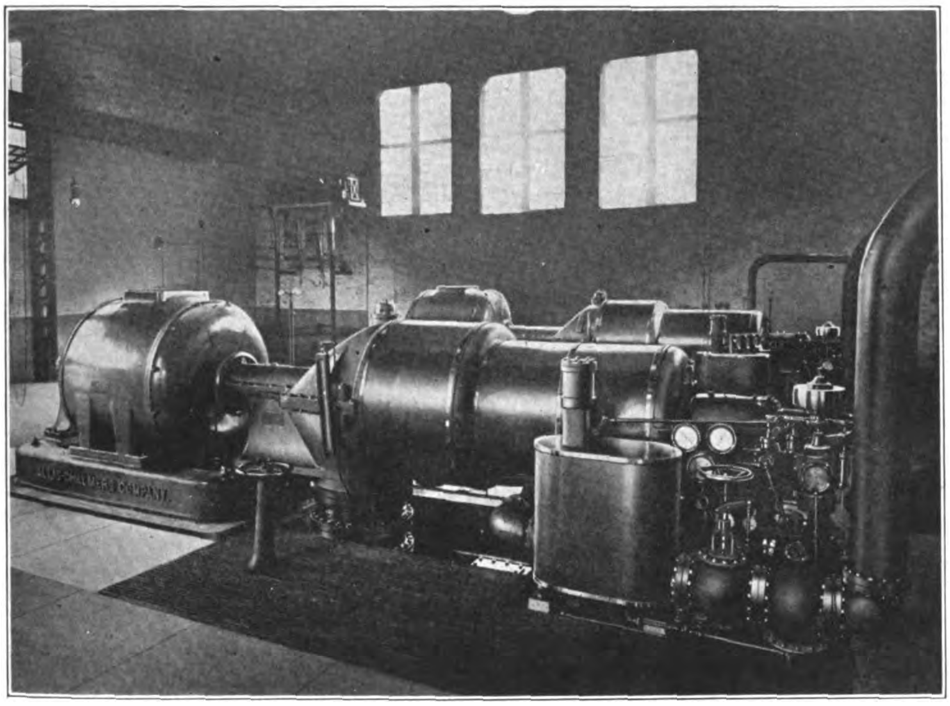
Current from the main generator busbars passes to the outgoing lines through double-throw switches, ammeters, wattmeters and fuses, all such circuits being also put through integrating wattmeters, 300,000-circular-mil cable being used, with high-voltage rubber insulation. The wiring from the generators to the switchboard is open work, fastened to the underside of the engine-room floor. The busbar system is in duplicate. Any machine or any feeder can be operated off of any set of buses. The switchboard rests on insulated stringers, with a panel and necessary apparatus for each turbo-generator and exciter.

The railway board consists of two panels, each controlling a 216-horse-power motor, and two panels each controlling the railway generators driven by these motors in the power plant substation. One panel contains the starting devices and a rheostat for these machines. There are also two feeder panels, one feeding the interurban line and the other on the city line.

Two panels control a storage battery and differential booster.

In a separate building, located about sixty feet from the main generating station, is a battery installation supplied by the Electric Storage Battery Company, which has a capacity of 480 ampere-hours and consists of 288 chloride accumulator cells. A smaller storage battery, consisting of the same number of cells, but having a capacity of 320 ampere-hours, is installed in the substation at Swayzee.

The lines are equipped with Westinghouse low-equivalent arresters and Westinghouse choke-coils, to which ready access is had from the gallery. The lighting feeders have General Electric lightning arresters and choke-coils manufactured at the station. On the direct-current railway system Garton lightning arresters are used, there being four of these to every mile. Wirt lightning arresters are provided at each transformer on the lighting circuit.



Two 1,000-Kilowatt, 1,800-Revolution-Per-Minute, Sixty-Cycle, Allis-Chalmers Steam Turbines and Generators Installed in Power-House of the Kokomo, Marion & Western Traction Company, Kokomo, Ind.

The line of interurban road is built with easy curves and a maximum grade of no more than two degrees, most of the track being laid on the level. The right of way is forty feet wide and owned entirely by the company. Seventy-pound A. S. C. E. rail is used, joined by six-bolt standard splice bars.

The bonds are of the Ohio Brass Company's manufacture and consist of 0000 compressed bonds and soldered bonds on the interurban line and 00 compressed bonds on the city tracks. Rails are cross-bonded every half mile with 0000 copper wire.

The road is ballasted with crushed stone and gravel six inches deep, underneath the ties, 1,000 cubic yards of stone and 300 cubic yards of gravel being used to the mile. The ties are of white oak. Side-arm construction has been used for the entire course of the line, cedar poles being placed along ten miles of the interurban system, chestnut poles on the remaining eighteen miles and cedar and iron poles in the city. The brackets are nine feet, with one-and-one-half-inch tubing made by the Ohio Brass Company. The lightning arresters, four to the mile, are grounded by means of No. 4 copper wire and three-quarter-inch iron rods driven into the ground by the side of the pole and also connected to the rail. The wires consist of two 000 trolleys suspended by the Ohio Brass Company's Type "D" hangers. The feeder wires are 300,000 and 500,000 circular mil copper line feeding on to the interurban wires ten miles from the power station. The feeder from the substation is stranded aluminum equivalent to 300,000 circular mil copper. Spans are 100 feet in length.

There is a bridge crossing the Wildcat Creek near Greentown and there are two overhead railway crossings and several small steel culverts. The high-tension wires cross the bridges on timber projections at the sides of the bridge, the trolley wires being supported from stands fastened to the overhead steel work. At Marion the crossings which span the Pennsylvania and Chicago, Cincinnati & Louisville railways are of the girder type.

Everything connected with the physical equipment of the system has been very carefully looked after, and one of the best evidences of this is the power-house itself, which is a well-planned, well-built fireproof structure. The exterior walls are faced with standard pressed brick, laid in three-quarters English bond with headers in each fourth course, affording a thorough bond into the wall. All of the interior surfaces in the engine room which have not been enameled are faced with Kokomo pressed sand brick of buff color and the remaining brickwork is of the ordinary kiln-run quality. Tile roofing covers the building.

The lighting system of the company has developed at an almost incredible rate. One feeder now goes out from the power station to the North Kokomo distribution system and another supplies South Kokomo, each being fed from the 2,200-volt, two-phase primary circuits; and in addition there are four series alternating-current arc circuits of fifty lights each, fed from transformers at 4,000 volts. The towns of Swayzee and Greentown are both furnished with lighting current taken through transformers from the high-tension lines and stepped down to 220 volts.

A stone quarry, which was originally owned and operated by the company in order to provide crushed rock for ballast, but has since passed into the possession of others, is located on the line of the interurban railway, and the larger part of the product of the plant, about 300 cubic yards per day, is transported by the company to the steam roads and out into various parts of the state for use in improving town and country roads. All of the machinery of this quarry used in crushing, elevating, etc., as well as of another quarry having similar capacity, is operated by motors running on alternating current taken from the power circuits.

Among other important customers taking power for motors are a brass works and spark-coil factory, two machine shops, a large flour mill, an automobile manufactory, bottling works, leather and harness establishment, glass factory, canners, planing mill, cooperage plant, mitten works, lumber yards, and nearly all of the smaller factories and shops in Kokomo, representing no less than eighty-four distinct industries. The use of small single motors and groups of two or three operated for various purposes is also growing throughout the city, so that electric drive has become one of the recognized features of the town. To accomplish this result, which has been brought about within comparatively recent time, T. C. McReynolds, secretary-treasurer and manager, and P. H. Palmer, the company's engineer and lighting superintendent, have made a systematic study of local power requirements and are prepared to give each prospective customer a detailed statement as to just what improvements can be effected in his particular case by the substitution of motor drive in place of power applied through shafting, belting, etc.

The company's campaign has not stopped at factories, shops, stores or industrial establishments of any kind, but has been carried into the homes of the city. Electric lighting is now becoming general and more than one-half of the company's customers have electrical apparatus of one kind or another, including laundry irons, heaters and cooking utensils. If progress made along this line during the next few years is at all commensurate with present indications, it will mean an enormous increase in business; and the probability is that more will be done in this direction than the most sanguine would believe, for the results of such work multiply almost in geometric ratio.

G. J. Marott, who lives in Indianapolis, is president of the company; T. C. McReynolds, secretary, treasurer and manager; P. H. Palmer, engineer, and H. P. Martzolf, superintendent of transportation. To each of these officials must be given credit for far more than the average enterprise and foresight and also to those actively concerned in the operation of the system for downright hard work.

Dark Spots with Alternating-Current Moving-Picture Machines.

To the Editor of the Electrical Review:

I was rather interested in a short article on the subject of dark pictures from a moving-picture machine, and having recently seen and tried the Kennelly stroboscopic fork at Atlantic City I thought I would show the article to a fellow townsman who is very successful in this line of business, having four shows on the road.

Instead of being interested in the article he was more amused and showed, from his experience, such a thing was impossible. In the first place, the alternations in the current are 7,200 per minute, or 120 per second, while the pictures move before the arclight beam at the rate of not more than fifteen to twenty per second, so that coincidence between the two is impossible.

He also stated that the majority of moving-picture men know nothing about lenses, and that most of the trouble comes from improper arrangement, and also from focusing. One rather startling thing he showed me was that the current used on his arc was sometimes more than sixty amperes, in some cases going as high as eighty. He says it is necessary to run it up to this in order to get a perfectly white screen, his sometimes being thirty feet in diameter.

E. W. Stevenson, E. E.

Wilkes-Barre, Pa., September 17.

THE DISCOVERY AND DEVELOPMENT OF THE LAWS OF THERMODYNAMICS.[1]—I.

BY DUGALD CLERK.

At the middle of the last century the steam engine had attained to a high degree of perfection. Its development was, it is true, incomplete; but it had been successfully applied to all the great duties of the mine, the waterworks, the factory, the railway and the steamship. The engines were mechanically excellent; the fuel economy was good, and they were built in units of thousands of horse-power. Steam power, in fact, was revolutionizing the whole of the social and industrial conditions of the globe. Notwithstanding this great material and engineering success, the world was in complete darkness as to the connection between steam motive power and heat. It was seen that motive power of almost any magnitude could be obtained by the agency of heat; but how it was obtained, and how much power was connected with a given quantity of heat, was quite unknown. The fuel consumptions of existing engines were known, and certain modes of improving economy were evident, and engineers were busily engaged in testing these modes by the slow but sure methods of invention, design, construction and operation in practical work; but in this they had but little aid from pure science. The science of thermodynamics did not yet exist.

New light was dawning, however, which gradually illumined the whole world of pure science and engineering practice.

Men of the first rank in intellect—Newton, Cavendish, Rumford, Young and Davy—had long before expressed the opinion that heat was not material in its nature, but was a mode of motion; but their opinions, although to some extent supported by experiment, made little impression upon the scientific world, and in 1850 we still find the most distinguished physicists adhering to the "caloric" or material theory of heat.

The great change from the errors of the old theories to the truth of the new was due to the work of Joule, Thomson and Rankine in Great Britain, and of Carnot, Meyer, Clausius, Helmholtz and Hirn on the Continent. The story begins with the work of Carnot in 1824, who published in Paris in that year a pamphlet entitled "Reflections Upon the Motive Power of Heat." He was attracted by the problem of the steam engine and the air engine.

[1] Presidential address delivered to the Engineering Section of the British Association for the Advancement of Science, Dublin, September 3.

He saw that heat and motive power were connected in some manner, and he endeavored to settle in a quantitative way the limits of that connection by the invention of an ideal series of operations, by means of which the greatest conceivable amount of mechanical power may be obtained from a given quantity of heat under given circumstances. For the purpose of his demonstration he assumes only two things: (1) That if heat be added to any body under standard conditions of temperature, pressure and volume, and the body be carried through any series of mechanical processes, returning ultimately to the standard condition of temperature, pressure and volume, then the quantity of heat added to the body is the same as that which has been discharged from it; (2) no process can exist whereby a given mechanical energy can increase its own quantity. On these indisputable assumptions he bases his ideal cycle, which consists of four simple and easily imagined operations, occurring within a cylinder behind a piston, so arranged that during the cycle work can be done by the working fluid upon the piston, or work done by the piston on the working fluid.

First Operation—The given volume of the working fluid is to be imagined as confined at its highest temperature and pressure behind the piston, and heat is to be added to keep the temperature constant, while the fluid expands, moving the piston and doing work upon it.

Second Operation—The supply of heat is cut off, and the working fluid expands, also doing work on the piston, while its temperature falls to the lowest point and its volume increases to its maximum.

Third Operation—The piston returns, compressing the working fluid, but allowing the heat of compression to escape, so that the temperature remains during the operation at its lowest point.

Fourth Operation—The piston compresses the working fluid, without allowing any loss of heat, to such an extent that the temperature rises again to its highest point, and the working fluid exists at the end of this operation at the same volume, pressure and temperature as at the beginning.

This assumed series of operations would give a certain available work area, the indicated power of the engine, inasmuch as the work done by the working fluid would be greater than that done upon it. If, however, it be assumed that in all the operations the direction of motion of the piston be reversed, then compression without loss of heat would take place in the second operation; further compression, but with sufficient heat loss to keep temperature constant, would occur in the first operation; the fourth operation would follow with expansion, and the third operation would conclude also with expansion. The engine would be reversed by beginning with the second operation, moving the piston backward in the order second, first, fourth, third. Carnot shows that this reverse operation would be performed by exactly the same amount of work as was given out by the direct operation, and that an amount of heat would be returned at the higher temperature equal to that which was added in the first case.

An engine which fulfils these conditions, Carnot states, will give the greatest amount of work which can be obtained from a given quantity of heat falling through a given temperature range. And it is evident that this must be so, because, if we assume the existence of any engine under the same conditions giving a greater amount of work from the same heat, then that engine could drive a Carnot engine in the reverse direction in such proportion as to return to the higher temperature a greater amount of heat than it abstracted, and so mechanical energy could be obtained without any heat fall whatever. This marvelous demonstration is obviously independent of the nature of the working fluid; it applies equally to all working substances, whether solid, liquid or gaseous, whether the physical state changes or not. It at once gives a standard of the limit of mechanical power which could possibly be obtained from a given amount of heat and a given temperature fall.

The Carnot cycle operations, as here given, are applicable either to the material or to the dynamical theory of heat; but Carnot originally stated that the whole of the heat added in the first operation was to be discharged in the third. Under the material or caloric theory work was supposed to be done by the fact of fall in temperature. Naturally, as the heat was material, it could not be destroyed or changed into mechanical energy. The production of mechanical energy was supposed to be incidental to the fall of temperature, much in the same way as mechanical energy was produced by the fall of water level, and this analogy is used throughout Carnot's work of 1824.

Carnot thus succeeded in proposing a standard of efficiency which was applicable to any heat engine, whatever the working fluid and whatever the operative cycle. By his method a limit could be set, fixing the maximum of mechanical energy to be obtained from a given heat quantity and a given temperature range. To reduce this to numerical values it was necessary, however, to experiment on any one working fluid within the desired temperature range in order to determine the work area in its relation to heat quantity and temperature fall. Carnot's writings show that he intended to make such observations; and had he succeeded, thermodynamics would have become a science at an early date. Carnot's death, however, in 1832, at the sadly early age of thirty-six years, prevented this development.

The name of Sadi Carnot will always be remembered by mankind as the founder of one branch of the thermodynamics of the heat engine.

His work remained practically without notice for thirteen years after his death, when, fortunately, it attracted the attention of William Thomson during his attendance at the laboratory of Regnault in the year 1845. Thomson was then twenty-one years of age, and had already attained a considerable scientific reputation. He took up the study of Carnot's work with enthusiasm. He became professor of natural philosophy in the University of Glasgow in 1846, and in 1848 he read a paper before the Cambridge Philosophical Society: "On an Absolute Thermometric Scale Founded on Carnot's Theory of the Motive Power of Heat and Calculated from Regnault's Observations." Like Carnot, Thomson accepted the material or caloric theory of the nature of heat, although, like Carnot also, he had doubts as to its truth. Assuming its truth, however, he carried Carnot's reasoning much further, and deduced from the Carnot cycle a thermometric scale which was absolute in the sense that it defined the idea of temperature independently of the properties of any particular body.

It is very difficult to carry one's mind back to the material theory of heat, but it is necessary to do so in order to appreciate the rigid accuracy of the reasoning of both Carnot and Thomson; and it is especially desirable to do so in order to understand the great step made in this paper. According to the caloric theory, heat was supposed to be a subtle elastic fluid which permeated the pores of bodies and filled the interstices between the molecules of matter. The fundamental quality imagined of this caloric or heat fluid was that of indestructibility and uncreatability by any humanly controlled process. Bodies became warmer when caloric was added to them, and grew colder as it left them. Caloric, however, might be added to a body without heating it. In this case the heat was called "latent," and the state of the body changed from solid to liquid, or from liquid to vapor or gas.

Caloric, too, was required in greater quantities for some substances than others in order to warm the body equally. The capacity for caloric was thus greater in some bodies than in others.

If any particular body were heated without change of state, it was hotter—that is, its temperature rose when the quantity of caloric present was increased. It was not difficult to define equality of temperature. This was defined by a constant condition when brought into contact. But it was very difficult indeed to define temperature on any rational scale.

To the acute and brilliant intellect of William Thomson it became apparent that he had in the Carnot cycle a powerful instrument capable of widely general use, apart altogether from the theory of heat engines; and he here uses it in a most skilful way to give definiteness and universal application to the idea of temperature, as Professor Larmor states, "elevating the idea of temperature from a mere featureless record or comparison of thermometers into a general principle of physical nature."

Thomson accordingly defines equal differences of temperature in terms of the reversible or Carnot engine.

Equal temperature differences are to be differences between the temperatures of the source of heat and the refrigerator, when the proportion of work produced from a given quantity of heat is the same. Thermometers graduated in degrees calculated in this way could naturally be treated as instruments based on definite principles, independently of any properties of any particular material. The idea of temperature here was in rigid logical consistency with the caloric theory of heat, and it carried out completely the analogy between power derived from the same quantity of heat falling from a higher to a lower level, and resembling a fall of water in producing its effects. For equal quantities of caloric, as of water, temperature fall was regarded as similar to fall in space, and so an accurate idea of the nature of temperature difference is attained.

This definition, however, gave a scale greatly differing from that of mercurial, air and other thermometers, the degrees defined by it corresponding to larger and larger intervals on the air thermometer as temperature increases. Professor Tait pointed out also that on such a scale the temperature of a body totally deprived of heat is negative-infinite.

All these difficulties do not detract from the fundamental importance of the idea here enunciated for the first time: the idea of an absolute thermometric scale theoretically applicable to all bodies—solid, liquid and gaseous. On the caloric or material theory of heat, motive power is obtained during the letting down or fall from a higher to a lower level of a given quantity of heat. The quantity of heat does not alter in the process; it is only its relative level which alters. There is no reason, therefore, for mentally limiting the amount of mechanical energy obtainable from any given quantity of caloric, just as there is no reason for limiting the amount of mechanical energy to be mentally derived from a given weight. Any desired quantity of energy may be derived from a weight of, say, one pound, if it only be allowed to fall far enough, assuming gravity to be constant through the range.

The investigation of the work to be derived from a given quantity of heat at a given temperature is thus a matter of experiment, which can be settled by measurement of the properties of a few bodies.

Reasoning, it is conceived, in this way, Thomson follows up his absolute thermometric scale work with an investigation entitled "Carnot's Theory of the Motive Power of Heat," described in a paper read in 1849 before the Royal Society of Edinburgh, in which he calculates from Regnault's experiments on steam the power developed by a Carnot reversible engine when using one-centigrade heat unit; that is, the heat necessary to heat one pound of water through one degree centigrade for temperatures from one degree to 231 degrees centigrade, the temperature falling in the engine in each case to 0 degree centigrade.

In this paper he asks himself two questions: (1) What is the precise nature of the thermal agency by means of which mechanical effect is to be produced without effects of any other kind? and (2) How may the amount of the thermal agency necessary for performing a given quantity of work be estimated?

Using Regnault's values for the properties of steam, he calculates the lines of compression and expansion without heat loss, the lines of compression and expansion with heat flow at the lowest temperature, and heat addition at the highest temperature, and thus arrives at the work area per heat unit let down. He tabulates these results and shows that what he calls "Carnot's function" diminishes as temperature rises, using the ordinary centigrade scale. On the caloric theory the methods are rigidly logical and correct, but some inaccuracy is introduced by the necessity of that theory for the discharge of the same amount of heat at the third operation as is taken in on the first. The paper is of great interest, however, because it shows clearly how fully the distinguished author realizes the necessity for re-examining the standard ideas of the nature of heat. Two paragraphs make this very clear:

"7. Since the time when Carnot thus expressed himself the necessity of a most careful examination of the entire experimental basis of the theory of heat has become more and more urgent. Especially all those assumptions depending on the idea that heat is a substance, invariable in quantity, not convertible into any other element, and incapable of being generated by any physical agency; in fact, the acknowledged principles of latent heat would require to be tested by a most searching investigation before they ought to be admitted, as they usually have been, by almost every one who has been engaged on the subject, whether in combining the results of experimental research or in general theoretical investigations.

"8. The extremely important discoveries recently made by Mr. Joule, of Manchester, that heat is evolved in every part of a closed electric conductor moving in the neighborhood of a magnet, and that heat is generated by the friction of fluids in motion, seem to overturn the opinion commonly held that heat can not be generated, but only produced from a source where it has previously existed either in a sensible or in a latent condition. In the present state of science, however, no operation is known by which heat can be absorbed into a body without either elevating its temperature or becoming latent, and producing some alteration in its physical condition; and the fundamental axiom adopted by Carnot may be considered as still the most probable basis for an investigation of the motive power of heat, although this, and with it every other branch of the theory of heat, may ultimately require to be reconstructed upon another foundation when our experimental data are more complete. On this understanding, and to avoid a repetition of doubts, I shall refer to Carnot's fundamental principle, in all that follows, as if its truth were thoroughly established."

In these two paragraphs Thomson sums up the whole situation in 1849, and promises further investigation and further attempts to deduce the nature of the connection between heat and work.

Assume, then, the truth of the caloric theory of heat, as Thomson does in the 1849 paper; we have a complete theory of the heat engine, based on the Carnot cycle, accounting for efficiencies which vary with temperature differences, but requiring no definite mechanical equivalent of heat; nay, antagonistic to the existence of such an equivalent. The caloric theory, as has been pointed out, is quite consistent with the theoretical possibility of obtaining an indefinitely great amount of mechanical energy from any given quantity of heat, provided the letting down, or fall of level, be indefinitely great.

At the time we are discussing—1850—the bare conception of the idea of an absolute zero of temperature is one which is startling in its boldness, and it must have been difficult, indeed, then to imagine any definite line of proof which could be followed to establish the real existence of such a physical limit. We are so familiar with the existence of very high temperatures, vastly transcending the temperatures in which we personally exist, that we can hardly conceive a temperature limit on the ascending side—that is, we can hardly think of any given high temperature which could not, under quite conceivable circumstances, be exceeded. We know, for example, that any metal—say, platinum—may be melted if its temperature be sufficiently increased; that a further sufficient increase will convert the liquid metal to the gaseous state, and that the gaseous metal may be heated indefinitely while in that state. We know the behavior and properties of many substances at high temperatures, and are aware of the strong tendency of all chemical compounds, when highly heated, to split up into the elementary bodies composing them. All this we appreciate, but we find it difficult to see how a point of temperature could be reached when it could be said: This is a physical limiting point on the ascending scale; we may heat a substance up to this temperature, but it is impossible to conceive of any higher temperature. It is necessary here to distinguish between a conceivable limit to an ascending temperature and a practical limit under existing conditions. We may thus place limits, say, to the temperature of coal-gas and air explosions, or the temperatures possible from the electric arc; the limit with coal-gas and air depending on one set of conditions, and the electric arc upon another set, such as the vaporizing point of carbon, and so on. In the same way, at the middle of last century it would have been considered quite reasonable to suppose that human existence was carried on at an intermediate plane of temperature, and that temperatures might exist as low, relatively to our mean temperature, as our known furnace and combustion temperatures are high. At this time, no doubt, such an idea was quite a reasonable one.

No such limit could be proved, even by the aid of the Carnot cycle, reasoning on the material theory of heat. If we assume that heat is material, and that in some way temperature fall doing work resembles, as Carnot supposed, the fall of water doing work in passing from a higher to a lower level, then no absolute zero is possible, because the same quantity of heat is supposed to exist at the low as at the high temperature. On this theory nothing in the idea of temperature suggests a possible physical limit. On the material theory the notion of temperature is one to which it is exceedingly difficult to attach a precise meaning.

Thomson's promises of further investigation were fulfilled in 1850, in which year he definitely accepted the dynamical theory of heat, and finally abandoned the material. His conclusions are given in a memoir of the first importance, which was read before the Royal Society of Edinburgh in 1851. It was entitled "On the Dynamical Theory of Heat." Before dealing with it, however, it is desirable to consider the work of Joule and others on another side of thermodynamics.

Long before 1850 the equivalence of mechanical work and heat quantity had been accepted by many scientific men, and Rumford had, indeed, made measurements of a rough kind. It remained, however, for Joule experimentally to determine the mechanical equivalent in the most accurate manner, and place what is now known as the first law of thermodynamics upon the sure basis of absolute experimental determination. His first paper was read before the Cork meeting of the British Association in 1843, and at the Oxford meeting in 1847 he read another, "On the Mechanical Equivalent of Heat," describing the results of experiments with paddles rotating in liquids driven by falling weights. By these years of work he had absolutely demonstrated the equivalence of heat quantity and mechanical work, so that no loophole of escape seemed possible; it appeared as if the material theory was rendered intellectually impossible to the trained intellect. This was not the fact, however, as is evident from both Joule's and Thomson's accounts of that British Association meeting.

Joule's earlier paper had been coolly received. Indeed, it is evident that the idea of a mechanical equivalent of heat was still distasteful to the physicists of the day, and its discussion was looked upon with dislike. Joule, at the 1847 meeting, addressed a small audience, and the account of his experiments was received without enthusiasm. This adverse atmosphere, so discouraging to the investigator, was quickly removed, however, when a young man rose to make his remarks and, by his enthusiastic comment and clear reasoning, at once succeeded in attracting the interest of those present. This young man was William Thomson, Professor of Natural Philosophy in the University of Glasgow. Speaking of this, his first meeting with Joule, at Manchester forty-six years later, Lord Kelvin said: "I can never forget the British Association at Oxford in the year 1847, when, in one of the sections, I heard a paper read by a very unassuming young man who betrayed no consciousness in his manner that he had a great idea to unfold. I was tremendously struck with the paper. I had first thought it could not be true because it was different from Carnot's theory, and immediately after the reading of the paper I had a few words of conversation with the author, James Joule, which was the beginning of our forty years' acquaintance and friendship. . . . I gained ideas which had never entered my mind before, and I thought I, too, suggested something worthy of Joule's consideration when I told him of Carnot's theory." This meeting was indeed fateful for the future of the science of thermodynamics, as it resulted in co-operation between two men of giant intellect, who between them performed most of the experimental work which was necessary to make thermodynamics an exact science. Their work alone sufficed to place the first and second laws of thermodynamics on the firm footing of accurate experiment and logical deduction.

Although Thomson was much struck by Joule's experiments, he did not accept the dynamical theory of heat at once. As he stated himself, "I had first thought that it could not be true because it was different from Carnot's theory."

Joule's discoveries at this date may be thus expressed:

Heat and mechanical energy are mutually convertible, and heat requires for its production, and produces by its disappearance, mechanical energy in the proportion of 1,390 foot-pounds for each centigrade heat unit, a heat unit being the amount of heat necessary to heat one pound of water through one degree centigrade.

Knowing, as Thomson did, that mechanical energy could be produced by the agency of heat, but that its amount varied with the temperature and temperature fall, Joule's discoveries seemed antagonistic to Carnot's demonstration; and, convinced as he was that Carnot's law was true, he naturally felt at first that there must be some other way of looking at Joule's discoveries seemed antagonistic himself.

Joule naturally believed in his own manner of looking at his results, and he apparently agreed with Thomson as to the antagonism between what may be here called the Carnot and Joule laws.

The material theory of heat might have been true; in which case there was no more need for any direct quantitative connection between heat quantity and mechanical energy than between the mass of a body and its mechanical energy. Any unit of mass may acquire any conceivable amount of mechanical energy if its velocity be great enough, and so any unit of heat on the caloric theory may produce any conceivable amount of mechanical energy if the temperature fall be great enough. Joule considered the Carnot law to be so inconsistent with his law that in one of his papers he proposes its abandonment as inconsistent with discovered facts. At this point the two ideas seem to be in opposition. The germ of reconciliation, however, is found in observations by Thomson in both the 1848 and 1849 papers. In paragraph eight, quoted here from the latter paper, it is stated:

"In the present state of science, however, no operation is known by which heat can be absorbed into a body without either elevating its temperature or becoming latent, and producing some alteration in its physical condition."

This is equivalent to saying that no case has been observed where heat disappears doing mechanical work. In a note occurring in the same paper he alludes to the fact that engineers always assume that the amount of heat found in the condenser of the steam engine was the same as that taken into the engine by the steam, in the following terms:

"So generally is Carnot's principle tacitly admitted as an axiom that its application in this case has never, so far as I am aware, been questioned by practical engineers."

This was quite accurate. Hirn's demonstrations that heat disappears in a steam engine when work is done were not made until 1857, eight years later.

In the 1848 paper he states:

"The experiments of Mr. Joule, of Manchester, seem to indicate an actual conversion of mechanical effect into caloric. No experiment, however, is adduced in which the converse operation is exhibited; but it must be confessed that as yet much is involved in mystery with reference to these fundamental questions of natural philosophy."

Here we find Thomson's mind engaged —in 1848 and 1849—with the very matter requiring proof. Joule had proved the generation of heat by means of mechanical work; Thomson required the proof of the converse case—the disappearance of heat when mechanical work was done by the working fluid.

This proof was forthcoming in the results of experiments on the compression and expansion of air. Accordingly, we find the Carnot and Joule principles reconciled in Thomson's paper of 1851, and the important deduction made of an absolute zero of temperature —273 degrees on the centigrade scale. The introduction of the idea of the mechanical equivalent of heat leads at once to an absolute zero of temperature, and allows of the determination of this physical lower limit by the use of the Carnot cycle for investigating the efficiency of a perfect engine using any working fluid. Air was the working fluid actually investigated, and the determination of its properties at ordinary temperatures was a vitally important result of the co-operation of Thomson and Joule. Their experiments lasted for many years, and their rigorous investigation disclosed the fact that internal work was done in expanding a gas; in fact, that in a gas expanding isothermally doing work, part of the heat only disappeared in external work and part was absorbed in separating the molecules.

The Joule and Carnot laws are now known as the first and second laws of thermodynamics.

The second law, in modern form, may be thus stated:

Although heat and work are mutually convertible, and in definite and invariable proportions, yet no conceivable heat engine is able to convert all the heat given to it into work. Apart altogether from practical limitations, a certain portion of the heat must be passed from the hot body to the cold body in order that the remainder may assume the form of mechanical energy.

The proportion of the total heat convertible into mechanical energy depends on the absolute temperatures of the hot and cold bodies; it is unity minus the lower absolute temperature upon the upper absolute temperature.

It appears that during Thomson's struggle to reconcile the two apparently opposing laws, Clausius, who had seen the same difficulty, arrived independently at its solution and published a paper "On the Motive Power of Heat and the Laws of Heat Which May Be Deduced Therefrom," at the Berlin Academy, in February, 1850. In this paper Clausius discusses Thomson's difficulties, and also arrives at the conclusion that the Carnot cycle may be reconciled to Joule's law by the omission of the supposition that during the third process the same amount of heat is discharged from the cool body as was taken in from the hot one. He states:

"On a nearer view of the case we find that the new theories were opposed, not to the real fundamental principle of Carnot, but to the addition that no heat is loss. For it is quite possible that in the production of work both may take place at the same time: a certain portion of heat may be consumed, and a further portion transmitted from a warm body to a cold one; and both portions may stand in a certain definite relation to the quantity of work produced. This will be made plainer as we proceed; and it will be, moreover, shown that the inference to be drawn from both assumptions may not only exist together, but that they may mutually support each other."

In his 1851 paper Thomson gives Clausius full credit for solving the difficulty between the Carnot and the Joule principles. Thomson gives Clausius the full credit for priority, but states that he was working on the same problem, and had arrived at the same solution in the year 1850, before he had seen Clausius's work. Clausius, however, assumed the theory of a permanent gas, which required the absence of internal work, but Thomson was not prepared to assume this without experiment. This determination rigidly to prove every necessary assumption, and his clear conception of the points necessary for proof, led to the extensive series of researches undertaken by Thomson and Joule with the object of determining how much gas thermometers differ from an absolute scale as determined by the combination of the Joule and Carnot laws.

(To be continued.)

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

ELMIRA WATER, LIGHT AND RAILROAD COMPANY.

The earnings of the railroad department of the Elmira Water, Light and Railroad Company for the quarter ended June 30 shows gross of $58,117; expenses, $42,-222; net, $15,895; other income, $2,914; total income, $18,809; charges, $15,589; surplus, $3,220.

KANSAS CITY RAILWAY AND LIGHT COMPANY.

The report of the Kansas City Railway and Light Company for the fiscal year ended May 31 shows gross earnings of $6,070,116; operating expenses, $3,228,-170; net earnings, $2,841,946; other income, $105,680; total income, $2,947,626. This was $122,186 more than that for the fiscal year ended May 31, 1907. The balance available for dividends amounted to $853,132.

PHILADELPHIA RAPID TRANSIT COMPANY.

The annual meetings of the Union Traction Company and the Philadelphia Rapid Transit Company were held in Philadelphia on September 16. The directors of the Union Traction Company were re-elected and two new directors were elected to the board of the transit company.

The report of the Philadelphia Rapid Transit Company showed that the deficit for the last fiscal year is only $92,048.78. Receipts from all sources amounted to $18,557,502.86; cost of operation, licenses, taxes and fixed charges, $18,649,551.64. The deficit for the preceding fiscal year was $364,048.53.

A resolution was carried to increase the indebtedness of the company from nothing to $5,000,000. This loan is to be met with the unencumbered assets of the Union Traction Company as collateral, and includes valuable securities of the various underlying companies.

CUMBERLAND TELEPHONE AND TELEGRAPH COMPANY.

The report of the Cumberland Telephone and Telegraph Company for the month of August and eight months ended August 31 shows gross for August of $490,511; expenses, $287,636; August net, $201,875; interest and taxes, $37,-724; August surplus, $164,151. Eight months' gross, $4,046,583; expenses, $2,353,317; eight months' net, $1,693,-266; interest and taxes, $298,081; eight months' surplus, $1,395,185.

MONTREAL STREET RAILWAY COMPANY.

The report of the Montreal Street Railway Company for the month of August and eleven months ended August 31 shows August gross of $329,772; expenses, $164,262; August net, $165,510; charges, rentals, etc., $70,077; August surplus, $95,432. Eleven months' gross, $3,329,-059; expenses, $1,978,659; eleven months' net, $1,350,400; charges, rentals, etc., $586,966; eleven months' surplus, $764,-434.

AMERICAN RAILWAYS COMPANY.

The report of the American Railways Company for the year ended June 30 shows gross income of $2,927,436; receipts, income from stocks and bonds owned, $479,029; miscellaneous income, $17,728; total income, $498,757; total deductions, $171,645; net, $327,112, equal to 6.4 per cent on the $5,095,100 capital stock. The gross earnings of the subsidiary companies increased $59,280 over 1907, or 2.07 per cent. The total number of passengers carried was 68,762,586, an increase of 1,137,855. Stockholders were paid $305,706 in dividends, leaving a balance of $21,406 to be added to the surplus account. The American Railways Company controls the Bridgeton & Millville Traction Company, Bridgeton, N. J.; Springfield Railway Company, Springfield, Ohio; People's Railway Company, Dayton, Ohio; Altoona & Logan Valley Electric Railway Company, Altoona, Pa.; Chicago & Joliet Electric Railway Company; Chicago & Desplaines Valley Electric Railway Company, Joliet, Ill., and Scranton Railway Company, Scranton, Pa.

Steam Turbines in Power Stations.

Harry Webster, associate member of the Institution of Electrical Engineers of Great Britain, presents a summary in the *Electrical Review* (London), September 4, of facts and knowledge which he considers, from his experience, to be of the greatest importance. In operating steam turbines of the Parsons type the temperature of the steam should not exceed 550 degrees Fahrenheit. This will give all the usual advantages to be obtained by the use of superheat without danger in a well-constructed turbine. A good mercury pocket at the steam inlet to the turbine is essential, with a properly protected thermometer kept in continuously, so that the temperature of the steam can be noted at any moment. A sudden rise of temperature from any cause may do considerable mischief in a very short time. A precaution which can not be too carefully observed is the prevention of any solid matter coming over with the steam. Good lubrication is of the greatest importance, and can be achieved by using a good mineral oil, keeping all trace of water out of it. Water can only get into the oil at two or three places, and will generally be found to proceed either from the steam sealing devices at the ends of the turbine or from the water in the oil-cooling tank. This can easily be located by separating a small quantity of water from the oil and putting it through the standard soap test for hardness. Should it prove to be hard water, the fault should be looked for in the oil-cooling tank; but, if distilled, it must be proceeding from the sealing glands. There is every reason to expect a large demand for low-pressure or exhaust-steam turbines, as undoubtedly a great number of really modern and efficient reciprocating engines are in use at the present time, and it is often preferable to install a low-pressure turbine to take the exhaust from these, and thus utilize every available pound of steam rather than to scrap the engines. Some good examples of this combination are already installed and are giving excellent results, the working pressure of the steam being as low as one pound per square inch. Mr. Webber considers that the barometric condenser is of the greatest advantage in a steam-turbine installation, but the governing feature, when deciding upon the type of condenser, will be the quality of water available. A point which it is well to bear in mind with condensing plant for steam turbines is that, owing to the absence of oil, all iron and steel parts are liable to rusting. He has found that steel rings fitted to the buckets of air pumps rust quickly, although the bucket and barrel are bronze; whereas phosphor-bronze rings last indefinitely.

Georgia and Florida Independent Telephone Companies.

A convention of independent telephone companies from Florida and Georgia was held at Bainbridge, Ga., on September 11. The convention was largely attended, some 16,600 telephones being represented. A permanent organization was effected, with the following officers: President, Dr. J. G. Dean, Dawson, Ga.; secretary and treasurer, W. N. Drake, Pelham, Ga.; vice-president for Florida, Dr. W. L. Moor, Tallahassee; vice-president for Georgia, T. E. Gurr, Bainbridge.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Electrical Equipment of the Royal Mail Steamship Orcoma.

The Pacific Steam Navigation Company's new twin-screw steamship Orcoma, of 11,532 tons, is the newest and largest of the company's fleet. The electrical equipment marks an advance in steamship fitting-up. Accommodations have been provided for 250 first-class passengers, 200 second-class passengers and a large number of third-class passengers. The machinery consists of two sets of quadruple-expansion, four-crank engines having cylinders twenty-six inches, thirty-seven and one-half inches, fifty-three and one-half inches and seventy-six inches in diameter by fifty-four-inch stroke, with three double-ended and three single-ended boilers for a working pressure of 210 pounds per square inch. The electric generating plant consists of four sixty-five-kilowatt, 110-volt, continuous-current generators, direct-driven by high-speed engines. The ship's lighting comprises 1,500 sixteen-candle-power incandescent lamps, three arc lamps for cargo purposes, and one Admiralty type Morse code signaling lamp. One of the large whistles is controlled by an electrical apparatus which admits of its being operated by a small handle on the navigating bridge. It can, in addition, be switched on to a special clock in the wheel-house which blows the whistle automatically at intervals of every sixty seconds. The ventilating plant consists of two eight-horse-power Allen enclosed motors driving Sirocco fans for ventilating the stoke-holes; four enclosed motors driving fans for ventilating the galleys and lavatories, and sixteen fifty-four-inch ceiling fans for ventilating the dining saloons. Eighty-six nine-and-one-half-inch trunnion fans are installed in the first-class staterooms. The laundry installation is driven by a five-horse-power enclosed motor. A passenger elevator serving the four passenger decks is driven by an eight-horse-power enclosed Siemens motor. There is also an electrically operated hoist for raising provisions from the refrigerating chambers. The galleys and sculleries are equipped with eight motors for spit-turning, knife-grinding, potato-peeling, bread-kneading, boot-cleaning and dish-washing. There are also an electrically driven bacon-cutting contrivance, electrically heated radiators, ovens, hot plates and irons, and the barber shop is fitted up with electrically driven hair brushes and fans in connection with the hair-drying apparatus. A very complete system of electric bells keeps the principal officers in close touch by means of an intercommunicating telephone system.—*Abstracted from Electrical Engineering (London), September 3.*

An Electrical Farm at the Electrical Exposition in Marseilles.

A model electrical farm at the electrical exposition in Marseilles is described by J. A. Montpellier. There is great scarcity of labor in the agricultural districts of France on account of emigration to the cities, but it is here shown how electricity can be made to perform all the arduous work on the farm, thus replacing human labor and remedying the existing evil. The modernized farm, which covers a surface of 800 square metres, is one of the most interesting attractions at the exposition, all the buildings of a typical farm being faithfully reproduced. The dwelling is equipped electrically throughout; there is an electric cooking stove in the kitchen simpler than that in the modern villa; an electric pump supplies ozonized water; there is an electric bread-kneader and an electric oven in the bakery; the laundry is furnished with a special pump, electric wash machines and irons; in the winter an electric fan supplies heated air to all the rooms, and it may be used to supply air cooled by ice in the summer. In the yard are a centrifugal pump installed over a well and driven by a small motor; plows, thrashing machines, huskers, winnowers, etc.; everything in full operation. The wine-cellar equipment is remarkable. It has a wine pump, grape-picker, beater and press, all operated electrically. For the manufacture of olive oil special electrically driven machinery is provided, such as presses, crushers, pumps, filters, etc. In the poultry house there is a bone-crusher, herb-cutter, electric brooders and breeders. The cowhouse contains a carrot-cutter, grain-crusher, oil-cake mill, root-cutter, as well as special apparatus for milking the cows. The dairy is furnished with the most modern utensils, cream separators, beaters and churns, manufacturing butter and cheese in view of the public. A pump and ice-making machine complete the outfit. In the stable an electric straw-cutter has been installed and also electric shears for shearing sheep. Bad odors in stables need no longer exist. Their disinfection and sanitation are efficiently effected by ozonized air produced by a special ozonizer. A shop containing a forge with an electric blower, an electrically driven band-saw, grindstone and other tools completes the installation of the farm. The vegetable garden has also received attention, for by means of electricity intensified cultivation may be practiced, so that it will be possible to obtain in winter strawberries, tomatoes and other early vegetables.—*Translated and abstracted from L'Electricien (Paris), August 29.*

The Manufacture of Carbide of Calcium.

A short history of this industry in Europe is here given by E. Rosenthal. It is well known that the experiments of Moissan and Wilson gave birth to this industry. The simplicity of the method of obtaining carbide of calcium in an electric furnace, namely, the treatment of a given mixture of lime and coke by an electric arc, gave rise to the crisis in 1900. In France, where the patents of Bulier were upheld, those factories that had been equipped for the manufacture of carbide were obliged to utilize their water power in other ways. But gradually, in France as in other countries, the factories formed combinations and thus became stronger; the methods of operation were improved, and if in 1900 all the factories were in the same position technically, this is no longer the case to-day. Furthermore, the German and French markets are regulated by two selling syndicates, of which most of the factories are members. The purely economic evolution of the carbide industry is not dealt with, the author discussing in this article the technical methods and various furnaces. The first furnaces were of circular or square section with a very heavy sheet-iron wall, which was covered inside by a thick layer of compact carbide. A square carbon electrode (forty to sixty centimetres square and 1.8 to two metres long) was suspended inside of the furnace and connected by thin copper sheets to one of the poles of a generator or transformer, while the other pole was connected to the graphite crucible. The intermediate space was filled with the material to be treated, a mixture of lime and coke, which was transformed into carbide by the heat of the arc. The carbide was allowed to cool in the crucible and then removed in the shape of a cone. A typical installation of that time utilizing 800 horse-power contained eighteen furnaces, of which twelve were operated simultaneously. Each furnace consumed 2,000 to 2,500 amperes, and the operation lasted from two and one-half to three hours. The mass of carbide was allowed to cool for about one and one-half hours, and it took one-half hour to recharge the furnaces. To manufacture a ton of carbide required, at that time, about 750 kilogrammes of coke, 1,000 to 1,100 kilogrammes of lime, and the consumption of the electrode did not exceed thirty kilogrammes. To obtain good results it was necessary to use coke containing few cinders and lime containing neither phosphor nor sulphur. Besides this, it was of advantage to use the raw material in small pieces or pulverized, as its fusion is thereby hastened. The Compagnie Electrometallurgique patented in 1889 a type of furnace meeting these conditions. The method of allowing the carbide to cool in the furnace, which results in a great loss of heat and a rather low output, was soon followed by the continuous operation of a closed furnace. An American, L. H. Hartenstein, even obtained a patent on this process. The material to be treated surrounded the entire extremity of the movable electrode and covered the arc during the whole operation. At intervals varying from fifty minutes to two hours, according to the work and the type of furnace used, the carbide was made to flow off into ingot molds. In this manner the consumption of the electrodes and the cost of production in general were greatly reduced. The efforts of manufacturers were directed toward perfecting details of the furnace and all phases of the process. Instead of suspending the electrodes from clamps or bolts, clamps with water circulation were invented, which at the same time permitted the electrodes to descend in the measure that they were consumed, and thus only a part of the electrode was traversed by the current and exposed to the direct action of the furnace. The furnaces were made larger and of different forms. In 1900 a furnace with two suspended and movable electrodes was patented by the Société Metallurgique of Froges. This furnace was a double one with two arcs in series, the tension of which could be regulated. Gin and Leleux invented similar arrangements and applied them in their installations. In 1904 Keller took out a patent on a furnace having several fusion chambers with electrodes connected by channels to a common central crucible, where the fused masses accumulated. Morani proposed a furnace with inclined fixed electrodes placed opposite each other so as to form two walls, the distance between which could be varied. Between them was placed an auxiliary electrode not in the electric circuit and serving merely to allow the arc to pass between the fixed electrodes. He generalized this arrangement and applied it to furnaces operated by three-phase current. Finally, the Compagnie Continentale d'Electricite of Glaris and its manager, M. Lanhoffer, obtained a patent on a method of manufacturing calcium carbide that deserves special mention. In view of the two phases of the process that take place in the furnace—the phase of transformation proper and the phase of fusion—M. Lanhoffer utilizes the furnace with two electrodes and separates the two phases which succeed each other in the same furnace, but are simultaneous in two furnaces connected together. An arc is formed between the crucible and the electrode and the mixture filled in, which is transformed into carbide. This carbide accumulates in the crucible in the form of a pasty mass, with which the electrode is gradually brought in contact. The current then acquires a very great intensity and its voltage is reduced to the value necessitated by the resistance of the carbide and other parts of the circuit. In this manner the carbide is fused very rapidly and is allowed to flow off. The two furnaces being in series, the phase of reduced tension or fusion in one furnace may be made to coincide with the phase of high tension or transformation in the other furnace. It is only necessary to lower the electrode in one and raise it in the other; then the flowing off alternates in the two furnaces and the process is entirely continuous. These furnaces are now in use in a number of factories. The electrode consumption is only ten to twelve kilogrammes per ton of carbide, and the production seven to eight tons per 1,000 horse-power in twenty-four hours. L. H. Hartenstein has recently obtained a patent on a three-stage furnace, in which the calcination of the lime, the mixture of lime and coke, the treatment of the mixture by the arc and its transformation into carbide are effected at the same time.—*Translated and abstracted from La Lumière Électrique (Paris), August 29.*

Interpole Traction Motors.

Dick, Kerr & Company have developed a series of interpole motors particularly suitable for tramway systems where extensive use is made of electric braking, and in any circumstances where the duty is more than ordinarily heavy. In some cases the motors will stand as much as 100 per cent overload without injury. The field frame is made in the usual form, of two bowl-shaped castings of soft steel of high permeability, thereby securing the smallest possible weight. The two halves are fitted together with a carefully machined joint to insure a good magnetic circuit and to make the frame both watertight and dustproof. The lower part of the frame is hinged to the upper half, permitting the lower field coils to be easily inspected and cleaned. Each armature bearing box is contained in a separate solid casting independent of the motor frame altogether, being held in position in the main motor frame by a tongued and grooved joint and firmly fixed by studs. The armature can therefore be lowered with the bottom half for inspection, or can be retained in position in the top half, as may be desired. It can further be removed from the main shell with its bearing boxes complete if occasion requires it. The main pole-pieces are made up of laminated sheet-steel punchings riveted together, and are bolted to the inner surface of the frame. The pole-pieces are interchangeable. Special arrangements are made for supporting the main field coils, two flat steel springs, each capable of exerting a pressure of about 400 pounds, being inserted between the field coil and the shell. The coils are held in place by the pole shoes themselves and brass washers which cover the surface of the coil. The interpoles are of solid steel, situated symmetrically between the main poles, and fixed in position by rivets. The interpole field coils are clamped in position by independent screws. Especially good ventilation of the armature is secured by means of the fanning action of the connections between the armature coils and the commutator bars. These connections are made of thin, flat copper strips, which, when the armature rotates, act as fan vanes and draw a current of air through the motor. This artificially produced draft is so effective that it enables a motor to run fully twenty-five per cent cooler than would be possible otherwise.—*Abstracted from the Electrical Engineer (London), September 4.*

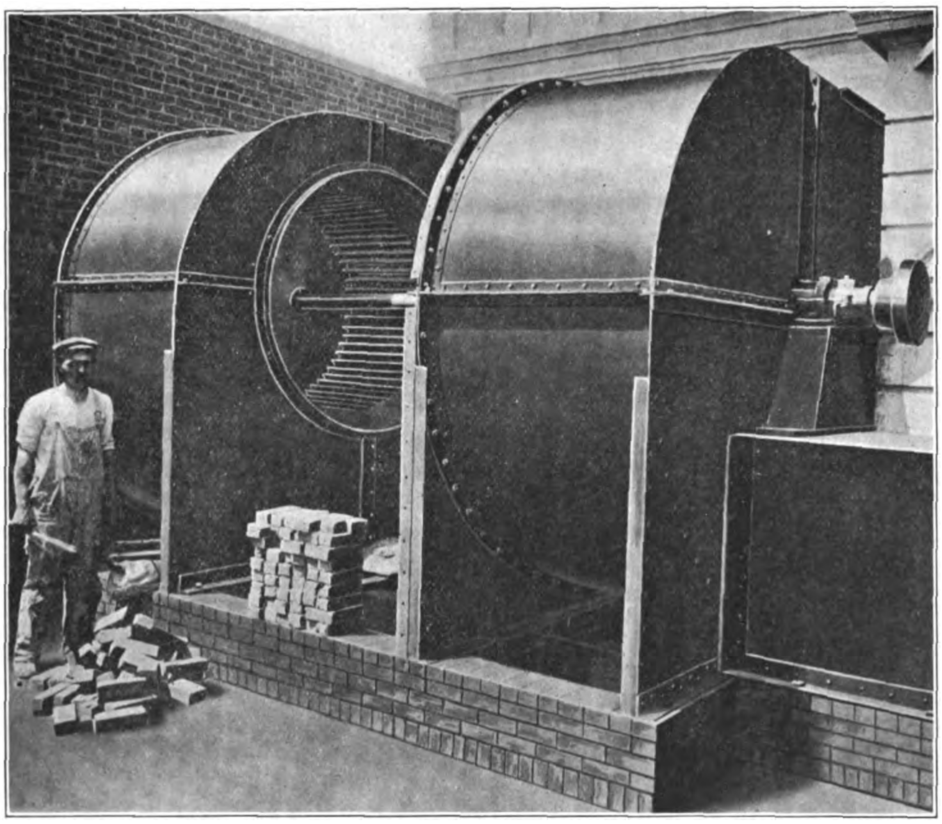
INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A Notable Sirocco Fan Installation.

There has just been completed on the roof of the Hotel Astor a fan installation of so unusual a character as to make it of especial interest. The installation consists of two sixty-six-inch single-inlet Sirocco fans running on the same shaft. This shaft is fourteen feet between bearings.

The fans draw from a common intake chamber five feet eight and one-half inches wide. They are direct-connected to a thirty-five-horse-power motor. The capacity of the fans is 50,000 cubic feet of air per minute each, against a three-quarter-inch water gauge. The flue through which the fans exhaust is of brick. The photograph showing the principal features of the installation was made prior to the bricking up of the central intake.



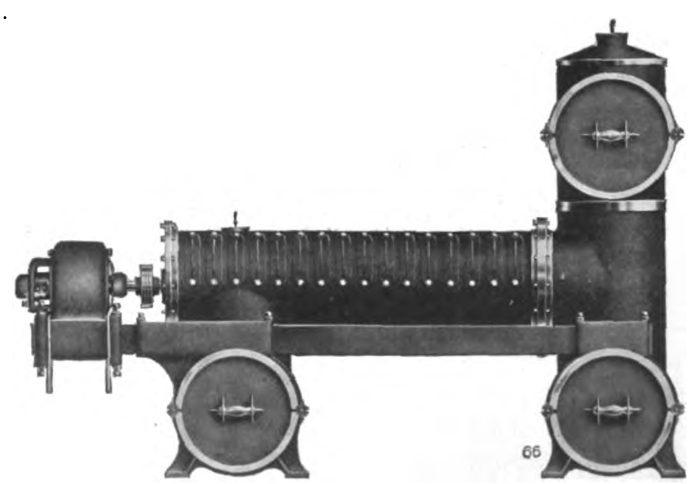
Sirocco Fan Installation on Roof of Hotel Astor, New York City.

The light weight and small size of the Sirocco fan for the heavy duty required made it possible to mount the fans on the same shaft, thus saving not only in cost of installation but in power. The power saving is said to amount to twenty-five per cent.

Electrical Cleaning.

What has been called a new science, the science of cleaning, owes its latest development and wide applicability to the electric motor. The suction method of cleaning is fast taking the place of the broom and dust-pan, which stir up the dust and allow most of it to resettle. Instead of this old-fashioned, semi-hygienic method, modern ingenuity has devised the scientific, yet simple, expedient of sucking in the dust and germs from floors, carpets, upholstery, or any other place where they may accumulate, and transferring them through tubes to a suitable receptacle, where they are collected in a condensed condition. In addition to its hygienic perfection, this method has the advantage that it is easy, and consequently cheap, to operate. The system consists of the cleaning tools, which resemble brushes; the flexible tubes and the exhausting machine, which contains the dust separator. The exhauster and dust separator can be conveniently located in the basement or cellar and connected by piping to inlets in the various rooms and halls, where the flexible connections can be made.

The fact that the exhaust collector requires power to drive it, at first limited the application of this principle to places which had convenient power plants, but with the electric motor its use has been greatly extended. At present, office buildings, theatres and residences are being extensively provided with exhaust cleaning outfits. The latest improvement in exhaust collectors has been made possible by the continuous rotary action of the electric motor. This is the application of the turbine principle to the exhauster. The accompanying view shows one of these turbine exhausters driven by a form L motor, built by the Crocker-Wheeler Company, Ampere, N. J. The turbine has only two bearings and, in addition, the automatic dust extractor is an integral part of the cleaner and no power is wasted in drawing the air through any screens or other retarding mediums before it passes



Electrically Driven Turbine Dust-Exhauster.

through the machine. When electrically driven the apparatus can not be disabled by freezing, as may be the case when the dust-laden air current has to pass through a humidifier or where the power is obtained from steam.

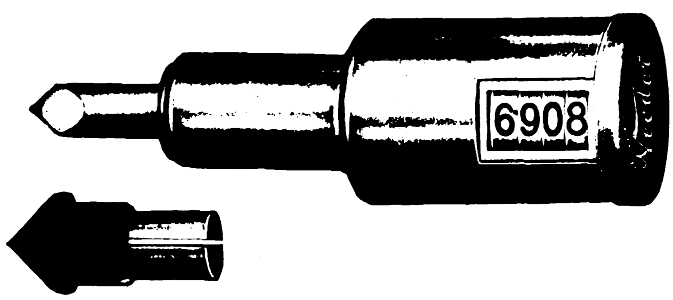
The cleaning tools used with this system have large orifices so that they will suck not only the dust but tacks, pins and scraps of paper as well.

The machine shown in the illustration is one of large size. The Crocker-Wheeler Company has been for some time supplying motors for exhausters of all sizes for use in various kinds and sizes of buildings.

Speed Counters.

The difficulty which has been encountered in obtaining accurately the number of revolutions of a generator or motor will be readily overcome by the use of a new speed counter put on the market by the Veeder Manufacturing Company, of Hartford, Ct. This instrument is shown very clearly in the accompanying illustration. It consists of a revolution counter which is operated through a clutch, the two jaws of this clutch being held apart by a helical spring when the counter is not in use.

The counter is used by placing its point against the shaft the speed of which is to be measured. So long as it is held with a light pressure, the clutch is out of engagement and the instrument does not register. A watch can be held in the other hand and at the beginning of a minute, by a slight pressure on its end, the counter is started registering. If the pressure is released at the end of a minute the counter instantly stops. The difference between the reading of the counter at the beginning and end of a minute is the revolutions per minute of the shaft.



Speed Counter with Insulated Tip.

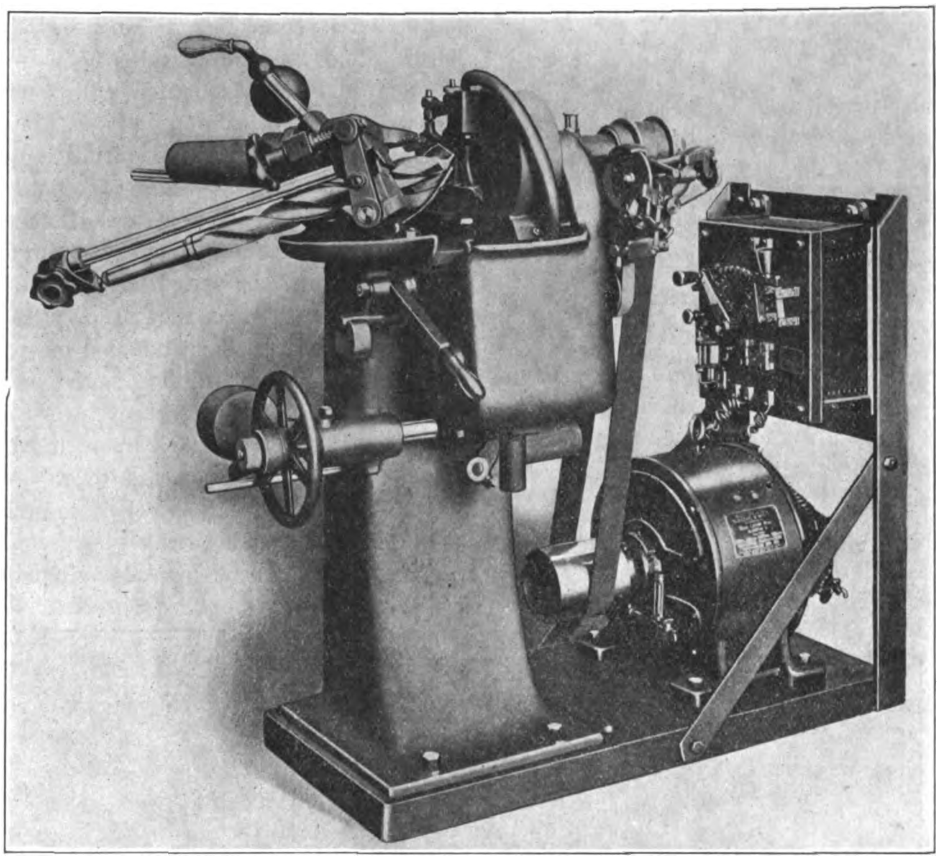
No arrangement is provided for setting the register back to zero; this operation taking more time than is necessary to set down the two readings of the counter and find the difference between them. The register is direct-reading, having all the figures in line; this prevents mistakes in reading the instrument.

This speed counter is peculiarly adapted to electrical work because it is not affected by magnetism and also because an insulating tip is provided which prevents any short-circuit through the instrument, and does away with the necessity of using a stop-watch.

Drill Grinding by Machinery.

It is a well-recognized fact that there is a theoretically correct shape for a drill, whether of the flat or twist type, in order to obtain the maximum amount of work from the drill. It is also fully admitted that hand grinding can not give this best shape and for this reason more power is required by the hand-ground drill than is necessary. In addition to this, a drill incorrectly ground will not bore a uniform hole to size.

Drills correctly ground and pointed will not only drill to size with minimum power, but when straight they will wear the drill press less than if incorrectly ground or out of true. In the latter case the force required to hold the drill steady brings a strain on the drill press which causes the bearings of the spindle to wear.



A Motor-Driven Sellers Drill Grinder.

The drill-grinding machine illustrated herewith is manufactured by William Sellers & Company, and is equipped with a standard Westinghouse motor of two-horse-power capacity. The entire outfit is self-contained with starting switch and motor complete. The grinder is suitable for any type of double-tip drills, varying from five-sixteenths inch to three inches in diameter.

The grinding of the tips is done on the face of the stone, or grinding wheel, which insures a correct surface as the drill is moved over the entire face of the wheel. By a special device the correct pointing of the drill is secured.

An interesting feature is the method adopted for providing an ample supply of water at the grinding surface. The wheel proper is protected by a cover at all points except where the drill comes in contact with it. On the cover there is an adjustable nozzle through which water is delivered in an abundant flow to both drill and wheel without splash or waste. The water is moved by a small centrifugal pump driven from the main motor.

The entire equipment is very simple, so that a skilled workman is not required; any man of ordinary care can operate the machine with perfect satisfaction.

The application of the motor to this grinder permits the machine to be located in the shop at any point desired, without reference to shafting or belts. It secures the maximum economy of driving power, inasmuch as the entire outfit may be stopped whenever not in actual use.

Milling Machine.

Many direct, as well as indirect, advantages resulting from driving machine tools by electric motors have resulted in a gradual improvement in the methods of attaching the motors.

In many instances the characteristics of the motors have been such that modifications could be made in the tools to such an extent that they were considerably simplified, as well as their productive capacity increased, by considering the motor and the tool as a unit in making the original designs. These applications may be contrasted with the somewhat older method of applying a motor to a standard belt-driven tool.

As direct and alternating-current motors have characteristics of a different nature the method of applying these two different types of motors is materially different. For that class of service requiring a variable cutting speed, the direct-current adjustable-speed motor is especially well adapted. A good example of this is shown in Fig. 1, where a fifty-horse-power Westinghouse motor is shown applied to a heavy milling machine manufactured by the Ingersoll Milling Machine Company. The motor has an initial speed variation of from 500 to 1,000 revolutions per minute, the speed being controlled by means of a drum-type controller not shown in the illustration, mounted at a point convenient to the operator.

In addition to the speed variation obtained in the motor, there are change gears, giving speed variations of about seven to thirty-five revolutions per minute, and the feed may be varied from one-half to fourteen inches, as may be required. The miller is particularly adapted to such heavy work as paneling locomotive side rods—which is perhaps as heavy work as such machines are called upon to do. The tool is powerful enough to remove forty-five cubic inches of steel per minute when taking a slabbing cut.

With the alternating-current equipment, as shown in Fig. 2, the speed of the motor is fixed and it is necessary to supply a suitable run of gearing, which may be operated by a lever to obtain the required changes in speed. As before, the speed range runs from seven to thirty-five revolutions per minute of the tool.

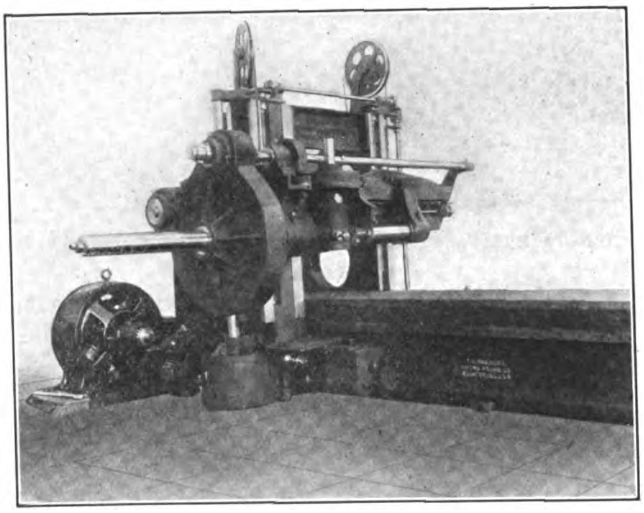


Fig. 1.—Milling Machine with Direct-Current Motor.

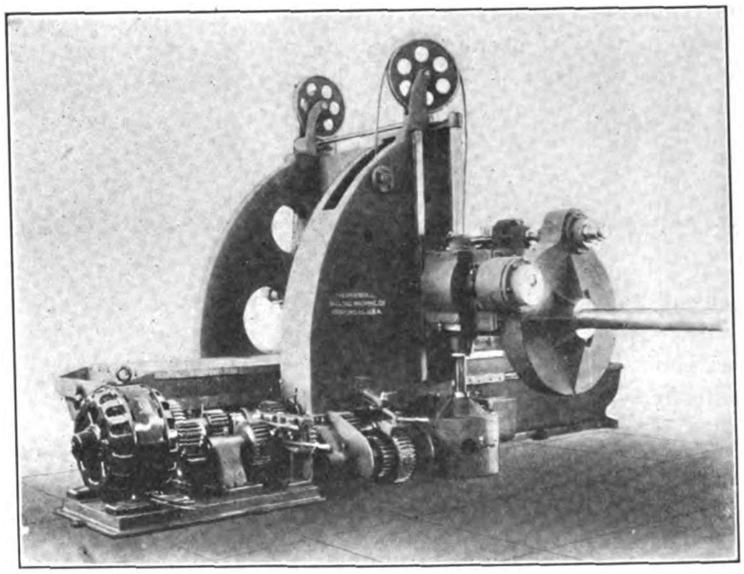


Fig. 2.—Milling Machine with Alternating-Current Motor and Gear.

Famatina Development Corporation.

The Famatina Development Corporation, which is interested in the development of copper mines near Chilecite, Argentine, is installing a hydroelectric plant, the generating equipment for which consists of two 200-kilowatt, 240-volt, revolving field generators with direct-connected exciters, together with a suitable switchboard and transformers for stepping the voltage up to 13,200 volts. The generators are belt connected to a line shaft driven by two four-foot Pelton water-wheels capable of developing 630 horse-power at 300 revolutions per minute. The head is 230 feet, the pipe line being 6,661 feet in length.

In addition to the generating station there are also two substations, one located at the smelter a short distance from the generating station and the other at the mines. The power in the smelter is taken direct at the generator voltage, while that in the mine is stepped down from 13,200 to 240 volts. In addition to the apparatus mentioned above, the General Electric Company also supplied several induction motors of various sizes for use both at the mines and at the smelter.

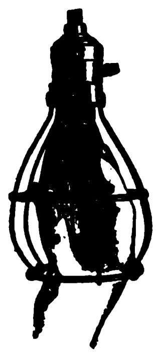
This installation is comparatively small, but is interesting from the fact that a twenty-mile transmission line will be erected from their generating station to the mines for transmitting only 100 horse-power (ultimately 200 horse-power), this comparatively large expenditure probably being due to the scarcity of fuel.

New German Cable Company.

The German-South American Telegraph Company has been founded in Berlin, Germany, with a capital of 4,000,000 marks. This capitalization will be increased from time to time as the business progresses. It has been stipulated that two-thirds of the board of directors must be of German nationality and must reside in Germany. The electrical manufacturing firm of Felten, Guilleaume & Lahmeyer, which originally obtained the concession and passed it on to the new company, will supply and lay down the new cable, and negotiations are under way with the Brazilian Government in regard to securing a landing place.

A Heavy Wire Lamp Guard.

The accompanying illustration shows a heavy wire lamp guard which has been placed on the market by Herbert T. Foster, of Worcester, Mass. This guard is firmly attached to the socket, and does not touch the lamp nor depend upon it



Heavy Wire Lamp Guard.

for support in any way. The same guard can be used with either a sixteen-candle-power or a thirty-two-candle-power lamp, and a lamp may be removed and a new one inserted without the guard being taken from the socket.

The advantages of this guard make it especially desirable for general factory and shop use, car-barns or any other place where a lamp is required to be protected.

A Thoroughly Insulated Incandescent Lamp Guard.

Quite recently there has been a good deal of prominence given to the possible danger which may exist if a metal lamp

Fibre Lamp Guard.

guard should become charged from a high-tension circuit through a defective cable or broken-down insulation, rendering the guard alive. A few weeks ago announcement was made of death by shock to a young man who had carelessly taken up a wire lamp guard which was afterward found to be defectively insulated.

The accompanying illustration shows a lamp guard made by the Benjamin Electric Manufacturing Company, Chicago, Ill., which, because of its construction and the material of which it is made, eliminates the possibility of injury from shock. The handle is made of well-seasoned and thoroughly insulated wood, and the guard proper is made of narrow strips of insulated fibre. The strips are placed radially to the lamp and cut off very little of the illumination from the light source.

First Annual Report, Public Service Commission, Second District, State of New York.

The first annual report, for the year 1907, of the Public Service Commission for the Second District, State of New York, has been issued. The commission took office and entered upon the discharge of the duties imposed upon it by law on July 1, 1907. The Second District commission has jurisdiction over all the counties of New York state except New York, Kings, Queens and Richmond. There have been created six separate divisions of the commission, as follows: Division of Light, Heat and Power; Division of Railroad Engineering and Inspection; Division of Statistics and Accounts; Division of Traffic; Division of Tariffs; General Office.

The work assigned to the Division of Light, Heat and Power is the supervision of all gas corporations, electrical corporations, the inspection and testing of gas and inspection and testing of gas meters, the inspection and testing of electric meters, the supervision of municipal electric plants, so far as power is given to the commission.

The Division of Railroad Engineering and Inspection includes the inspection and supervision of the physical properties of both steam and electric railroads.

This report covers the period for the six months ended December 31, 1907. On that date there were seventy-one electric railroads operating in the second district. These roads owned and operated 1,510 miles of track and leased or controlled 159 miles. There were 171 electrical companies and fifty corporations supplying both gas and electricity. For the inspection of electric meters the second district has been divided into four electric-meter inspection districts, with respective headquarters at Yonkers, Albany, Utica and Rochester. An inspector of electric meters, appointed from a list of eligibles furnished by the state Civil Service Commission, is stationed in each district, under the supervision of a chief inspector at Albany.

Vol. i of the report contains, in addition to the matter which is summarized below, appendices comprising the miscellaneous orders which have been issued by the commission during the period covered by the report. There is a general index and an index of the report of the Board of Railroad Commissioners. Vol. ii contains the abstracts of reports of corporations. It includes assets and liabilities, cost of road and equipment with distribution of cost, securities, funded debt, dividend-paying stock, non-dividend-paying corporations, road and equipment, miles of road operated, locomotives and cars in service, income with deductions and revenue from operation; operating expenses, distributed as to maintenance of way, etc.; freight operations, classification of commodities, passengers carried, monthly wages of employés, highway and railroad crossings and casualties of steam railroad corporations and electric railroad corporations, and gas and electrical companies. A supplement to the report comprises two magnificent maps showing in colors the steam railroads and the electric railroads operated in the state of New York.

The Kansas Gas, Water, Electric Light and Street Railway Association.

The eleventh annual meeting of the Kansas Gas, Water, Electric Light and Street Railway Association will be held at Pittsburg, Kan., October 8 and 9. Headquarters will be established at the Stilwell Hotel. The programme has been announced as follows: President's address, C. L. Brown, Abilene, Kan.; "Street Lighting—Arc and Series Tungsten," N. R. Birge, General Electric Company, Schenectady, N. Y.; "Electrical Jobbers," P. B. Chaney, Monarch Electric Company, Kansas City, Mo.; "The Correct Rate to Be Charged by Central Stations," W. A. Scothorn, Hutchinson, Kan.; "Commercial Insulation of Wire," F. H. Dimick, International Lecture Institute, New York, illustrated by lantern slides; "Finances of the Light Business," H. V. Forest, superintendent Winfield Electric Light Company; "Steam Turbines," C. R. Mackay, manager Toledo Railway and Light Company, Toledo, Ohio; "Incandescent Lamps," S. E. Doane, chief engineer National Electric Lamp Association, Cleveland, Ohio; "Our System of Bookkeeping and Records," Dow R. Guinn, Pittsburg Water Supply Company.

Current Electrical News

DOMESTIC AND EXPORT.

NEW WIRELESS TELEGRAPH COMPANY—Articles of incorporation have been issued to the Southern Wireless Telegraph Company, which is capitalized at $1,000,000, and which will have its headquarters at Little Rock, Ark. The company proposes to install a station and to place Little Rock in connection with eighteen other stations in Arkansas, Louisiana, Mississippi and Oklahoma. It is proposed to have the new station at Little Rock in operation in a short time and to locate the other stations as soon thereafter as possible. George A. Parker is president of the company, Harry C. Hale secretary and R. T. Balch treasurer.

WASHINGTON ELECTRIC ROAD INCORPORATED — The Spokane, Columbia & Western Railway Company is the name of the new electric and steam road which the Graves interests will build from Spokane into the Big Bend country. Articles of incorporation for the new railroad have been filed at the county courthouse, the capital stock being $3,000,000. Jay P. Graves's name does not appear as one of the incorporators. These are: Clyde M. Graves, Waldo G. Paine, W. G. Davidson, H. B. Ferris and Will G. Graves. All are connected with the Inland Empire system. The road will run from Spokane to the mouth of the Spokane River, seventy-five miles. Surveyors have been in the field for several weeks. Ample power will be available at the new power plant owned by the Graves interests at Nine Mile to operate the new line and the present lines of the Inland Empire system.

NORTHERN COLORADO POWER COMPANY TO ISSUE BONDS —The Northern Colorado Power Company has decided to increase its bond issue from $3,000,000 to $6,000,000, to provide money for proposed extensions to its transmission lines and to increase the capacity of its power plant at Lafayette. It was provided that the outstanding $3,000,000 be retired, and the present holders receive a like amount of the new bonds. The additional $3,000,000 in bonds will be utilized for construction work. Transmission lines will be extended from Greeley to Lafayette by way of Brighton. President Barker is planning to supply a large amount of power for irrigation purposes. There is, he says, a growing demand for electricity for pumping water on farms and the company is preparing to meet the demand. Scores of wells are being sunk on farms, and water will be pumped for irrigation.

NEW INCORPORATIONS.

ALBANY, N. Y.—Valatie Telephone Company. Valatie. $10,000. Incorporators: Edwin D. Howe, Wilson Miller, Valatie.

CHICAGO, ILL.—Traction Lighting Company. $100,000. Incorporators: Fred H. Atwood, Charles O. Loucks and Henry Tupper.

SPRINGFIELD, ILL.—Saline County Traction Company. $5,000. To build an electric line from Eldorado to Carriers Mills in Saline county.

SPRINGFIELD, ILL.—Roanoke Telephone Company, Roanoke. $2,000. Incorporators: P. W. Kennell, E. W. Rediger and J. J. Beer, Jr.

DOVER, DEL.—Safety Electric Railway Company. $50,000. Incorporators: A. H. Angle, A. Barbeel, Philadelphia, Pa.; W. I. N. Lefland, Dover.

BOISE, IDA.—Canyon Light, Power and Water Company, of Shoshone County. $250,000. Incorporators: Ellis L. Hale, W. R. Miller and L. C. Wilson.

NASHVILLE, TENN.—Great Falls Power Company, Davidson County. Amended charter, increasing the capital stock from $20,000 to $625,000.

AUGUSTA, ME.—Tuolumne River Power Company. $500,000. Officers: President, Charles D. Shaw, of Greenville; treasurer, William M. Shaw, of Greenville.

LOS ANGELES, CAL.—El Monte Home Telephone Company. $25,000. Incorporators: J. S. Killian, F. P. Sappington, Edgar O. Fawcett, I. Kauffman and A. F. Snell.

ALBANY, N. Y.—Westchester County Automatic Telephone Company. $100,000. Incorporators: Frederick Hughes, Helen Degnon, Joseph L. Abrahams, Yonkers, and others.

CLEVELAND, OHIO—International Independent Telephone Company. $10,000. Incorporators: C. Y. McVey, W. H. Hillhouse, J. C. Boush, W. H. Sheppard, W. E. Cary, Jr.

TRENTON, N. J.—Haytian Electric Company, Jersey City. $100,000. Incorporators: L. M. Arthur, S. H. Parsons and J. L. Egan. To generate electric current for heat, power and light.

BEEBE, ARK.—Beebe Light and Power Company. $10,000. Incorporators: J. S. Smith, president; M. Strickland, vice-president; E. Roberts, secretary and treasurer; G. H. Hills and F. D. Worthington.

GRAFTON, W. VA.—Oakdale Telephone Company, of Oakdale, Mercer County, W. Va. To construct and operate a telephone line. $1,000. Incorporators: J. R. Boyd and fifteen others of Mercer County.

DENVER, COL.—Naturita Valley Rural Telephone Company. $1,500. Incorporators: G. A. Akers, H. H. Ross, Henry Tamm, Roger L. Williams, George W. Hook, Arthur Priestley and K. B. Northrup.

OAKLAND, CAL.—Jahnke Aerial Telephone Company. $200,000. Directors: Albert Jahnke, John T. Geraty, Frank J. Golden, L. M. Sherwood, C. H. Halzborn, W. L. Harshbarger, W. R. Anderson and A. Kovanik.

JERSEY CITY, N. J.—The Billings Mutual Telephone Company, Jersey City. To operate public telephone exchanges and systems. $500,000. Incorporators: P. B. Moss, G. M. Hays, J. N. Perry, Billings, Mont.; S. S. Moore, Jersey City.

FORT SMITH, ARK.—Fort Smith-Oklahoma Light and Traction Company. $30,000. Formed for the purpose of owning and operating in Arkansas and Oklahoma, to deal in real estate, natural and artificial gas, etc. Incorporators: P. K. Reiss, I. S. Lowrey, E. H. Thomas, Rudolph Ney and C. P. Wilson. Mr. Reiss is president; Mr. Lowrey, vice-president; Mr. Thomas, secretary, and Mr. Ney, treasurer.

HARRISBURG, PA.—Kutztown Rural Telephone and Telegraph Company. $10,000. To operate in Berks and Lehigh counties, touching Kutztown, New Tripoli, Krumsville, Weaverville, Kingston, Steinsville, Wannamaker's, Lynnport, Roberts Corners, Werley's Corners, Sweitzer, Lynn Valley, Clausville, Guthsville, Maxatawney, Park Avenue and Monterey, all in Berks and Lehigh counties. Treasurer, Charles A. Stein, of Kutztown.

NEW MANUFACTURING COMPANIES.

NEW YORK, N. Y.—The International Wire Company, with a capital stock of $250,000, has been incorporated to act as contracting, mechanical and electrical engineer, and to manufacture cars, trucks, etc. The incorporators are A. A. Harrison, J. A. Walsh, Brooklyn; E. H. Cook, Wilkes-Barre, Pa.

ALBANY, N. Y.—The Nonpareil Electrical Manufacturing Company has been chartered with a capital of $50,000 to manufacture and deal in electrical supplies. The headquarters of the company will be in New York city. The incorporators are C. S. Shuman, A. F. Braatz, New York city, and E. M. Speer, New Jersey.

PERSONAL MENTION.

MR. E. H. BURLINGAME has resigned as manager of the Oelwein Light, Heat and Power Company, Oelwein, Iowa, to accept the position of superintendent of the People's Gas and Electric Company, of Chillicothe, Mo.

MR. J. H. CLUNE, Washington, Pa., has been appointed superintendent of the Butler division of the Bell Telephone Company, succeeding H. A. Trax. Mr. Trax has been transferred to the office of the general superintendent at Pittsburg.

MR. W. A. CATTELL, president of the Petaluma & Santa Rosa Railway Company, Petaluma, Cal., has tendered his resignation, to take effect October 1. He will be succeeded by E. M. Van Frank, general manager of the company. The pressure of private business was given as the reason for Mr. Cattell's retirement.

MR. GEORGE N. TIDD, general manager of the Scranton (Pa.) Electric Company has been made managing director of the Municipal Steam Heating Company, of Syracuse, N. Y. Both Scranton and Syracuse capital is interested in the company. This appointment will not interfere with Mr. Tidd's present connection.

MR. CUSTER L. FARNSWORTH, who for five years has been superintendent of the electric department of the Ludlow Manufacturing Company, Ludlow, Mass., has accepted the position of superintendent of construction with the Fitchburg (Mass.) Electric Lighting Company, and begins his work there October 1.

MR. C. E. F. AHLM, Cleveland, Ohio, has been retained as consulting engineer by the Board of Public Service of Lima, Ohio, in connection with the municipal electric lighting plant to be built in that city. The plant will consist of one 200-kilowatt and one 300-kilowatt units, 2,300-volt, sixty-cycle, three-phase, direct-connected to compound engines, and $80,000 has been appropriated for the work, which will begin at once.

MR. L. E. FISHER, of Danville, Ill., has tendered his resignation to President W. B. McKinley, of the Illinois Traction System, effective on January 1, 1909. Mr. Fisher will be succeeded as general manager of the McKinley system by H. E. Chubbuck, of Ottawa, Ill. Mr. Fisher entered the service of the Illinois Traction system in 1901, previous to which he had been superintendent for a short time of the electric light and power company at Paris, Ill. Mr. Fisher will engage in the railroad construction business.

MR. HENRY J. PIERCE, president of the International Railway Company, Buffalo, N. Y., announces that he will resign from the presidency of the company at the annual meeting on September 29, and that he will be succeeded by Thomas Penny, of the law firm of Norton, Penny & Sears. Mr. Pierce intends to devote all his time to the affairs of the Amsterdam corporation formed last May by himself and W. J. Wilgus, former vice-president of the New York Central & Hudson River Railroad Company. The company is engaged in the contracting and engineering business in New York.

MR. C. L. DE MURALT has been reappointed professor of electrical engineering at the University of Michigan for the coming year. During the winter season Professor Muralt will devote his attention to the consideration of the more general aspects of applied electricity. The course of lectures will include the discussion of: (1) The characteristics and application of alternating and continuous-current motors; (2) the design, construction and operation of electric plants; (3) the principles and methods of transmitting, distributing and controlling alternating currents; (4) the calculation and operation of electric railways, and (5) the management of electric properties, with special references to the commercial aspects of electrical engineering.

MR. GEORGE H. GUY, the well-known litterateur and secretary of the New York Electrical Society, is the author of a most interesting article entitled "Real Navigation of the Air," in the September issue of the *American Review of Reviews*. Mr. Guy has been a close student of the subject of ballooning and aeronautics for many years, and has enjoyed the friendship and confidence of the prominent aeronauts of the day. He is in possession of probably the finest collection of data on this subject, and his facile pen has turned to good account in this article the essential information which the world is so anxious at the present time to secure concerning navigation of the air. The article is not simply descriptive, as Mr. Guy draws upon his knowledge of the subject in interpolating a good deal of philosophy as to the possibilities of the future development of the science of aerial navigation.

OBITUARY NOTE.

MR. ALBERT P. SEYMOUR, for many years active in the firm of Pass & Seymour, Incorporated, manufacturers of electrical specialties at Solvay, N. Y., died last week at his residence in Monrovia, Cal. He retired from the business in 1906 on account of failing health, disposing largely of his interests, and had since resided in Monrovia. A year ago he went to Syracuse, N. Y., on a visit, and on October 5 was taken ill at the residence of J. Brewster Gere, where he was confined to his bed until about July 1 of this year. He then returned to California. Mr. Seymour was actively engaged in business in Syracuse for many years. He was connected for some time with the Electric Light and Power Company, now the Syracuse Lighting Company. Later he became a member of the firm of Pass & Seymour, which became Pass & Seymour, Incorporated. He is survived by Mrs. Emily Seymour, his widow; Albert P. Seymour, of Monrovia, his son; and Mrs. T. S. Johnson, his sister, and his sister-in-law, Mrs. A. H. Seymour, both of Syracuse.

TELEPHONE AND TELEGRAPH.

QUINCY, ILL.—Articles of incorporation have been filed for the Fall Creek and Payson Telephone Company, with headquarters at Fall Creek.

SANDY CREEK, N. Y.—H. C. White, who owns the Pillar Point telephone line, is arranging to give Dexter, Brownville and Watertown complete local lines with Watertown connections.

EMAUS, PA.—The town council has given permission to the Pennsylvania Telephone Company to build its line through the borough. The company is arranging for the extension of a line to Carbondale, the town council having granted the necessary franchise.

WILKES-BARRE, PA.—The Pennsylvania Telephone Company has awarded contracts for the necessary construction material in connection with the placing under ground of its wires in certain sections of the city, in accordance with an ordinance recently passed.

TREMONT, ILL.—The village board of Tremont has granted to the Farmers' Mutual Telephone Company a franchise to run its line though the village. The franchise runs for twenty years. The company is pushing the work of construction on the new line, which is being built south from Tremont.

DUBUQUE, IOWA—At the annual meetings of both the directors and the stockholders of the Interstate Telephone Company all the officers and directors were re-elected with the exception of Director J. J. Kahn, of Elkader, who was succeeded by George Kreibs, of Elkport. The officers and directors are as follows: President, J. M. Dunn, Earlville, Iowa; vice-president, R. W. Gadsen, Dyersville, Iowa; treasurer, C. M. Laxson, Earlville, Iowa; secretary, J. H. Denkhoff, Dyersville, Iowa. Directors: George Kreibs, Elkport; V. H. Stevens, Dubuque, and J. L. Paine, Fayette, Iowa.

HARTFORD, CT.—With the object of bringing about a general improvement in service conditions, the Southern New England Telephone Company has planned to place in effect, on October 1, in the cities of Bridgeport, Hartford, New Haven and Waterbury, certain adjustments of its residence rates which, it is believed, will lead to a more general adoption of single or individual lines by subscribers and thereby tend to eliminate the existing delays resulting from the large usage of party-line service. In substance, the company's plan contemplates the provision of single-line domestic service in these four cities at the rate of $36 per annum. This rate will be applied to those existing subscribers who are at present paying net charges of $40 per annum in Waterbury and $48 per annum in Bridgeport, Hartford and New Haven for a domestic single-line service and will be offered to new subscribers desiring such service. The two-party line service at present furnished in Bridgeport, Hartford and New Haven at the rate of $36 per annum will be discontinued, and the existing subscribers to domestic service at that rate will be provided with single lines at the same rate.

ELECTRIC LIGHTING.

DUNKIRK, N. Y.—The water board has awarded to the Westinghouse Company the contract for a twenty-five arc-lamp equipment.

ELLWOOD CITY, PA.—The Pennsylvania Power Company is to rebuild its plant which was destroyed by fire several months ago.

ROGERS, ARK.—W. R. Felker has sold his electric light and water plant at Rogers to W. S. Merkle, of St. Louis, who has taken charge of the plant and is now operating it.

BEAVER, PA.—The citizens of College Hill Borough have voted in favor of a $15,000 bond issue, the proceeds to be used to improve the town electric light plant.

FORT GIBSON, OKLA.—The Fort Gibson ice and electric light plant has been destroyed by fire. The origin of the fire is unknown. The loss will not exceed $20,000.

CARTHAGE, N. Y.—The village board of trustees of Carthage has signed a five-year contract with the Carthage Electric Light and Power Company to light the streets at $60 a light.

HAMILTON, OHIO—Lindenwald and East Hamilton, suburbs of Hamilton, are to be lighted electrically by the municipal lighting plant. The work of extension will cost about $20,000.

FLORESVILLE, TEX.—At a meeting of the city council F. Largen asked for a thirty-year franchise in consideration for which he proposed to construct an electric light plant in Floresville.

FAIRMONT, W. VA.—A new electric light company has been formed to be known as the Independent Power and Light Company. The officers are: L. C. Wyer, president; A. H. Donnelly, secretary.

BRISTOL, VA.—The Bristol Gas and Electric Company has closed a contract for new generators, turbine engines and other machinery aggregating $50,000 in cost, to be installed in its Bristol plant.

PARIS, ILL.—At a meeting of the city council an application for a thirty-year franchise was made by a company of local business and professional men, who wish to establish a plant for gas and electric lighting and hot-water heating.

LIMA, OHIO—Judge Mathers has made permanent the temporary injunction granted preventing members of the city council from reconsidering their action in passing the ordinance providing for an $80,000 municipal electric light plant.

SCRANTON, PA.—By a deal consummated recently, the Scranton Electric Company secures control of the Standard Electric Light, Heat and Power Company, of Avoca. The Scranton company now has a chain of light companies from Pittstown to Priceburg.

VIROQUA, WIS.—Having arranged with the city for an extension of its franchise, the Viroqua Electric Lighting Company will rebuild its plant and put in an entirely new service. The plant will be enlarged so as to meet the demands of the city for years to come.

KAUKAUNA, WIS.—The Kaukauna Gas, Electric Light and Power Company, which is composed of Milwaukee capitalists, has leased the new electric power plant just completed by the Green Bay & Mississippi Canal Company, with a capacity of 2,500 horse-power.

SALTILLO, MEX.—Important changes to the street lighting system of Saltillo are being made. The entire system has been rewired and larger and improved arc lights are being installed. The large, modern electric light plant has been completed and is ready for operation.

MONTGOMERY, ALA.—The Montgomery Light and Water Power Company announces that it intends to run an entirely new transmission line from Tallassee, Ala., thirty miles from this city, to Montgomery. The expenditures which the company has planned will amount to $100,000.

BUFFALO, N. Y.—The Cataract Power and Conduit Company has made application to the Public Service Commission at Albany for permission to issue $120,000 in gold bonds. The issue is desired to cover the purchase of additional lands and the extension and improvement of the power plant.

SALT LAKE CITY, UTAH—George H. Brumhall, representing a mining company in Utah County, has filed application for rights to the waters of Santaquin creek. It is proposed to withdraw twelve second feet of water from the creek to generate 1,200 horse-power for mining machinery and lighting purposes.

TURNERS FALLS, MASS.—At a meeting of the Turners Falls fire district it was voted to accept the report of the committee on street lights and the prudential committee was instructed to draw up a five-year contract with the Franklin Electric Light Company for seventy-six incandescent lights of sixty candle-power and sixteen arc lamps.

ONTARIO, ORE.—The Interstate Light and Water Company is running a line from its power plant at Horseshoe Bend on the Payette River to Weiser and from there it will be extended to the city. Aluminum wires are used in the construction of this line, which will later be connected with the Ox Bow Tunnel plant and the line extended to Boise. Six thousand volts will be transmitted.

NORWICH, CT.—In its annual report the gas and electric commissioners show that the department has made a profit of $26,986.15 during the year ended July 31. There was an income showing an excess over cost of production of $41,286.53. From this there had to be deducted five per cent for depreciation, leaving the net earnings as given above. This is an increase of $4,300 over last year and $7,000 over that of 1906.

BIRMINGHAM, ALA.—At a meeting of the directors of the Coosa River Electric Company it was decided to amend the charter of the company so as to enlarge the scope of the corporation. The company will begin to build a dam across the river in a short time and also to construct locks at the most suitable places along the river. The aim now is to supply electric power to all parts of the state in as short a time as possible.

WAPAKONETA, OHIO—The contract for the new municipal electric light plant at New Bremen, Ohio, was divided among three of the bidders. The Western Electric Company, of Columbus, was awarded the contract for furnishing the generator at its bid of $5,500; the St. Mary's Machine Company will furnish the gas engine, and the Westinghouse Electric and Manufacturing Company will supply the switchboard and connections.

NEW ORLEANS, LA.—Announcement is made of the awarding of contracts here and in Milwaukee, Wis., for the establishment of a complete electric lighting plant for Lucedale, Miss. Gregory M. Luce is to install the plant, which will furnish lights for his large mill interests there, as well as public-service lighting. It was stated that the contracts awarded reach fully $20,000. The Hollifield Electric Company, of Mobile, was awarded the contract for wires, insulation, poles, etc.

JERSEY CITY, N. J.—The board of aldermen, sitting as a committee of the whole, received a proposed ordinance that is intended to grant a twenty-year franchise to the Mutual Benefit Electric Light and Power Company to open the streets of this city and lay conduits therein for the supplying of electricity. The ordinance was drafted to meet the objections which prompted Mayor Wittpenn last June to veto an aldermanic grant to the company, of which James M. Seymour, Jr., of Newark, is president.

GADSDEN, ALA.—At a meeting of the city council the franchise asked for by the Etowah Light and Power Company, to allow it to enter this city with its wires for the sale and distribution of light and power, was granted, with some slight modifications. The company agrees to be ready to give service within eighteen months and puts up a forfeit of $2,000 in case of failure. No provision was made in the franchise for a lower rate of charges than now obtains. The present rate is sixteen cents per kilowatt-hour.

COAL CITY, IND.—Capitalists have closed a deal for the Steiner land, at Cataract, Owen County, on which the cataract falls of Eel River are located. The tract of land embraces both the upper and lower falls, for which the company paid $150,000. It also purchased 303 acres of land from Lowery Brown and Warren Meek, for which it paid $19,000, making the total purchase price $169,000. This gives the company possession of all the land between the two falls. A dam fifty feet high and estimated to cost $150,000 will be built just above the lower falls, which will create a reservoir between the two falls covering 600 acres. Power-houses will be erected at the lower falls and one of the greatest electric light plants in the state established. A traction line from Indianapolis will pass through Cloverdale and across the top of the dam and on to Brazil. It is said the proposed plant will be able to generate electricity enough to light every town in this part of the state.

BIDDEFORD, ME.—Active work has been begun by the Limerick Water and Electric Company, a subsidiary company of the Limerick mills, in the development of its water power at The Ledges, about three miles from Limerick village, and by January 1 it is hoped to have a power plant in operation there which will develop 600 horse-power, which will be sufficient to operate the mills of the company, and also furnish power for electric lights in Limerick village, and to operate an electric railway between Limerick and East Waterboro, the nearest railroad point.

YPSILANTI, MICH.—The city council has granted a thirty-year franchise to the Washtenaw Light and Power Company. General Manager Hemphill says that $60,000 will be expended in the construction of a plant and in the improvement of the Huron River. The ordinance provides that the needs of Ypsilanti shall be supplied with electricity developed within a radius of five miles of the city before power or light is supplied to outside cities. The rates are not to be above those in other cities of similar size. Construction will be begun this fall or early in the spring.

SALT LAKE CITY, UTAH—As a result of the purchase of its bonds by a syndicate of British capitalists, the Salt Lake Public Service Company has resumed work on the construction of its power plant in Cottonwood canyon after a shutdown of many months. J. J. Chambers, manager of the company, has severed his connection and all construction work will be under the direction of J. C. Hornung, resident engineer for the Schott Company of Chicago. It is expected application will be made to the council by the company for a renewal of the franchises to supply Salt Lake City with heat and lighting facilities. Most of the original franchises have expired since taken out.

SAN BERNARDINO, CAL.—The troubles involving the Metone Power Company, the Mountain Power Company and the Pacific Light and Power Company, which have occupied the attention of the local courts for the past four years, have been settled out of court, and notices of dismissal of action filed in the several cases. These suits were brought to settle the water rights of the various power companies in the canyon of the Santa Ana River east of this city and north of Redlands, and it is understood that a settlement was effected by reason of the sale of the property of the Mountain Power Company to the Edison Electric Company, which at the same time came to an agreement with the other companies involved. It is now announced that a large power plant will be installed as quickly as possible.

ASHEVILLE, N. C.—In the Federal Court Judge Pritchard appointed P. A. Wilcox as receiver of the Carolina Water, Light and Power Company, which has plants at Darlington and Marion, and of the Florence Light and Power Company, of Florence, all in South Carolina. Mr. Wilcox has also been named as receiver of the Rock Hill Water, Light and Power Company. Mr. Wilcox was appointed receiver of the Darlington, Marion and Florence plants on the bill in equity filed by the Real Estate Trust Company, of Philadelphia. In the case of the Carolina Water, Light and Power Company, the receiver was authorized to issue $30,000 in receiver's certificates to meet maturing obligations, and $20,000 of such certificates on account of the Florence Company. Mismanagement and financial inability to meet bond obligations are charged in each bill.

ELECTRICAL SECURITIES.

Since the bull movement was inaugurated last June there have been a good many prophesies as to its termination, and wonderment as to the real reasons underlying such a considerable improvement in prices. In many quarters it was held that the improvement was not justified by any inherent increase in values, but that it was stimulated for certain reasons by strong interests which had the market pretty well under control. Last week the reverse happened, and the sharpest break since the bull movement was inaugurated occurred, leading issues making losses extending from about four to ten points. While the break in this instance is held to be more or less due to an election scare, it is just as difficult to find any real reason for the demoralization as it was to estimate the reasons for the previous improvement. That the political situation is important no one will deny, but that it has changed materially in the last two months is difficult to prove. Trade conditions are making a slow and irregular improvement, but there is a better evidence of improvement now than there was two months ago. Money, it is true, is firm, but there appears to be an abundance of it ready for safe and sane investment. The crop outlook is certainly no worse than it has been, and it is to be expected that the decline of last week is merely a spasm, and will be checked very shortly, and things move again in a more satisfactory way.

Dividends have been declared upon the following electrical securities: Washington Water Power Company, of Spokane, Wash.; regular quarterly dividend of 1¾ per cent, payable October 1 to stock of record September 21. American Cities Railway and Light Company; regular quarterly dividend of 1½ per cent on the preferred stock, payable October 1 to stock of record September 21. Bangor (Pa.) Railway Electric Company; regular quarterly dividend of 1¼ per cent, payable October 1 to stock of record September 20. St. Joseph (Mo.) Railway, Light, Heat and Power Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable October 1 to stock of record September 15. Tri City Railway and Light Company; regular quarterly dividend of 1½ per cent, payable October 1 to stockholders of record September 23. Duluth Edison Electric Company; regular quarterly dividend of 1½ per cent on the preferred stock, payable October 1 to stock of record September 26. Providence Telephone Company; regular quarterly dividend of 2 per cent, payable October 1. American Telephone and Telegraph Company; regular quarterly dividend of 2 per cent, payable October 15 to stock of record September 30. Colorado Telephone Company; regular quarterly dividend of 1¾ per cent, payable October 15 to stock of record September 30. Bell Telephone Company of Canada; regular quarterly dividend of 2 per cent, payable October 15 to stock of record September 25. Canadian Westinghouse Company, Limited; quarterly dividend of 1½ per cent, payable October 1. General Electric Company; quarterly dividend of $2 per share, payable October 15. Butte Electric and Power Company; quarterly dividend of 1½ per cent, payable October 1. Massachusetts Lighting Companies; regular quarterly dividend of 1½ per cent, payable October 15. St. Joseph Railway, Heat, Light and Power Company; quarterly dividend of 1¼ per cent, payable October 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED SEPTEMBER 19.

New York:	*Closing.*
Allis-Chalmers common	10¼
Allis-Chalmers preferred	30½
Brooklyn Rapid Transit	49½
Consolidated Gas	143½
General Electric	139
Interborough-Metropolitan common	11
Interborough-Metropolitan preferred	31
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	67
Mackay Companies (Postal Telegraph and Cables) preferred	67½
Manhattan Elevated	133
Metropolitan Street Railway	28
New York & New Jersey Telephone	115½
Western Union	59½
Westinghouse Manufacturing Company	71¼

Boston:	*Closing.*
American Telephone and Telegraph	127¼
Edison Electric Illuminating	230
Massachusetts Electric	48
New England Telephone	117½
Western Telephone and Telegraph preferred	75

Philadelphia:	*Closing.*
Electric Company of America	10
Electric Storage Battery common	35
Electric Storage Battery preferred	35
Philadelphia Electric	9¾
Philadelphia Rapid Transit	18¾
United Gas Improvement	85½

Chicago:	*Closing.*
Chicago Telephone	146
Commonwealth Edison	107
Metropolitan Elevated preferred	42
National Carbon common	67
National Carbon preferred	109

ELECTRIC RAILWAYS.

BURLINGAME, CAL.—H. W. Hagen, of San Mateo, has applied to the city council of this place for an electric railroad franchise to San Mateo beach.

ROCHESTER, N. Y.—The Rochester Railway and Light Company will reconstruct its storage battery plant at the station at the foot of Factory street at a cost of about $10,000.

MINEOLA, N. Y.—The board of supervisors has granted the New York & North Shore Traction Company the right to extend its trolley line from Mineola to Hicksville by way of Westbury.

SHEBOYGAN, WIS.—From the present progress of work on the Milwaukee and Fox River Valley Railroad it is expected that the line will be completed next spring. Grading operations will begin in a short time.

NEW YORK, N. Y.—The railway service of the Brooklyn Rapid Transit over the Williamsburg Bridge was opened on September 16 when Mayor McClellan drove a six-car "L" train from the Manhattan side to Brooklyn.

MERCERSBURG, PA.—It is stated that the Byrons, proprietors of the steam tanneries in Mercersburg and Williamsport, Md., are at the head of a company being formed to finance and build a trolley line connecting the two towns.

WEATHERFORD, TEX.—The survey for the Fort Worth, Weatherford & Mineral Wells interurban is completed to Millsap, eight miles from Mineral Wells, and the work of raising $250,000 subscription in the three cities has been begun.

DUBUQUE, IOWA—A gang of surveyors in the employ of the Clinton, Maquoketa and Dubuque Interurban Railroad Company is making surveys of the country between Dubuque and Maquoketa for the purpose of locating a route for proposed line.

DOYLESTOWN, PA.—Charles L. Baum and Samuel Crothers, Jr., have been appointed receivers for the Philadelphia, Bristol and Trenton Street Railway Company, which has defaulted in the payment of six months' interest on its $165,000 mortgage.

CHICAGO, ILL.—The Aurora, Elgin and Chicago Electric Railway will extend its line from Wheaton to Maple Park, Ill., where it will connect with its Clinton (Iowa) division, giving the railway company a direct line from Clinton, Iowa, to Chicago.

ROANOKE, VA.—J. W. Hancock, manager of the Roanoke Railway and Electric Company, announces that the contract for the company's new office building has been awarded to C. W. Hancock & Son, of Lynchburg. Work will be commenced immediately.

NEWARK, N. Y.—The village board has extended the franchise of the proposed Geneva, Phelps & Newark trolley line another year. On account of the recent business depression there was more delay than was expected in financing the road. It is stated that work will begin in the spring.

WALLA WALLA, WASH.—A franchise has been granted the Washington & Oregon Traction Company giving it the right to operate electric cars over the principal streets of the city for a period of twenty-five years. In consideration of this franchise the company agrees to pay the city $8,000.

CHEYENNE, WYO.—Work on the extension of the Cheyenne street railway system to Fort Russell, a distance of three miles, is to be begun at once, the War Department having authorized the railway company to use a right of way north of the main driveway connecting the city with the post.

ST. LOUIS, MO.—The Missouri Electric Railroad Company, a subsidiary of the United Railways Company, which recently took over the St. Charles & Western line, has filed its $1,000,000 bond mortgage to the Mercantile Trust Company as trustee in St. Louis. The bonds run for ten years at five per cent.

DES MOINES, IOWA—Articles of incorporation have been filed for the company proposing to build a railroad between Des Moines and Council Bluffs. It is capitalized at $30,000. The present officers are as follows: J. W. Russell, president; Frank M. Tompkins, vice-president; M. H. Miller, secretary; E. Lockwood, treasurer.

CONNELLSVILLE, PA.—The Manor Valley Street Railway Company has let the contract for the construction of a line from Irwin to Herminie to Ryan & Campbell, of Latrobe. Work will begin at once. The construction of the road alone will cost about $50,000. The Manor Valley Company is composed of Irwin and Manor capitalists.

IOWA CITY, IOWA—The city council has granted a franchise to Henry Negus, of this city, and I. J. Hamiel, of Tipton, for the construction of a street railway in Iowa City. Local capital is largely interested, and it is believed that the line will be constructed within two years. It is designed principally to serve the residents of the east and southeast portions of Iowa City.

COLUMBUS, OHIO—Stockholders of the Columbus Railway and Light Company at a meeting unanimously voted to ratify the lease of the properties of the Columbus Public Service Company, from the Columbus Light, Heat and Power Company, which was formed to take over the Public Service properties. The lease runs fifty years and includes all the franchises of the Public Service Company.

ST. LOUIS, MO.—Within two months surveys will be under way for the proposed electric railway to connect Mobile with Citronelle, Ala., thirty miles. Right of way has been secured. Over $500,000 will be spent. C. A. Elkins, of Louisville, Ky., and George S. Bressler, of Gulf Crest, Ala., are promoters of the project. The name of the line will be the Mobile & Gulf Interurban Electric.

LANSDOWNE, PA.—It is stated that the Philadelphia & West Chester Street Railway Company is negotiating for the purchase of the Chester & Darby division, and the Chester & Wilmington division of the Chester Traction Company, which belong to the Interstate Railways Company. It is said that the Philadelphia & West Chester Traction Company desires to extend its line to Wilmington.

ALBANY, N. Y.—Articles of incorporation have been filed in Albany by the promoters of the Greater New York Traction Company. The application for a charter sets forth that the company wants to build and operate an electric street railway in Fulton, Cortlandt and William streets and Maiden Lane, Manhattan Borough, connecting with the Brooklyn Bridge and ferries. The proposed rate of fare is three cents. The capital is $15,000, and the incorporators: C. F. Thum, Arthur G. Still, Joseph W. Spencer, Frank S. Burns, Charles M. Koop and others, of New York city.

YORK, PA.—It is stated that a new trolley line from York to Baltimore is to be built by York, Philadelphia and Maryland capitalists. The line has already been built from York to Hanover, and a survey will be made from that point. It is proposed that the cars connect with the Emory Grove line, which comes to this city, giving the people of York a route to Baltimore by trolley. It is said that a Philadelphia banking house will finance the scheme. Those interested are Captain W. H. Lanius and ex-Judge W. F. Bay Stewart, of York; H. W. Gitt and George Gitt, of Hanover; Dr. James H. Sherman, J. E. Mosenheimer, Jacob A. G. Frederick and Jacob N. Dehoff, of Carroll County.

DATES AHEAD.

American Institute of Mining Engineers. Annual meeting, Chattanooga, Tenn., October 1-3.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 5-6.

Empire State Gas and Electric Association. Annual meeting, New York city, October 7.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Pittsburg, Kan., October 8-9.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

Railway Signal Association. Annual meeting, Washington, D. C., October 13-15.

Order of the Rejuvenated Sons of Jove. Annual meeting, Buffalo, N. Y., October 15-16.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Association of Car-Lighting Engineers. First annual meeting, Chicago, Ill., November 18.

INDUSTRIAL ITEMS.

THE TUNGSTOLIER COMPANY, 520 Citizens' Building, Cleveland, Ohio, is distributing a leaflet containing several testimonials from satisfied users of the Tungstolier system of lighting, bearing particularly upon the saving, the illumination, and the life secured with this system.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, Chicago, Ill., is introducing a new insulating paint made by Frank S. DeRonde Company, of New York city. Mr. DeRonde was long connected with the Standard Paint Company. The company is also sending out a metal polish, made by the same company. It is claimed that the two articles have superior merit.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has ready for distribution a new bargain list of motors. These motors are in packed St. Louis stock. They are second-hand motors only inasmuch as they have been in service. They have been cleaned up, refinished, repaired where necessary, and are sold at low prices with the same guarantee as is given on new machines.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has secured an order from the Kobe Electric Railway Company, of Kobe, Japan, for two 500-kilowatt, twenty-five-cycle, engine-type, three-phase alternators; two twenty-kilowatt, 125-volt marine-type exciters; one forty-kilowatt motor-generator set; four forty-kilowatt transformers; 100 GE-78 railway motors complete, and a complete switchboard equipment for the power-house.

THE NEW YORK INSULATED WIRE COMPANY, 114-118 Liberty street, New York city, has published price list No. 22, entitled "Rubber-Covered Wires of Quality." This list gives prices on rubber-covered wires on the various copper bases, from eleven cents to twenty-one cents, besides containing various tables which will be found of considerable service. The booklet will be sent upon request to any one who uses or deals in rubber-covered wires.

THE BLAKE SIGNAL AND MANUFACTURING COMPANY, 246 Summer street, Boston, Mass., is constantly in receipt of testimonials to the excellence of its soldering flux. The following is a sample testimonial which has recently been received: "Enclosed please find twenty-five cents in stamps, for which please mail me as much Blake tube flux as this amount will pay for. I have used the sample tube you mailed me and it certainly is all that is claimed for it, and then some."

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has closed a contract with the Chicago City Railway Company to furnish and install in the Plymouth Court substation a storage battery complete with booster, switchboard and wiring, rated at 4,800 amperes for one hour, it being permissible to discharge the battery at rates up to 9,600 amperes in emergency service. The battery is to be operated on a 550-volt bus. It will be charged at times of light load and discharged, as occasion may require, on the peak loads.

THE NATIONAL BATTERY COMPANY, Buffalo, N. Y., announces that the receivership under which the company has been operating since last February was terminated on August 19. The claims against the National Battery Company have been settled, and the entire property has been restored to the stockholders. It is also stated that the full control of the reorganized company has been secured by the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., well known as the maker of battery-charging rheostats and other electrical controlling devices. The plant of the National Battery Company will remain at Buffalo, but the business will be conducted under new management and with ample capital.

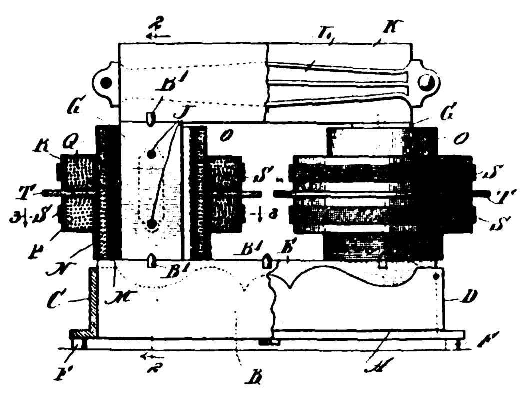
Record of Electrical Patents.

Week of September 15.

898,430. ELECTRICALLY CONDUCTIVE RAILWAY-RAIL JOINT OR CONNECTION. Bancroft G. Braine, New York, N. Y., assignor to the Rail Joint Company, New York, N. Y. Filed October 25, 1907. The railway is equipped with connecting plates contacting with the heads and base flanges.

898,473. RAILWAY SIGNAL. John Hoffer, Louisville, Ky. Filed January 14, 1908. Connections leading from the main switch to the signal operate an electric bell.

898,485. DEVICE TO PREVENT TROLLEY WHEELS FROM JUMPING. William O. Lane, Cleveland, Ohio. Filed December 20, 1907. The trolley pole is equipped with a forked bracket provided with a clamping plate.



898,529.—Electrical Laboratory Apparatus.

898,506. APPARATUS FOR THE PRODUCTION OF OZONE. John R. Quain, London, England, assignor of one-half to Edward Applegarth, London, England. Filed February 12, 1907. Means are provided for passing air through relatively narrow passages, the electrodes operating in vacuo.

898,509. ELECTRICAL-CIRCUIT PROTECTOR. Charles A. Rolfe, Adrian, Mich., assignor, by mesne assignments, to Rolfe Electric Company, Rochester, N. Y. Filed December 29, 1903. The contacts are normally under tension, and are held apart by a heat-concentrating device adapted to soften or melt the holding material.

898,529. ELECTRICAL LABORATORY APPARATUS. Chester H. Thordarson, Chicago, Ill. Filed April 17, 1905. A magnet-wound transformer for extremely high potentials.

898,540. ELECTRICAL FITTING. Edson B. Wilcox, Meriden, Ct. Filed May 29, 1908. An insulated electrical fitting.

898,544. TELEPHONE TRANSMITTER. Henry F. Albright, Elizabeth, N. J., assignor to Western Electric Company, Chicago, Ill. Filed October 28, 1907. The movable button is held in a bushing mounted in the diaphragm.

898,576. TELEPHONE SWITCH. Verne E. Green, Galva, Ill. Filed August 6, 1907. A common bus alternately connects a series of extension circuits.

898,578. ELECTRIC HEATER. Andrew J. Holmes, Tacoma, Wash. Filed May 10, 1906. An alternating-current coil heater.

898,607. ILLUMINATING APPARATUS. Jean Schmidt, Frankfort-on-the-Main, Germany. Filed May 8, 1907. A plurality of arcs is supported on translating members which have a common reciprocal movement.

898,619. TELEPHONE APPARATUS. Frank W. Wood, Newport News, Va., assignor to Charles Cory and John M. Cory, New York, N. Y. Filed April 17, 1907. A combination concentrically arranged mouthpiece and trumpet.

898,620. TELEPHONIC APPARATUS. Frank W. Wood, Newport News, Va., assignor to Charles Cory and John M. Cory, New York, N. Y. Filed April 5, 1907. A combination transmitter and receiver.

898,648. ELECTRIC CLOCK. Monnosuke Higuchi, New York, N. Y. Application filed November 3, 1903. Means are provided for rendering the alarm circuit inoperative.

898,649. ELECTRIC CLOCK. Monnosuke Higuchi, New York, N. Y. Filed November 3, 1903. Means are provided for selective ringing of the alarm.

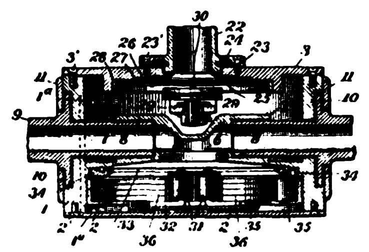
898,675. PASSENGER-RECORDING SYSTEM FOR TRAINS. Walter E. Parr, Sparta, Mo. Filed December 6, 1906. The system is designed to check the whole and half-fare passengers boarding the car.

898,686. ELECTRIC BELL. Tito Rosati, Florence, Italy, assignor of one-fourth to Ferdinand R. Sari and Bartolomeo G. Giuliana, Washington, D. C. Filed August 7, 1907. The bell is actuated by a high-potential circuit, and is put in operative condition by a low-potential circuit.

898,691. ELECTRIC-FURNACE PROCESS. George O. Seward and Franz von Kügelgen, Holcombs Rock, Va., assignors, by mesne assignments, to Electro Metallurgical Company, West Virginia. Filed February 21, 1906. New lengths of the electrode are successively fed to the charge without withdrawal of the electrode from the charge.

898,696. ELECTRIC LIGHT BULB CHANGER. Charles F. Southworth, Cambridge, Mass. Filed February 13, 1908. A combination of a rod and a cup having a continuous, elastic, annular rim.

898,698. FUSE BOX. John O. Stiners, Denver, Col. Filed October 26, 1906. A movable fuse carrier provided with pairs of contacts is mounted upon a contact plate.



898,620.—Telephonic Apparatus.

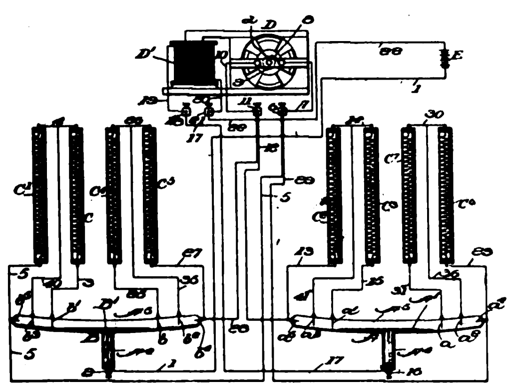
898,699. PORTABLE TELEPHONE APPARATUS. Frederick F. Strong, Boston, Mass. Filed April 3, 1905. A microphone arrangement with a flexible ear-piece.

898,715. INCANDESCENT LAMP. Frederick M. Bennett, New York, N. Y. Filed March 6, 1908. The filament is arranged to distribute the illumination in useful directions.

898,752. METAL FILAMENT FOR ELECTRIC INCANDESCENT LAMPS. Hans Kuzel, Baden, near Vienna, Austria-Hungary. Filed July 16, 1907. The stem is equipped with guide wires both at the end and at its middle position.

898,756. OUTLET BOX. George A. Lutz, New York, N. Y., assignor to American Circular Loom Company, Portland, Me. Filed January 5, 1907. The junction piece is provided with openings providing ringlike parts.

898,766. ELECTRIC SWITCH AND SYSTEM OF CONTROL. Joseph V. Mott, New York, N. Y. Filed February 2, 1907. A variable fluid resistance rheostat.



898,766.—Electric Switch and System of Control.

898,771. COMBINATION ELECTRIC-SERVICE CUTOUT AND METER PANEL. Henry E. McGowan and Edwin R. Ellsworth, New York, N. Y. Filed March 9, 1907. The measuring instrument and the cutout box are mounted on a single panel.

898,785. ELECTROLYTIC APPARATUS. Marcus Ruthenburg, Lockport, N. Y. Filed January 18, 1907. The outer tanks are sealed against the atmosphere and contain inner porous cups.

898,796. TELEPHONE SET. Sol S. Sonneborn, New York, N. Y. Filed October 1, 1907. The magnet receiver is mounted in the hollow stem of the desk set.

898,822. PLURAL LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed February 23, 1907. A multiple socket equipped with a screw base.

898,823. PLURAL LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed Feb. 27, 1907. The plug cluster has a central and an outer contact member.

898,824. PLURAL LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed February 28, 1907. The plug is adapted to co-operate with a suitable socket, and carries a plurality of lamp-holding devices.

898,825. PLURAL LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed March 1, 1907. The plural lamp socket is provided with a central contact and an outer contact adapted to co-operate with socket contacts.

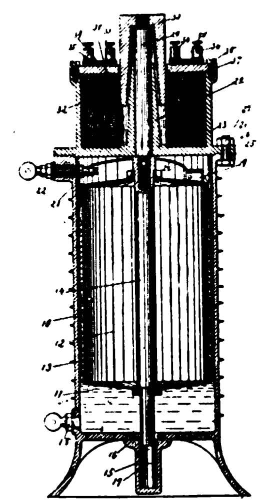
898,826. PLURAL LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed March 1, 1907. A canopy cluster with a central contact and a side contact adapted to co-operate with a suitable socket.

898,847. APPARATUS FOR EXPLODING MINE CHARGES. Charles I. Dodson, Pittsburg, Kan. Filed April 6, 1907. The clock is provided with means for automatically operating a switch.

898,848. MEANS FOR EXPLODING BLAST CHARGES. Charles I. Dodson, Pittsburg, Kan. Filed February 14, 1908. A latch is provided for holding the actuating means in inactive position.

898,862. ELECTRIC RAILROAD SIGNAL. Timothy C. Fogarty, Frank W. Brock and Frank A. Bowdle, Chatham, Ill. Filed January 13, 1908. A rigid device is operated by the movement of the car, the movement of the semaphore closing a magnetic circuit.

898,888. SPARK-GAP. Isaac S. Hirsch, New York, N. Y., assignor to E. B. Meyrowitz, New York, N. Y. Filed July 18, 1907. Means are provided for varying the spark-gap.



898,987.—Rheostat.

898,915. ELECTRIC SIGNALING OR TELEGRAPH APPARATUS FOR USE ON VEHICLES. Robert B. North, Soho, England. Filed June 4, 1907. A plurality of plates is provided, each contact plate having a separate designation or order.

898,921. INSULATOR. Thomas F. Purves, Wandsworth, London, and John Sinnott, East Finchley, London, England. Filed February 3, 1908. The insulator is provided with a leading-in cavity, and the chamber may be sealed with insulating material.

898,949. ADVERTISING DEVICE. Charles T. Wilks, Woodlawn, Ala. Filed May 21, 1908. A combination of an electric lamp, a lamp circuit, and a series of rollers.

898,968. SIGNAL. David H. Coker, Piedmont, and Whitfield A. Scarbrough, Choccolocco, Ala. Filed January 23, 1907. The circuit is opened and closed by the operation of the railroad switch.

898,979. PROCESS OF ELECTRICALLY CONNECTING FILAMENTS TO SUPPLY WIRES IN ELECTRIC GLOW LAMPS. Hans Kuzel, Baden, near Vienna, Austria-Hungary. Application filed January 19, 1906. Finely powdered metals are melted to form carbides at high temperatures.

898,987. RHEOSTAT. Heinrich Poth, Brooklyn, N. Y. Filed December 8, 1905. An electromagnet is adapted to vary the active amount of the resistance medium in circuit.

898,992. ALARM. Jay A. Robinson, Denver, Col. Filed October 26, 1907. The receiver hook is held in its lowest position by an electromagnet.

899,012. ELECTRIC CLOCK. Monnosuke Higuchi, New York, N. Y. Application filed November 3, 1903. The hour and minute strikes are actuated by electromagnetic means.

ELECTRICAL REVIEW

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CONTENTS

WHITE LIGHTS FOR SHIPS AND LIGHTHOUSES.

In the current Quarterly of the United States Naval Institute, Dr. John Herbert Claiborne, of New York, announces a very interesting theory concerning a system of lighting ships and lighthouses in substitution for the ones at present in use. Dr. Claiborne is of the opinion that color blindness and partial color blindness are much more prevalent than we imagine, and although the rules for the detection of this optical defect have been brought to a high point of efficiency, still, scientific men are fallible, and so are the rules which they enunciate.

The ordinarily refractive eye perceives objects within a distance of about twenty feet by rays of light which are approximately parallel. When objects nearer than twenty feet are looked at it becomes necessary to add some power to the refractive media, in order to see distinctly, since the rays of light that come to the eye from objects within that distance are divergent. The accommodative muscle of the eye automatically contracts, and the crystalline lens, which is elastic and resilient in its nature, springs forward. In this manner a positive meniscus is added to the eye, its strength varying directly with the nearness of the object looked at.

The rate of vibration of the waves arriving from a distant point has a peculiar effect on this accommodative muscle. The greater the accommodative act, the nearer the object appears. The long waves, such as the red rays, require more effort, and hence red appears nearest, while the blue, which has the shortest wave length, and therefore requires the least accommodative effort, appears farthest away.

Dr. Claiborne suggests that white electric light be utilized for signal lighting of both ships and lighthouses. In order to avoid confusion as to the port and starboard points aboard ship, he would place a series of lights in some geometric formation, such as a parallelogram for the port, and a star for the starboard indications. For the alternate flashing arc for lighthouses, or the alternate-color disc scheme of indication, he would substitute white electric lights arranged in some such geometric formation as would provide through its shape and size definite information concerning its position relative to a danger point.

Dr. Claiborne's suggestions are, of course, interesting, as they indicate a possible direction in which the electric light may find a further field of usefulness. His suggestions concerning color blindness and the difficulty of detecting it are of importance, however, in connection with any system of signaling, at sea or on land, in which luminous color signals are involved.

CENTRAL STATION COMPETITION WITH GAS POWER.

One of the most difficult classes of installation for the central station to displace with electricity is the gas-engine plant operated from city mains at a cost of from eighty cents per thousand cubic feet downward. In some communities the local gas companies have made a strong campaign for isolated-plant installations supplied from their mains, and the well-known efficiency of power production at full load in the modern gas engine is undoubtedly a telling argument with the consumer. With no boiler plant or producers to occupy valuable space, with steam piping and coal handling out of the way, the gas company finds it comparatively easy in many cases to secure the business, and not a few central station solicitors have had to wait sometimes a year or two before the operating results with the gas installation opened the way toward consideration of the substitution of electrical service.

In the isolated gas plant, however, more than the usual skill is demanded from the operating engineers, in comparison with steam-driven installations, to secure anything like permanent economy of power production. The quality of the gas may be kept close to the standard purity and heating value, but the problems of proper ignition, valve setting, cleanliness of moving parts and surfaces inside the engines, lubrication and water cooling are always present. If the isolated-plant owner does not realize the importance of having the best operating skill in his engine room, and at a cost commensurate with the ability of the men needed to keep the equipment in the very best condition, excessive depreciation is sure to set in, with ever-increasing breakdowns. The number of isolated-plant owners who neglect the condition of their plants in this way is very large, and the central station man who can directly or indirectly obtain any idea of the frequency of shutdown in such a plant has a strong basis for action in trying to secure a hearing for electric service.

In a recent case of this kind a factory making printing machinery installed a gas-engine equipment consisting of a forty-horse-power engine supplied with city gas, and another of the same size operated by a producer located on the premises. The cost of the gas ranged from eighty to sixty-five cents per thousand cubic feet, depending upon consumption. Power was transmitted through numerous belts and line shafts to the machines on the different floors, and to run the factory both engines were needed constantly. It was found that the cost of operation was greatly increased above the expected figures by the frequent failure of the engines to supply the necessary capacity continuously, the expense for repairs being considerable, but less important than the time lost by the factory force when no machinery was in operation. The local central station installed a thirty-five-horse-power motor on one floor and a ten-horse-power motor on another in place of the engines, with the result that the total monthly power bill barely exceeded the old labor cost in the power plant plus repairs. The results of tests with the motors showed that the actual working load in the factory under the new conditions is but forty to forty-five horse-power, whereas with the engine installation both machines were hard pressed to meet the ordinary daily demands.

In another instance, where an isolated gas plant of some 600 horse-power was installed with engineering skill at the owner's command, the cost of repairs has been found to be so high that it is only a question of time when central station service will succeed in displacing the present gas installation. In one recent month the cost of repairs to the engines was $1,500, and while the average is somewhat lower than this, the figures are not encouraging from the isolated-plant standpoint. The fact that several engines were installed has made it possible to keep up a reasonably continuous service even in face of the repairs required. The simplicity of electrical supply from the local central station organization, and the resulting freedom from shutdowns and repairs, will doubtless create notable savings in operation when the new equipment can be installed. The experience of most central stations is that unless the small private gas plant is operated with unusual skill, its costs are bound to be high enough in time to justify the substitution of electricity.

THE TELEPHONE IN MOUNTAINEERING.

Announcement of the completion of the Mount Rosa telephone line—the highest circuit in Europe—illustrates a new phase of telephone activity which should ultimately be productive of the most far-reaching good. The growing interest in high-mountain climbing during the past few years calls for the best resources of science and industry for the successful ascents of peaks in the less widely known of the great ranges of the world. The Mount Rosa line will greatly facilitate communication between the Regina Margherita Meteorological Observatory, at an altitude of 14,958 feet, and all the important telephone centres of Europe. The first section, just completed, from the observatory to the Col de Lys (11,962 feet above sea level and some two and one-half miles long) presented exceptional difficulties. Owing to the high winds and severe storms prevailing in these altitudes an overhead line carried on poles was out of the question, and it was thought that an insulated cable laid in the ground would make repairs impossible by gradually sinking into the ice. At the suggestion of Dr. Alessandri, chief of the physical observatories of Mount Rosa, who had been carrying on experiments as to the insulating qualities of dry snow in these regions, it was decided to lay a bare wire across the snow fields and glaciers. The wire has been laid for more than six weeks with no damage reported, and transmission is clear and distinct. From the Col de Lys downward the line will be carried on poles short enough to enable it to touch the ground and avoid oscillations. When completed the line will connect three observatories, and it will greatly improve communication at times when the meteorological conditions are unfavorable for visual signaling. The line will also be useful for sending messages to the valley as to the state of the weather on the mountain, preventing tourists from risking their lives on bad days, and also facilitating assistance from below in case of accident or other difficulties.

THE ACCIDENT ON THE BERLIN ELEVATED RAILROAD.

On September 26 a severe accident occurred on the electric elevated road of Berlin, Germany, in which twenty passengers were killed and as many severely injured, one of the latter, in fact, subsequently dying; and a score receiving lighter injuries.

A train from Möckern Bridge station to Bülow Street station collided at the famous triangle with one coming from Leipsig Place station to Bülow Street station, throwing the first car of the last train completely off the structure, the second being partially held in suspension over the edge.

This triangle has been studied by many of the foremost engineers, and this scheme of operation has been adopted in many electric traction systems; for instance, one will find the same principle in the City Hall loop and above the Ninety-sixth street station of the New York city subway. It consists of a double-tracked triangle in which the trains do not cross each other's tracks. However, when two or more trains running in the same direction try to make a switch simultaneously there is danger of collision, which apparently was the cause of the recent disaster.

The six tracks of this triangle change their elevation in crossing above or beneath the different legs. Inside of the triangle is a car barn and above the latter structure is a signal tower.

This triangle, as well as the whole elevated road, is well equipped with an interlocking signal system. The operator in the tower can not give a signal for a clear track until a train has passed a certain section of the track.

The movements of the trains entering the triangle are controlled by a group of three levers, which is interlocked with the group controlling the outgoing trains, so that when a single train passes the triangle six levers have to be operated. To facilitate operation these levers are operated by alternating-current motors supplied by a motor-generator set fed from the third rail. The trains may be run under a headway of two and one-half minutes.

The trains are made up of three or six cars. Under ordinary conditions three cars are run, consisting of two third-class cars, with a seating capacity of thirty-nine each, and one second-class car, with a seating capacity of forty-four, placed in the middle of the train. The third-class cars only are used as smokers and these are also the motor-cars. It was the first car (third class) containing the motorman and his assistant, which was thrown off the structure, while the middle or second-class car was held partially suspended.

The cars are built after American patterns, the seats running lengthwise. The side doors, however, are not near the end, but some distance away, so that there are seats on both sides of the doors. Under ordinary conditions the end doors are not open for public passage.

The Berlin Elevated Road has been in operation since February 15, 1902, and has had hardly any accidents, particularly on the triangle. Considering the efficacy of the system, it is difficult to explain how such an accident happened. A rigid investigation will probably show the fault, which can not be seen on the surface. Immediately after the accident the Government sealed up the signal system and took charge of the situation.

DEPRECIATION IN MUNICIPAL LIGHTING PLANTS.

Failure to provide proper allowance for depreciation has been the cause of no little embarrassment to municipal electric light plants in this country. One of the latest stations under municipal ownership to illustrate the importance of depreciation is the plant at Wakefield, Mass., which is in need of some $50,000 if it is to be brought up to date as a producing installation. In accordance with the laws of Massachusetts requiring a depreciation allowance of about three per cent to be set aside annually in municipal plants, the Wakefield plant has made such a provision for the last three or four years. Such an allowance, however, has not been adequate to overcome the deterioration of the plant, which has been going on for many years without suitable provision to offset it. At the last town meeting, on September 24, a special committee appointed to investigate the lighting conditions in the town reported against any further municipal operation of the generating station after power can be secured from the Malden Electric Company. It is figured that the cost of central station power to the town will be only three and one-quarter cents per kilowatt-hour, against its own cost last year of 4.6 cents, and only a trifling investment will be necessary on the part of the town.

Until municipal plants learn to provide for something more than mere operating expenses from the earliest days of service, their costs are bound to throw them more and more into the hands of the central stations, who are generally far better equipped to render satisfactory service for the same expenditure. The private company progressively operated has enough business sagacity to foresee the inevitable wear and tear upon the plant, and provides for it by setting aside from each year's income enough money to keep the apparatus up to date. The average city experimenting with municipal ownership is anxious to get all it can out of its plant; the citizens expect lower cost of service than private corporations charge, and the force of public opinion is in the direction of rather free accounting, except in those states where close control by commission is the order of the day. It takes all the plant's income to meet these demands. A common fallacy is to figure that the street lights cost the city nothing under municipal ownership, since the rates for commercial lighting and power are made high enough to bear the burden. It is easy for the municipality to allow the plant to go to pieces when the income is inadequate to permit suitable renewals. The cost of apparatus, also, is as a rule higher in the municipal plant than in the private central station of similar capacity. The Boston *Herald* has said, in commenting upon the Wakefield case: "The characteristic failure to apply to the administration of public enterprises the principles which are essential to private business circumscribes the field of practicable and profitable public ownership and operation in this country."

DETERMINATION OF WIRELESS WAVE FRONTS.

BY GREENLEAF W. PICKARD.

It has been assumed, from theoretical considerations, that wireless communication would be affected by the vicinity of

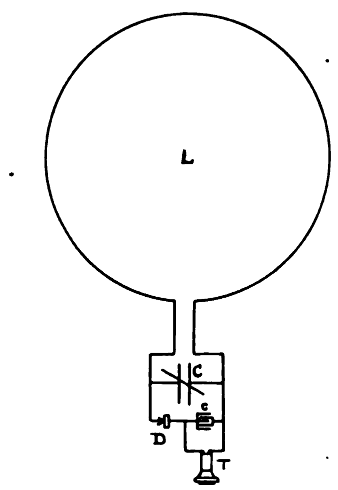


FIG. 1.—DIAGRAM OF CLOSED-CIRCUIT RECEIVING SYSTEM.

conducting structures, such as buildings, trees, etc. And it has been frequently observed in practice that a station in a city is not as effective as one on the seashore, where there are no energy-robbing obstacles in the path of the waves. It does not appear, however, that any one has determined just what the distortion

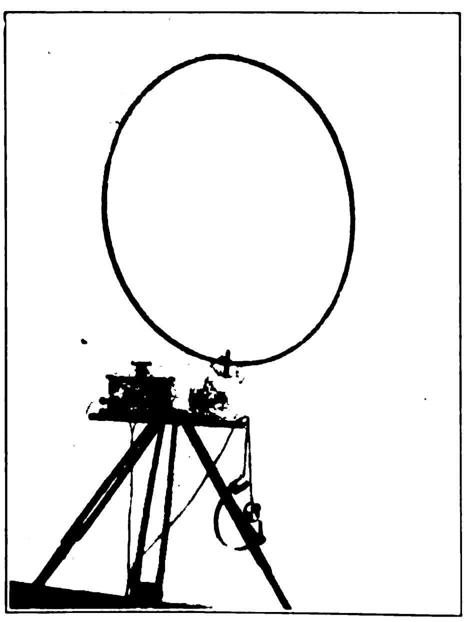


FIG. 2.—VIEW OF RECEIVING APPARATUS.

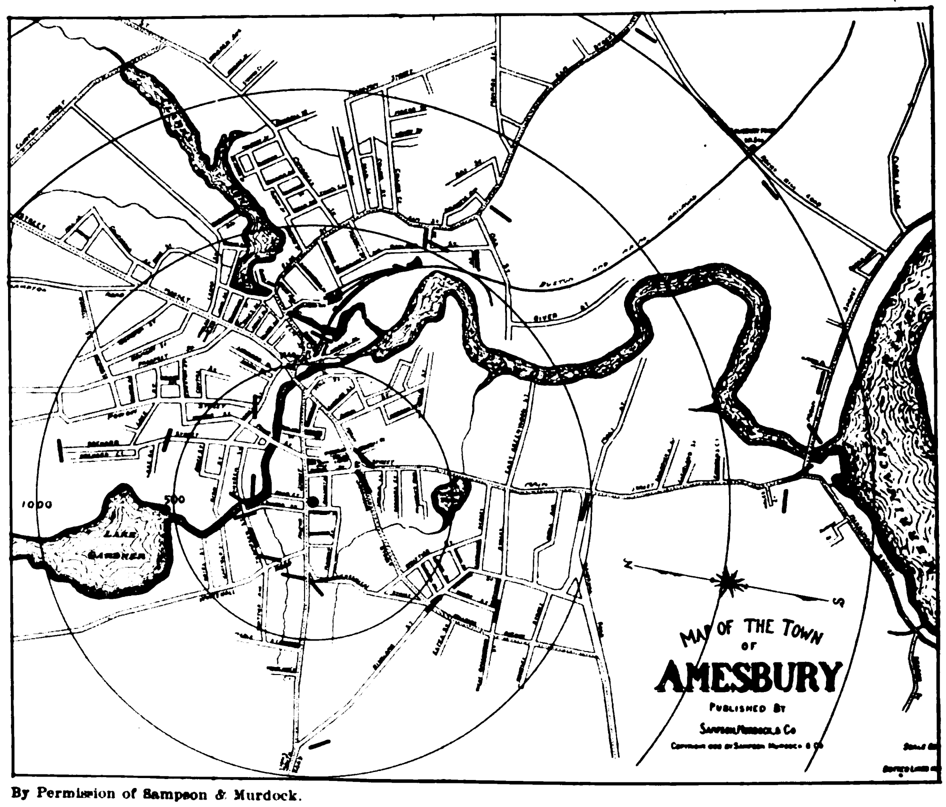
of the wave front really is, when this encounters buildings and other obstructions of a more or less conductive nature.

The writer has an experimental station in Amesbury, Mass., a town of about 10,000 inhabitants. As is usual in small towns, most of the buildings are wood, but there are many brick structures, the customary network of overhead wires, and a large number of shade trees, which might reasonably be expected to distort the waves used in wireless communication. Even a wooden house, transparent as the material may be to electrical waves, is usually lined with a system of well-grounded water and gas pipes, which gives the structure as a whole a conductive character. A series of wave-front determinations, made by means of the writer's underground receiving circuit,[1] showed clearly that such distortion existed and that the wave front in and about Amesbury was a very much warped surface indeed.

As determinations were only required at distances of a few wave lengths from the sending station, a very small closed circuit was employed, this being approximately one metre in diameter. This circuit consisted of three turns of No. 16 stranded copper wire, wound on a wooden hoop, its terminals being connected to a variable air condenser, and to a shunt circuit containing the writer's perikon[2] detector and a pair of high-resistance telephone receivers in multiple with a small fixed-value condenser. The circuit is shown diagrammatically in Fig. 1. It may be remarked that the use of three turns for the receiving circuit, in place of a single turn, is not for the purpose of gathering more energy from the waves, but merely to increase the inductance of the receiving circuit, in order that a conveniently small variable air condenser might be used for tuning.

For convenience in measurement and transportation, the entire apparatus was mounted on a tripod, the hoop being so mounted as to rotate freely on a vertical axis. The entire apparatus is shown in Fig. 2. Notwithstanding the small enclosed area of the circuit, it was found possible to receive intelligible signals at distances of over two miles from the sending station, and even to make determinations of wave-front direction.

The sending station was equipped with a three-wire aerial fan, 102 feet in height, connected by a simple autotransformer coupling with a closed oscillating circuit. In the closed oscillating circuit a glass condenser of 0.014 microfarad was used, charged to a potential of 20,000 volts. In all of the determinations the wave length used was 501 metres, and the power taken was 500 watts.



By Permission of Sampson & Murdock.

FIG. 3.—RESULT OF WIRELESS SURVEY.

The result of the wireless survey of Amesbury is shown in Fig. 3. For convenience in estimating distances, concentric circles have been drawn about the sending station, at intervals of 500 metres, or very closely, one wave length. At each

[1] "An Ungrounded, Closed Circuit for Receiving Wireless Signals," ELECTRICAL REVIEW, June 15, 1907. U. S. Patent No. 876,996.

[2] U. S. Patent No. 886,154.

determination point the apparatus was set up, and the hoop rotated until a null point was found, at which the sound of the sparks at the transmitting station ceased in the receiving telephones. As the closed circuit is actuated by the magnetic lines of force in the electrical wave, this null point is necessarily when the hoop is in the plane of the wave front, in which position it is not threaded by the magnetic lines. It was found easily possible to locate this null point to within a degree of arc. In Fig. 3 each position at which a determination was made is shown by a heavy short line, this line being the projection of the hoop on the map, or in other words a section of the wave front at that point.

Had there been no distortion of the wave front these short lines would in every case have been tangent to a circle

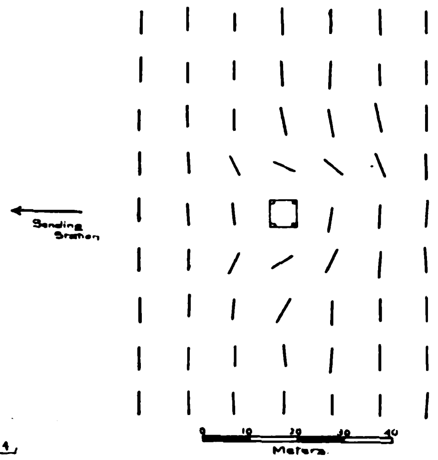


Fig. 4.—Wave-Front Determination, Showing Distortion in Vicinity of Obstructing Windmill Tower.

drawn through the point of observation on the sending station as a centre. While inspection of Fig. 3 will show several lines that are quite approximately so placed, it will at once be seen that the majority are by no means tangent; some, in fact, making angles of nearly ninety degrees with the theoretical undistorted wave front. As each such distorted portion of the wave means an eddy of lines of force around a conducting obstacle, with vertical electrical currents set up therein, it is evident that a considerable loss of energy is going on, to no other purpose than a slight heating of the obstacle.

Even such a high-resistance obstacle as a tree was found to make a perceptible eddy or indentation in the wave front,[1] while with a forty-foot steel windmill tower, distant some 1,500 metres from the sending station, a most marked distortion was found. This latter case was so interesting that the writer made a special study of the wave front in the vicinity of the tower, with the result shown in Fig. 4. It is hardly necessary to point out the resemblance to the well-known diagram of a current-carrying conductor in a magnetic field.

This simple method of mapping out the wave front in the vicinity of a wireless station is not only one of theoretical interest, but may have a practical application in determining, for example, why a station gives weak transmission in a certain direction. By the use of a larger closed circuit the survey could readily be extended to any desired distance from the sending station.

[1] In this connection it is interesting to note U. S. Patent No. 782,181, of G. O. Squier, for the use of trees as receiving antennæ

ILLUMINATING ENGINEERING SOCIETY.

SECOND ANNUAL CONVENTION TO BE HELD AT PHILADELPHIA, PA., OCTOBER 5 AND 6.

The second annual convention of the Illuminating Engineering Society will be held at Philadelphia, Pa., on Monday and Tuesday, October 5 and 6. The convention headquarters will be the Hotel Walton. Sessions will be held in the auditorium on the tenth floor of the hotel. An interesting exhibit of historical and scientific illuminating devices has been arranged adjacent to the convention room. Members will register at the assistant secretary's desk, convention floor, to obtain badges and cards for entertainment.

The following programme has been announced:

Monday, October 5, at 10.30 A. M.—Address of Welcome, Hon. John E. Reyburn, Mayor of Philadelphia. Presidential Address, Dr. Louis Bell—A study of the problem of street lighting in its broader aspects, especially with reference to the choice and placing of lamps in their relation to effective illumination. Report of Committee on Nomenclature and Standards, presented by Dr. A. C. Humphreys, president Stevens Institute.

On Monday, October 5, at 8 P. M., the following papers will be presented:

"Modern Gas Lighting Conveniences," by T. J. Little, Jr.

"Illuminating Value of Petroleum Oils," by Dr. A. H. Elliott.

"Street Lighting Fixtures: Gas and Electric," by H. Thurston Owens.

"Structural Difficulties in Installation Work," by James R. Strong.

"Architecture and Illumination," by Emile G. Perrott.

On Tuesday, October 6, at 9.30 A. M., the following papers will be presented:

"Intensity of Natural Illumination Throughout the Day," by Leonard J. Lewinson.

"The Integrating Sphere in Industrial Photometry," by Dr. Clayton H. Sharp and Preston S. Millar.

"The Ives Calorimeter in Illuminating Engineering," by Dr. Herbert E. Ives.

"Calculating and Comparing Lights from Various Sources," by Carl Hering.

"The Calculation of Illumination by the Flux of Light Method," by J. R. Cravath and V. R. Lansingh.

On Tuesday, October 6, at 2 P. M., these papers will be taken up:

"Street Lighting with Gas in Europe," by E. N. Wrightington.

"Design of the Illumination of the New York City Carnegie Libraries," by L. B. Marks.

"Engineering Problems in Illumination," by Alfred A. Wohlauer.

"Intrinsic Brightness of Lighting Sources," by J. E. Woodwell.

"Some Experiments on Reflection from Ceiling, Walls and Floor," by V. R. Lansingh and T. W. Rolph.

"The Relation Between Candle-Power and Voltage of Different Types of Incandescent Lamps," by Francis E. Cady.

Westinghouse Plan.

It was officially announced on September 28 that the bondholders' plan of reorganization of the Westinghouse Electric and Manufacturing Company, involving a foreclosure sale of the property, has been abandoned and in its place the so-called merchandise creditors' plan has been adopted.

It appears that the creditors' committee was unable to induce the stockholders to subscribe to the full quota of $6,000,000 of stock which was agreed upon last spring. There is, however, $4,500,000 of the new stock subscribed. The following official statement was issued recently by Joline, Larkin & Rathbone, counsel of the Jarvie committee, familiarly known as the Bondholders' Committee:

"The Readjustment Committee of the Westinghouse Electric and Manufacturing Company, of which James N. Jarvie is chairman, after a session lasting two days, adopted substantially the so-called merchandise creditors' plan, notwithstanding the fact that the cash subscriptions to the new assenting stock of $6,000,000 contemplated in such plan do not at this time exceed $4,500,000, and although the assent of a considerable amount of the bank debt and a portion of the merchandise debt still remains to be secured.

"This substitute or modified plan was adopted, however, with the distinct understanding that the plan will not be declared operative unless the full $6,000,000 of cash subscriptions and the assents of the bank creditors are in hand by October 27, 1908.

"The formal announcement of the plan and of its terms and conditions will be made the early part of next week."

THE FALK COMPANY'S PLANT.

THE FEATURES OF INTEREST OF A MODERN STEEL FOUNDRY AND MACHINE SHOP.

The Falk Company, of Milwaukee, Wis., operates the largest steel foundry and machine shop in the West. This plant has many features of special interest, particularly as concerns the economical arrangement and operation of the works.

The business of the Falk Company was started in an establishment devoted especially to the manufacture of street railway motor gears and track appliances. This department still constitutes an important division of the works, but the features of particular interest at this time are the foundry and power plant, the former a building 625 feet long and 295 feet wide at its largest part, having a capacity of 1,500 tons monthly. Steel castings of any size required up to forty tons capacity or more, and varying widely in character, are turned out.

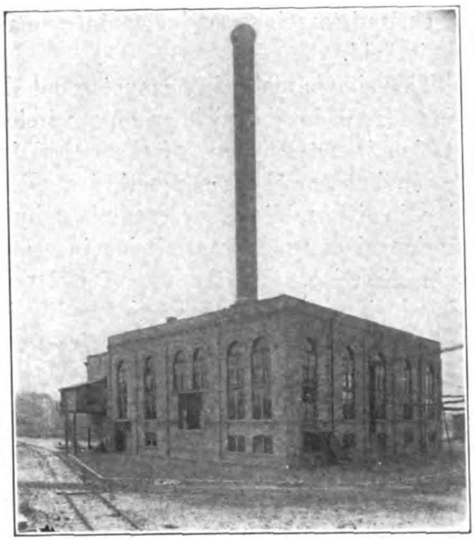
Pig iron is brought to the works over the Chicago, Milwaukee & St. Paul Railway, and left standing in cars on any one of the network of tracks which occupies a considerable portion of the company's ground. The cars are unloaded by means of a Cutler-Hammer two-ton lifting magnet at the end of a locomotive crane, and placed in piles between the tracks. An average analysis of each pile of pig iron or scrap is made, and the magnet is again called into play to load the iron directly into charging buckets carried on small industrial trucks. A record of the weight and contents of the buckets is then made, and the buckets are drawn up an incline to the charging floor of the furnaces. Charging machines feed the contents to one of two open-hearth furnaces, which are heated by oil fuel, which, after delivery in tank cars, is stored in three underground steel tanks, each with a capacity of 15,000 gallons.

The foundry is served throughout its length by eight traveling cranes built by Pawling & Harnischfeger, of Milwaukee.

The floor of the foundry is lighted in the daytime by side windows and a monitor extending the entire length of the building. At night arc-lamp illumination is used. The shops are heated in winter by means of the National Blower Company's system, which consists of forcing hot air through pipes running along the top of the building.

Unusually successful results have been obtained in this foundry by the use of electric welding. Bars welded by this method have stood tests of tensile strength up to 58,000 pounds per square inch.

The railway department of the Falk Company turns out cast-steel gears and forged-steel pinions, girder rail and high T-sections for city railways, low standard sections of from fifty-six to 100 pounds for steam and interurban lines, and a great variety of special work. This department has an exceedingly well-equipped machine shop.



Power Plant of the Falk Company, Milwaukee, Wis.

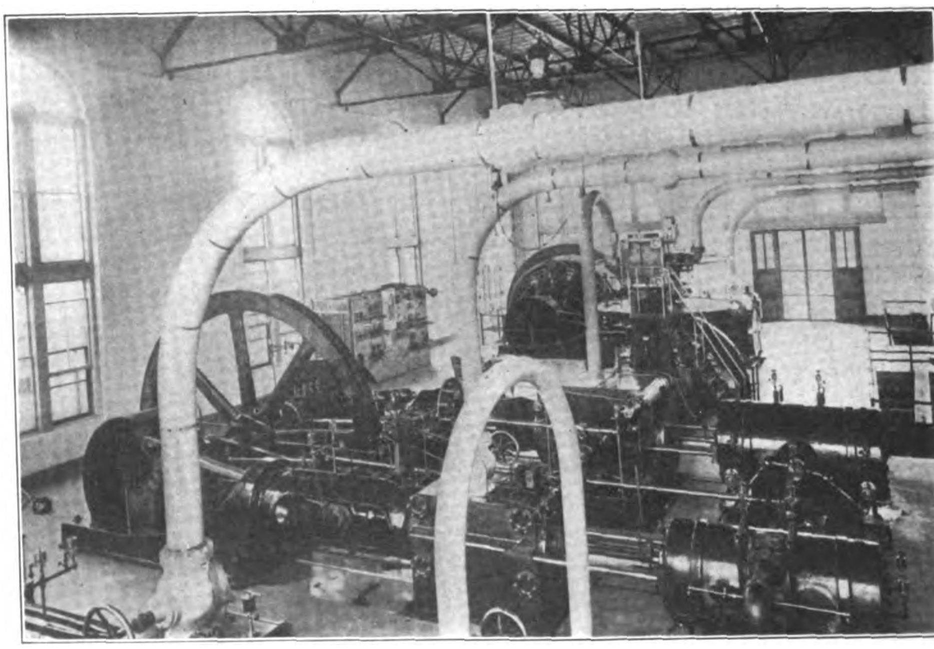
All of the work of the railway department is laid out and assembled before shipment. The laying out of the work is greatly facilitated by means of a special revolving crane of five tons' capacity.

All of the machinery in the entire works of the company which does not depend upon compressed air for its operation is electrically driven, principally by individual motors. In some instances short lines of shafting are used in such places as the pattern shop, cleaning department of the foundry, etc., where numbers of light-running machines make this arrangement most advantageous.

Electricity and compressed air are supplied from a new central power station, which is one of the most interesting features of the works. The equipment in all of its main details, including engines, generators, compressors, circulating pumps, etc., was furnished by the Allis-Chalmers Company, of Milwaukee, Wis.

The machinery consists of a cross-compound, condensing Reynolds-Corliss engine, twenty inches and forty-two inches by forty-two-inch stroke, operating at 100 revolutions per minute, and coupled to a 550-kilowatt, direct-current, 250-volt generator; an eighteen-inch and twenty-four-inch simple condensing Reynolds-Corliss engine of the vertical pattern, direct-connected to a 125-kilowatt, direct-current, 250-volt generator; and two air-compressors, one two-stage and the other single-stage, having capacities of 2,500 and 1,800 cubic feet of air per minute.

Lubrication is provided for the cylinders by sight-feed oil pumps and a gravity system. The oil flows after use to a five-chamber Turner filter, situated in the basement, and is pumped back to a 200-gallon tank located under the ceiling of the engine room.



Engine Room, Falk Company, Milwaukee, Wis.

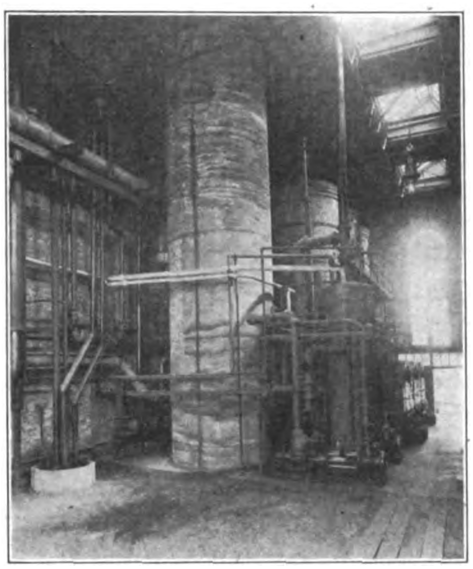
Three Wickes vertical water-tube boilers, designed for a working pressure of 150 pounds, and rated at 300 horse-power each, are located in the boiler room. These boilers are connected to a twelve-inch header, which divides into six-inch feeders serving the several engines. Steam is supplied at fifty pounds' pressure through large separators connected with Squire's traps.

All water for boiler feed is taken from the city mains, and first passed through the jackets and inter-coolers of the air-compressors before flowing to an open Crowley heater. Thence it is lifted to the boilers by one of two Burnham outside-packed plunger pumps of the Union Company's design, the second unit being used to work the turbine flue cleaner and for boiler washing.

Each furnace has independent dampers between it and the breeching, which connect with a reinforced concrete stack 180 feet high, having natural draft through an eight-foot flue. Each of the engines is connected to one of four Tomlinson barometric condensers built and installed by the Allis-Chalmers Company. The water flows from a nearby river to a deep well, where it is lifted to the condensers by means of steam-driven centrifugal pumps, one pump supplying two condensers.

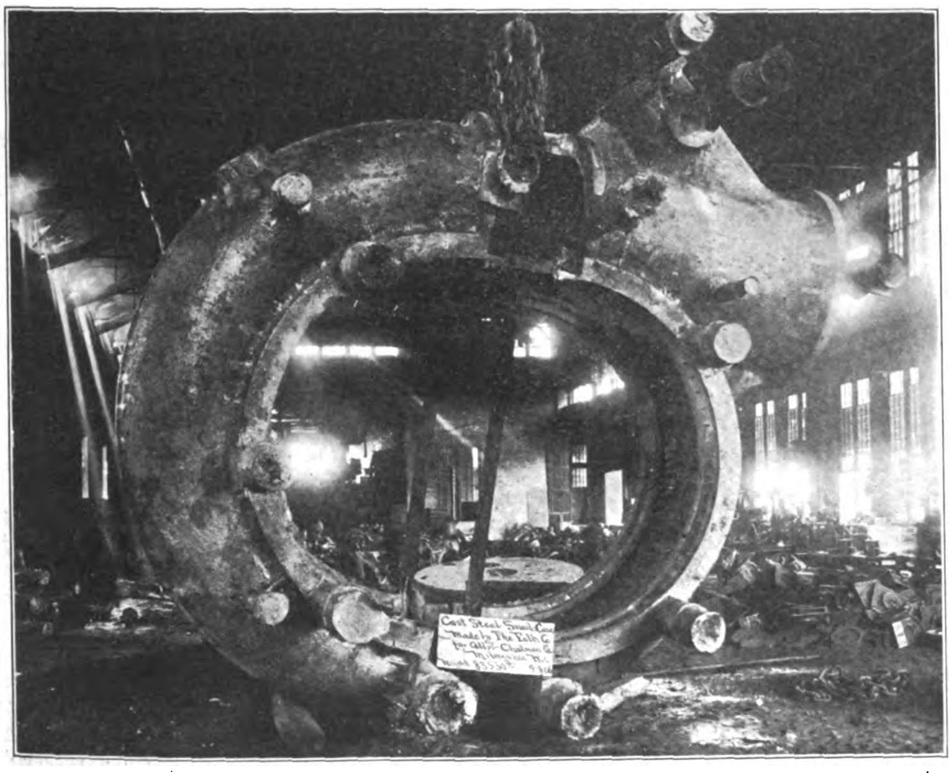
Coal is brought in on an inclined track and dumped over enclosed bunkers having a capacity of 400 tons, the cars being pulled by means of an electric hoist.

The switchboard was built by George F. Rohn, of Milwaukee, and is equipped with standard apparatus, including Cutler-Hammer switches. The distribution of current to the shops is through insulated underground cables, which feed a network of wires run in iron piping to the various departments where power is needed.



Boiler Room of the Falk Company, Milwaukee, Wis.

The plant is thoroughly equipped with modern appliances for conducting efficiency tests and gathering daily records, all of which are kept in constant service. This has had a very appreciable effect on the operating economy.



Cast Steel Snail Case, Made by the Falk Company for the Allis-Chalmers Company.

The company started in 1899 at its present site with a plant extending over less than a quarter of an acre. The present works have now an area of fifty acres, including a covered floor space of nearly ten acres. This rapid extension of the business is due to the efficient management of the works themselves, an interesting feature of which is the treatment of the employés and their relations to the officers and heads of departments. The company has demonstrated its ability to produce satisfactory castings, not only of a general character, but also those of the most difficult nature. In this way it has established itself with the largest and most particular users of steel castings in America.

The officers of the Falk Company are: Herman W. Falk, president; Otto H. Falk, vice-president; Charles L. Jones, second vice-president; E. A. Wurster, secretary and treasurer; Clarence R. Falk, works manager; Harold Falk, general superintendent; W. Frank Carr, chief engineer.

Annual Meeting of the Rejuvenated Sons of Jove.

The sixth annual meeting of the Order of the Rejuvenated Sons of Jove will be held at the Iroquois Hotel, Buffalo, N. Y., October 14, 15 and 16.

The meeting will open with a reception at 8 o'clock on Wednesday evening, October 14, at the Iroquois Hotel. At 10 P. M. there will be a special event for the entertainment of the Jovians.

At 9 A. M. on Thursday a trip will be made to the plant of the Roycrofters, at East Aurora, N. Y. At 10.30 A. M. an address will be made by Elbert Hubbard. At 12.15 o'clock luncheon will be served.

A business meeting will be held on Thursday at 2.30 P. M., at the Hotel Iroquois. Reports will be made by the auditing, financial and reorganization committees, and the officers of the sixth Jovian congress will report.

At 8 P. M. there will be an illuminated Jovian parade. At 9 P. M. there will be a grand rejuvenation at the cathedral of the Scottish Rite Masons. At 11 P. M. there will be a joviation, including a Dutch lunch, music, songs and speeches.

On Friday, October 15, a general meeting will be held at 10 A. M., when unfinished business will be taken up, and there will be a general discussion as to the needs of the order.

At 1 P. M. there will be a standing luncheon, and at 2.30 P. M. election and installation of officers.

The annual banquet will be held on Friday evening, at 7 o'clock.

Electrification of Steam Roads.

At the meeting of the Electric Club, of Chicago, Ill., on September 23, F. A. Sager, of the Arnold Company, delivered an address on "The Electrification of Steam Railroads."

"The railroads," he said, "will have to spend approximately $5,000,000,000 within a few years to keep up with the increase of traffic. By electrification at a cost of $4,000,000,000 they would increase their capacity to such an extent that no new trackage would be needed."

The meeting of the club was the first of a series which will be held for the purpose of throwing light on the electrification problem, and especially that of the Illinois Central suburban service.

In his address Mr. Sager took into consideration the work which had been done by the New York Central, the Baltimore & Ohio, the New York, New Haven & Hartford, the Erie and the New Jersey lines in the East, and at the St. Clair tunnel near Detroit.

The paper was followed by a general discussion in which the local situation was discussed, consideration being given to the difficulties which probably would be encountered, but the general opinion expressed was that the work offered no insurmountable obstacles.

"Electrification of the steam lines has been made slow chiefly for one reason," said Mr. Sager. "The men who have been trained by the old lines to high positions have a thorough knowledge of steam engineering, but little information as to electricity. On the other hand, the electrical engineers have been thoroughly trained in their specialty, but have not given their attention to the problems of the steam roads.

"The result is that the steam roads have had to call in electrical experts whose knowledge, as far as the old transportation went, was theoretical. They were unable to give past examples and experiences to add weight to their promises. But in practically every instance things have turned out, as to economy and efficiency, as the electricians said they would.

"It always has been thought that electricity could be applied with best results where the passenger traffic was large and broken up into frequent trains. Doubt was expressed as to the feasibility of applying electricity to the moving of freight. But the experiments have gone far enough to show that electricity far exceeds steam in economy and efficiency in three ways, as follows:

"At terminals where there are an unusual number of trains to handle. It is possible that legislators will come to realize this to such an extent that terminal electrification will be required by law.

"In mountain regions where there are heavy grades. Electricity will move trains more rapidly, with lessened cost of operation.

"At interior points where there is congestion due to large freight yards, junctions and unusual local traffic.

"It has been shown that electricity will very considerably reduce the cost of operation in suburban service. A very large economy has been shown in the eastern experiments, ranging from twelve to twenty-seven per cent. These savings were made when the initial expense of installation was still hanging on. As the extent of installation is increased the economy will be more marked.

"Necessity, however, will be the great factor in driving the roads to electrification. If money is still as hard for them to obtain when traffic starts to move again as it was a year ago, they will be driven to electrification in self-defense.

"It has been proved that the electric locomotive is forty per cent more efficient than the steam engine. It starts more quickly, moves more rapidly and will increase the capacity of switching yards on through tracks fully two-fifths. In other words, the installation of electricity would save millions and millions of dollars in new trackage and car equipment."

The Meeting of the Colorado Electric Light, Power and Railway Association.

The sixth annual meeting of the Colorado Electric Light, Power and Railway Association was held at Glenwood Springs, Col., September 16, 17 and 18. The first session was held at 4 o'clock, Wednesday, September 16, when a paper by S. E. Doane, chief engineer of the National Electric Lamp Association, was read. The next session was held at 8 o'clock Wednesday evening, when a paper entitled "The Operation of Hydroelectric and Steam Plants in Parallel" was read by J. C. Lawler, of Colorado Springs.

The third session was held at 10 o'clock Thursday morning, and papers were read by George Raymond Hall and John M. Mulvihill entitled, respectively, "The Electrification of Steam Railroads Operating in Mountainous Districts" and "The Popularizing of Public Utility Corporations by Careful, Painstaking Office Management."

The last session was held on Friday morning, when a paper by Clarence Renshaw, entitled "Some Notes on Single-Phase Railway Systems," was read.

The entertainment features of the meeting consisted of a trip on a special train on Friday afternoon to the works of the Central Colorado Power Company at Shoshone. The members made a thorough inspection of the dam, tunnels, building sites and tower construction.

On Thursday evening there was a rejuvenation of the Sons of Jove.

About thirty-five members and thirty-five associate members of the association were in attendance at the convention.

The following officers and committees were elected:

J. F. Dostal, Denver, Col., president.

W. T. Wallace, Cañon City, Col., vice-president.

J. C. Lawler, Colorado Springs, Col., secretary and treasurer.

Additional members of the executive committee—George B. Tripp, Colorado Springs, Col.; W. G. Matthews, Denver, Col.

Advisory committee—John A. Beeler, Denver, Col.; W. J. Barker, Denver, Col.; John F. Vail, Pueblo, Col.; C. K. Durbin, Denver, Col.; J. A. Cooper, Denver, Col.

Membership committee—L. M. Cargo, Denver, Col.; J. C. Davidson, Denver, Col.; C. H. Williams, Denver, Col.

Finance committee—Irving Hale, Denver, Col.; John A. Clay, Silverton, Col.; W. P. Eyre.

The Southern Idaho Irrigation Project.

J. G. White & Company, Incorporated, engineers and contractors, 43-49 Exchange Place, New York city, have commenced work on their contract to construct for the Idaho Irrigation Company, Limited, a complete irrigation system for about 150,000 acres of land situated in Southern Idaho. The water supply for this project will be obtained from Big Wood and Little Wood rivers. The lands to be irrigated are in the vicinity of Shoshone, Richfield and Gooding.

The irrigation system will consist of a storage dam, four diversion dams, four main channels, each leading to one of the tracts of land into which the project is divided and the complete system of distribution and drainage ditches necessary for the irrigation of these lands. The storage dam, which will form a reservoir of more than 150,000 acre-feet capacity, is to be built in the channel of Big Wood River in a lava cañon and is to be about 115 feet high, of rock-fill type with concrete core.

The diversion dams, two of which will be in the channel of Big Wood River and two in the channel of Little Wood River, are relatively small structures of sufficient height to raise the water to the level of the canals.

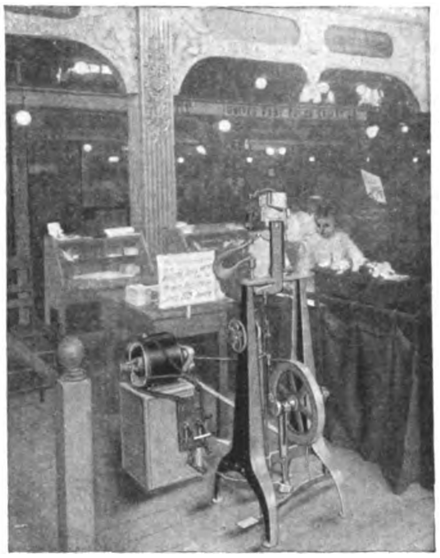
Electrical Machinery at a Shoe and Leather Exhibit.

The third annual National Shoe and Leather Market Fair, held at the Coliseum, Chicago, August 26 to September 2, was the most successful fair of its kind ever held. An idea of its size may be had from the fact that the huge Coliseum—the home of the Chicago Electrical Show—was completely filled with shoes, leather, machinery used in the shoe and leather industry and supplies. The decorations this year were even more elaborate than last year and, as they were uniform throughout, the effect was particularly pleasing. This applied not only to decoration but to the general arrangement of the booths as well. Each booth, being of a standard size and furnished throughout with mission furniture, gave each exhibitor an even chance to display his products.

Shoes were much in evidence of course, every kind from fine ladies' to men's high-top hunting boots being shown. This gave the retailer an opportunity to compare them side by side and get a line on the merits of each. To the average individual, however, this part of the display was not as interesting as the shoes in different stages of manufacture. Shoemaking and repairing machinery was shown in the Annex and it was here that the crowds lingered, watching some labor-saving machine do the work formerly done by hand. All these machines were driven by electric motors, both individual and group drive being used.

Booth of the Western Electric Company at the Shoe and Leather Fair.

Although the shoe and leather industry is a comparatively new field for electrical apparatus, great interest was shown by both exhibitors and visitors in the exhibit of the Western Electric Company. This company occupied a large booth in the Annex. Here both direct and alternating-current motors, arc lamps of various designs, exhaust and desk fans, and intercommunicating telephone sets were displayed. In addition to the motors shown in the Western Electric exhibit, Western Electric motors were seen in operation driving the shoemaking machines of other exhibitors. The arc lamps, too, on account of their brilliancy, brought a good many inquiries as to their adaptability to store and factory lighting and their superiority over the gas arc and



Bragg Automatic Shoe Nailer Driven by Western Electric Motor.

other forms of illuminants. This was particularly true of the Hawthorne "Short Arc" lamp, which, on account of its compact design—it being only twenty inches over all—met with general favor from those who, up to this time, had been unable to use arc lamps because their factories had low ceilings. The intercommunicating telephone sets for store and

Champion Shoe-Repairing Outfit Direct-Driven by Western Electric Motor.

factory use also came in for their share of attention from those interested in saving the time lost by the old walking-talking method of handling business. Many people were impressed with the advantages of an electric fan when they walked into the draft made by a sixteen-inch desk fan placed on a table near the aisle. The effect was particularly pleasing, however, for during the fair the Coliseum was uncomfortably warm and this booth was the one cool place in the building. Bulletins showing electrical apparatus designed especially for the shoe and leather market were distributed as well as general publications relating to lighting, power and telephone apparatus.

The Western Electric Company was very much in evidence throughout the fair and attracted quite a bit of favorable comment for its aggressive advertising. In the exhibits of four of the shoe-machinery companies whose machines were operated by Western Electric motors, namely, the Champion Shoe Machinery Company, the Puritan Manufacturing Company, J. E. Bragg & Company and the Dayton Last Works, were hung placards calling attention to the fact that the motors used were of Western Electric manufacture and that other electrical apparatus could be seen at the booth of the Western Electric Company in the Annex. This idea was further carried out by a placard hung in the Western Electric Company's booth explaining that Western Electric motors were in operation at the booths of these other companies.

A striking example of the efficacy of the moving exhibit was evidenced by the crowds which gathered around the booths where machinery in actual operation was exhibited. One of the best examples of this was the exhibit of the Champion Shoe Machinery Company. This exhibit showed a shoe-repairing outfit and harness-sewing machine. The repairing outfit consisted of a shoe stitcher, an edge trimmer, an edge cutter and a dust collector, all mounted on a common base and driven by a small, 110-volt Western Electric motor. The outfit was fitted with friction clutches which enabled the operator to put in operation any one part or the entire equipment at will, thus saving power and making this repairer a very economical machine. The dust collector is of much importance to the retailer because without it he would not be able to install his repairing outfit on the same floor with his shoe stock on account of the dust and dirt common to shoe repairing.

The entire equipment requires but one horse-power for its operation and runs at 500 revolutions per minute. The electric motor being a cheap, clean, reliable source of power, easily available at all times, is an ideal source of power here.

The Puritan Manufacturing Company also had an interesting exhibit of sewing machines. These were driven from a line shaft under the table on which the machines were mounted. A one-and-one-half-horse-power Western Electric direct-current motor was belted to this shaft and from the shaft a short belt ran up to each machine. This was an excellent example of group drive as applied to a number of similar machines.

The only moving sign at the fair was that in the booth of the Dayton Last Works. This sign, which was driven by a small direct-current Western Electric motor, was used to call attention to a line of shoe lasts known as the "Tread-strate."

J. E. Bragg & Company showed a new automatic nailing machine which, on account of the rapidity with which it operated, attracted a great many people to the booth of this company. This machine, known as the Crowe automatic shoe-nailing machine, is very simple in operation and at the same time very efficient. The nails are placed in a hopper and automatically fed down into a slot. The machine was driven by a small Western Electric direct-current motor similar to the one used by the Champion Shoe Machinery Company.

From every standpoint the fair was a success, as it brought together all the prominent shoe dealers and manufacturers and gave them an opportunity to study new methods of manufacture and see in actual operation the very latest labor-saving machines. The interest shown by the exhibitors and visitors at the fair in the electric motors and supplies showed that the shoe and leather field is one offering great opportunities to the manufacturer of electrical equipment.

To Discuss Railway Topics.

The executive committee of the National Association of Railway Commissioners has arranged for special addresses to be delivered at the meeting to be held at the rooms of the Interstate Commerce Commission in Washington, on October 6, as follows:

"Government Mediation in Railway Labor Disputes," by Martin A. Knapp, chairman Interstate Commerce Commission; "Regulation of Railway Capitalization," by Frank W. Stevens, chairman Public Service Commission, Second District, New York; "Car Efficiency," by Arthur Hale, chairman Committee on Car Efficiency of American Railway Association; "Uniform Rules Governing the Shipment and Carriage of Explosives and Other Articles Dangerous to Transport," by Dr. C. B. Dudley, president, and Colonel B. W. Dunn, chief inspector Bureau for the Safe Transportation of Explosives and Other Dangerous Articles.

Public Service Commissions.

At the recent meeting of the Vermont Electrical Association, in Bennington, Glenn Marston delivered an address on "Public Service Commissions," making some very interesting points, among which may be quoted the following:

"Every broad-minded person recognizes that in the main the interests of the public service corporations and the public are identical and that the object of a public service commission is to preserve this identity. A public service commission must protect the public and the corporations alike. The public is looking for the best possible service at the lowest possible rates; the corporation is looking for the most profitable business and realizes that it can only do its maximum amount of business by meeting to the fullest extent the wishes of the public. A public service commission should have the power to regulate rates, the quality of service, prevent competition, enforce satisfactory accounting and exercise a general supervision over the public utilities of the state.

"State regulation is far superior to any other method yet devised, because it removes the oversight of public utilities from local authorities. In the first place local regulation, and by that I mean either municipal ownership or municipal regulation of private companies, can not be provided by men familiar enough with the operation of the plants so regulated to make it trustworthy. The result is either an unfortunate laxity or a degree of municipal interference that sometimes goes so far as to put the company out of business.

"I want to emphasize the importance of a reasonable appeal to the courts from the decision of any commission which may be formed in this state. There should not be an unlimited appeal, because then a company might run to the courts at any time and tie up the decisions of the commission indefinitely. On the other hand, if no appeal is provided for, a corrupt or arbitrary commission would have powers which would put the companies absolutely at their mercy and the commission would not operate for the benefit of the public at large. It seems to me that the best way to provide for an appeal from the acts of the commission is to specify that the appeal shall be made within a certain time limit, say thirty days, and that it should be granted preference over all other cases in the court to which the appeal is taken.

"As to the duties of the commission, one of the most important is the enforcement of a uniform system of accounting, not only for the municipal plants but for the private companies. Municipal ownership has been consistently opposed by private companies for many years, not so much because the companies are opposed to municipal ownership in itself, but because they are opposed to the false and misleading accounts which are given out by the municipalities and which claim to show that the municipalities can manufacture electricity for less money than is possible under private ownership. A uniform system of accounting is just as valuable to the small company as to the large company—perhaps it is more so. I often hear the manager of a small company object to uniform accounting on the ground that his company can not make a good showing. That is the very reason why he should favor a commission which would enforce uniform accounting, because if it can be shown that his company does not operate profitably under the same accounting system as is used by the larger companies, he would be fully justified in going before the commission and asking that his rates be increased, so that he could operate at a reasonable profit.

"State regulation makes municipal ownership unnecessary. It makes it unnecessary for a city to invest a large sum, when the money could be used for other purposes more advantageously. It makes competition unnecessary for it takes the place of competition. All that can be looked for from competition is a desire on the part of each competing company to give better service and lower rates than the other, in fact, the rates can not be at their lowest when there are two competing companies because fixed charges must be met on unnecessary duplicate equipment.

"You may say, 'Why not competition in this business the same as in the grocery business?' The answer is that the grocer does not have to make a huge initial investment in complicated machinery and equipment with which to serve his customers, but buys his manufactured commodity from the wholesaler and acts as a distributing agent only, while the lighting company has to spend thousands of dollars before it can secure a single customer. It is the huge wastefulness of competition in public utilities that makes some other form of public regulation necessary, and it is only through the most generous co-operation of the public and the company that the lighting business can be made to attain its greatest usefulness and become the standard of enlightened business progress before the world."

A Modern Lamp-Making Works.

The New Factory of the Westinghouse Lamp Company at Watsessing, N. J.

WHAT do good light, pure air and pleasant surroundings mean to an employé? Whatever the answer may be, they mean just the same thing to the manufacturing business itself. These and the continuity of to work in rooms always filled with a plentiful supply of pure air. Although these new works of the company have been operating but a few months the reports of output in quantity and quality of the product stand as conclusive evi- strength to permit the addition of one or more stories when desirable.

All buildings are designed to be as nearly fireproof as possible, being constructed throughout of reinforced concrete.

GENERAL VIEW OF FACTORY AND GROUNDS OF THE WESTINGHOUSE LAMP COMPANY, AT WATSESSING, N. J.

operations in lamp manufacture are what the architects and engineers had in mind when they designed and constructed the works of the Westinghouse Lamp Company at Watsessing, N. J. A visitor to the works is struck by the unusually favorable condition under which the employés work. Tidiness is noticeable in every department. There is no crowding of employés; no foul air to make them drowsy and inefficient long before the day is done. High ceilings and plenty of windows make it possible for all dence that an employé will do more work and better work if placed amid surroundings that are healthful and inspiring.

The plant, which occupies a level site comprising fifteen acres of land, consists essentially of three structures—main manufacturing building, 521 by 100 feet, three stories high, with a floor-to-floor height of seventeen feet four inches; storehouse, 140 by eighty feet, four stories high, and power-house, eighty-three by sixty-six feet. The foundations of the buildings have been made of sufficient

Lighting and heating are supplied from a central power plant, which furnishes current for elevators, pumps, fans and for manufacturing operations.

The power-house is directly back of the storage house and is designed to contain 1,000 horse-power of Stirling boilers. The following installation furnishes the necessary power for the operation of the works at the present time:

One 250-kilowatt, alternating-current, direct-connected Westinghouse unit, with one twenty-five-kilowatt exciter; one fifty-kilowatt, alternating-current, direct-connected Westinghouse unit, with ten-kilowatt exciter; one ninety-kilowatt belt-driven generator; one forty-horse-power Westinghouse motor-generator set to supply direct current; one steam-driven air-compressor supplying air at from three to five pounds pressure for blow-pipe work; one motor-driven air-compressor, belt-connected, to supply air at 100 pounds pressure for distribution through the manufacturing building.

As a part of the power equipment, although placed in the manufacturing building, in the south end of the first floor, electrically driven, are seventeen vacuum pumps.

All mechanical processes are operated by electric drive, and the latest and best appliances used in lamp manufacture have been secured. Many of the machines used in these new works have been developed by the company's engineers and the company has built the machines at the works.

The buildings are heated by indirect radiation, large stands of heating stacks being provided on the ground floor, through which the outside air is drawn by electrically driven fans and distributed in galvanized-iron ducts through all parts of the buildings. Hot water is circulated through the heating stacks by an electrically driven centrifugal pump located in the boiler room of the power-house, where the water is heated by exhaust steam.

Special attention has been given to the matter of fire protection, and the entire plant is equipped with automatic sprinklers, which are supplied with water from a steel tank of 100,000 gallons capacity placed on a tower 100 feet high. Further fire protection is provided by a system of underground piping in the yard connecting with fire hydrants. This system is fed by a 1,500-gallon Underwriters' fire pump, which draws its water from an underground reservoir of 200,000 gallons capacity. A reserve water supply is secured by connection with the regular water service system of the town of Bloomfield, N. J.

Fire-escapes are located on three sides of the main building, and one on the storage house. All stairways in the building are constructed entirely of cement and iron, so that these may be relied upon as safe exits in case of fire. On every floor the stairways are separated from the working sections by fire doors.

A volunteer fire department is organized among the employés, and there are stations on every floor with a full equipment of fire-fighting apparatus, including hand chemical extinguishers, fire buckets, axes, hose, etc. These stations are clearly indicated by red lights. The fire department has a further equipment of a chemical wagon, with a capacity of ten gallons.

In the manufacturing building all rooms are made especially, light, large and airy, and are finished in light gray. Toilet accommodations, carefully designed and equipped with a view to health and comfort, are provided at convenient points on all floors.

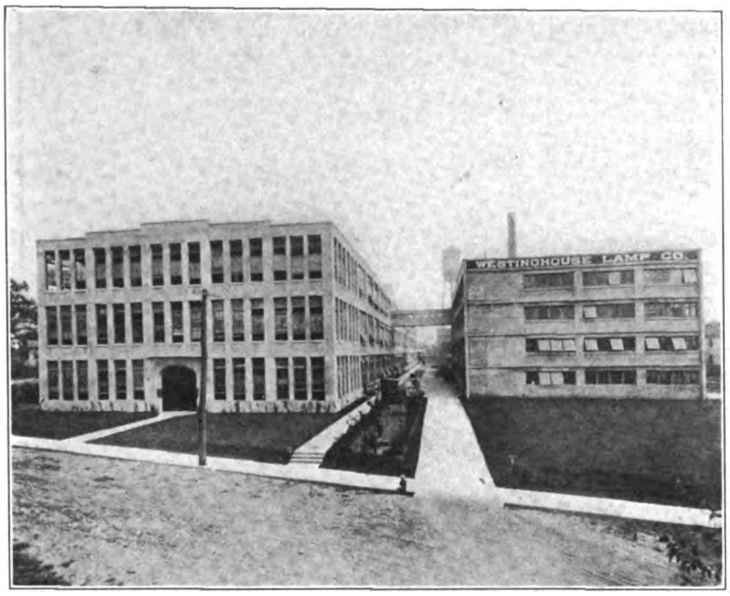
Drinking water is furnished on all floors at convenient intervals, from a well drilled to a depth of 550 feet on the company's property. This well supplies all the water needed for manufacturing purposes and fire protection.

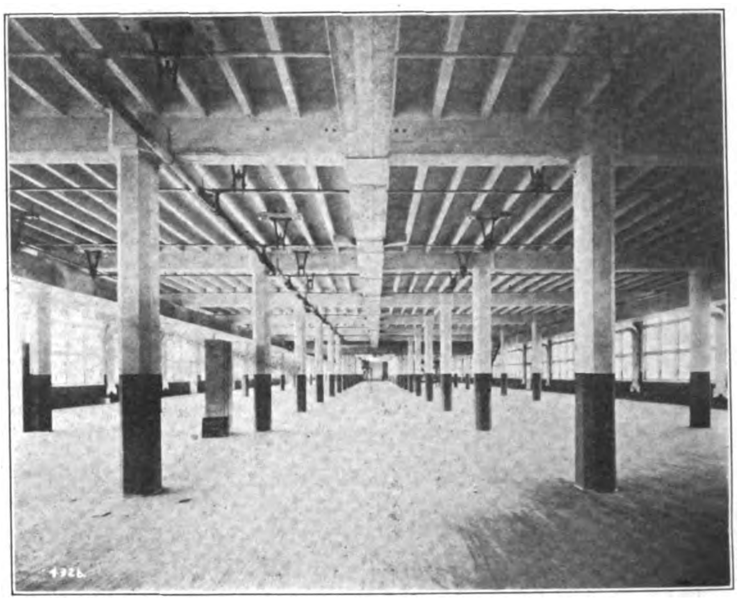
The storage house is the first building to be seen, coming from the railroad station. It was purposely placed adjoining the tracks of the Delaware, Lackawanna & Western Railroad and the Erie Railroad to facilitate the loading and unloading of material.

In the storage house are received and stored all the raw materials required in lamp manufacture. Starting at the storage house and ending in the same building is the best system of shop routine known to the art of lamp making. There is no back action to impede the work and every step is in one forward direction. There is interwoven with the manufacturing process so closely as to be part and parcel of it, a system of inspection and accounting, by means of which every important operation is inspected and approved by an expert before it is permitted to pass on to the next operation. A space on each floor of the main building nearest the storage house, about thirty feet wide and running almost its entire length, is reserved for the stores and inspection department.

It will be seen at a glance that this means to the customer a very high grade of product, and at the same time effects a tremendous saving to the manufacturer in preventing further operation on pieces once found defective.

It also makes it possible to operate the factory on the premium piecework system. Careful record being kept of the grade of work turned out by each operative, the inspector once a month is able to prepare for the management a statement showing clearly the quantity and grade of work turned out by each employé, as well as





View of Main Building and Storage Building, and Interior View of Factory Floor Before Occupancy, Westinghouse Lamp Company Factory, Watsessing, N. J.

the standing of one employé with another in the same class of operation.

The process of making the filament begins on the first floor of the main building. Here the filament undergoes fourteen operations, beginning with the preparation for the brew, the squirting into fibre, its washing, and later the winding of the fibre on drums which are electrically driven, each drum having one attendant to feed the fibre. Other operations include the forming of the filament on frames, then the packing, first for the preliminary furnaces and later for the final furnaces, then the sizing, cutting and counting. The counting, which is done by weight, is most interesting to the visitor, who is naturally surprised to learn that this method of counting is correct within two per cent, and is far more accurate than counting by hand.

The treating of the filament takes place on the second floor at the south end of the main building. Here there are four long treating tables, each providing room for eight operatives. Each operative has facilities for treating simultaneously four filaments in separate chambers of hydrocarbon gas. After this, inspection is made as to the length and cross-section of the filament, and check inspection is also made for resistance, shape, etc.

Reference should next be made to the process necessary to make the stem through which the leading-in wires are inserted before being sealed in the glass bulb. Glass in long tubes is cut into short lengths and fed into what are known as flanging machines. In point of economy of operation these are most interesting, being entirely automatic and requiring but one attendant to keep them filled and in adjustment. The hoppers at the top of the machines are kept filled with these short lengths, which, as they pass through the apparatus are heated on one end by gas flame and mechanically flanged.

After the insertion of the platinum-tipped leading-in wires, the anchor wire and the forming of the seal by an automatic clamping attachment which is a part of the stem-making machine, the finished stems pass through an inspection and stores department to long tables for the mounting of the filament. Here the stems are arranged in frames and the filament attached preparatory to the straightening of the leading-in and anchor wires. From this point the mounted stems, containing the leading-in wires, anchor wires and filament are passed through an inspection department to the sealing-in machines. However, we should now give some attention to the glass bulbs which, after having been washed and placed in the stores and inspection department, are taken to the tubulating machines, where by means of a needle gas-flame a tube is welded to the end of the bulb, which later provides a connection through which the lamp is exhausted. A large number of special tubulating machines are arranged

Lamp Basing Department, New Factory of Westinghouse Lamp Company, Watsessing, N. J.

on tables and there is one operator to each machine.

At the sealing-in machines the bulbs which have been tubulated meet the finished stems whereon the filaments have been mounted. These machines are equipped with holders for both the bulbs and stems, which are brought together in the proper position by the operator, and by mechanically rotating in an eight-flame gas blast the steam is sealed in the bulb, the joint being air-tight.

The special machines which are used for creating the vacuum in the bulb are provided with two-cylinder exhaust or vacuum pumps. Each operator has two lamps on the machine at once so that no time is lost during the process, as while one lamp is being subjected to the action of the exhaust pumps the other is being sealed off, that is, the tube which has been attached to the bulb in the tubulating process and through which the exhaust pump is drawing on the bulb, is fired off by hand into a symmetrical tip.

The bulbs which have been sealed in and exhausted pass through the stores and inspection department for examination and counting and then go down to the second floor for photometering. Here a force of experts test the lamps in darkened rooms to determine the rating, which is marked on the bulb in each case. From here the lamps pass to the first floor, where they meet the bases and where by means of rotating machines in which the bulbs are placed the bases are affixed and soldered by gas fire.

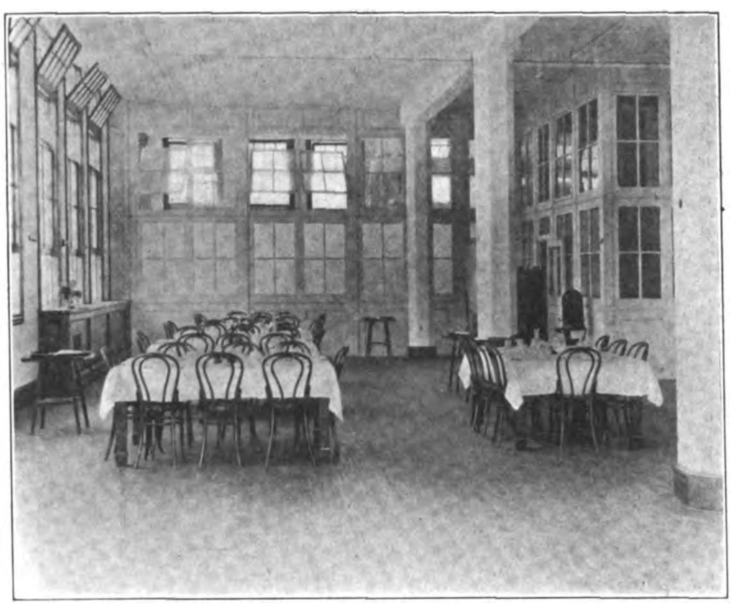
Such of the lamps as are packed for immediate shipment pass over to the shipping room. Stock lamps are carried to the upper floors of the storage house and held subject to order.

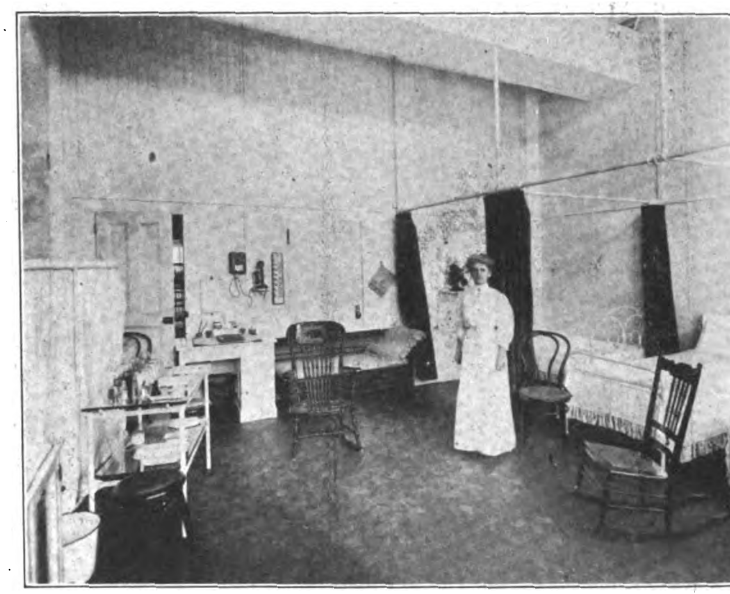
A special branch of manufacture not yet mentioned is the tungsten lamp manufacturing department, which occupies most of the second floor in the main building of the works and is devoted entirely to the manufacture of tungsten lamps, the larger quantities of which are made in the forty, sixty and 100-watt sizes. In the manufacture of tungsten lamps it has been the aim of the company to produce a highly efficient lamp which should be known everywhere for quality. The operations through which the tungsten lamps pass are too numerous and varied to explain in this article. However, it may be mentioned in passing, that for the operation of this department a large generating station has been provided for the making of hydrogen and nitrogen gases, and close beside this station is a large holder in which these gases are stored.

In the front of the building (the north end), on the first floor, are the private offices of the general manager and the assistant general manager; also of the correspondence and general offices, as well as the telephone exchange connecting with all departments.

Immediately above these offices on the second floor, and reached by means of a double stairway built of concrete, are the offices of the treasurer and auditor, the engineering department and the manager of works.

On the third floor, and also in the front of the buildings, are the dining rooms. There is a large dining room for the office employés, the foremen and their assistants, and private dining room for the officials of the company. Both dining rooms are directly connected with the kitchen.





Employé's Dining Room, and Medical Room, Westinghouse Lamp Company Factory, Watsessing, N. J.

Within the organization has been voluntarily formed by the foremen and their assistants, an organization known as the Westinghouse Foremen's and Assistants' Association. This organization has the hearty endorsement of the management of the company and is encouraged in every way in its endeavor to foster and develop a spirit of co-operation, one with the other, in the work of the various departments.

Meetings for the discussion of subjects pertaining to the interests of the company and employés are held at regular intervals, and outings are frequently held during the summer months.

In the near future it is the intention to equip, close by the works, a club, the building for which is now available. A library, reading room, shower baths, bowling alleys, billiard and pool, and other requisites of a modern social industrial club, will be provided.

Close by the works, on the company's property, is a baseball ground, upon which many of the employés play at noon and spare hours.

A unique feature in the organization of the Westinghouse Lamp Company is a dispensary and a rest-room for the employés. A regular physician has entire charge and gives undivided attention to this work, being on hand at all times to render medical advice or assistance when needed. Every needful thing is provided for the care of an employé who may be injured while in the performance of work, and other less important ailments are attended to and the medicine furnished without charge to the employés.

The entire work of designing and constructing was done by Westinghouse, Church, Kerr & Company.

THE DISCOVERY AND DEVELOPMENT OF THE LAWS OF THERMODYNAMICS.[1]—II.

BY DUGALD CLERK.

(Continued.)

Rankine, as early as 1849, arrived at the general equation of thermodynamics which expresses the relation between heat and mechanical energy and indicated the result of his investigations to the Royal Society of Edinburgh in February, 1850. Rankine thus arrived independently at the same result as Clausius about the same time. Both Rankine and Clausius, however, adopted certain theories as to the molecular structures and motions of gases, and their demonstrations to some extent depended upon their theories. To Thomson and Joule we are deeply indebted for the rigid proof of the two laws and for the rigid deduction of the modern scale of temperature and the determination of absolute zero in its modern form. Thomson now thus defines temperature:

"The temperatures of two bodies are proportional to the quantities of heat respectively taken in and given out in localities at one temperature and at the other, respectively, by a material system subjected to a complete cycle of perfectly reversible thermodynamic operations, and not allowed to part with or take in heat at any other temperature; or, the absolute values of two temperatures are to one another in the proportion of the heat taken in to the heat rejected in a perfect thermodynamic engine working with a source and refrigerator at the higher and lower of the temperatures respectively."

This definition leads to an absolute scale of temperature which is independent of the substance operated on, and Joule and Thomson's experiments have shown that this scale differs but slightly from that of the ordinary air-thermometer. Joule had suggested to Thomson, in a letter to him in 1848, that the probable value of Carnot's function is the reciprocal of the absolute temperature, as measured on a perfect gas-thermometer.

Thus Clausius appears to have anticipated Thomson, not in the suggestion of an absolute scale of temperature, but in the idea of an absolute zero founded upon the combination of Carnot's law and Joule's law. Thomson, in his papers, very modestly attributes the second law—the law of the transformation of heat—to Carnot and Clausius; but in this he undervalued his work, because Clausius appears to have assumed what Thomson and Joule proved—that is, the coincidence of the absolute scale with the air-thermometer scale.

It will thus be seen that the position usually assumed by the engineer at 1850, of the quality between heat given to the engine and heat given to the condenser, was fundamentally untrue. Without this deduction, however, no determination of values of the Carnot function could have led to the determination of an absolute zero. According to the material theory, as seen in the light of Carnot's cycle, a heat unit could give an indefinitely increased amount of work with lowering of the temperature. Nothing in the theory sets a limit to this increase and, accordingly, there is nothing to suggest an absolute zero. Immediately, however, we accept the dynamical theory of heat we find that one pound of water requires the exertion of 1,390 foot-pounds of work to heat it through one degree centigrade. We also know from the Carnot cycle that, under ordinary conditions of human existence, only a portion of this work can be returned; but as no conditions could conceivably exist in which a greater amount of work could be obtained from one pound of water than the 1,390 foot-pounds put into it to heat it through one degree centigrade, it follows that, inasmuch as the Carnot function increases with diminishing temperature, the limit of temperature is reached when, according to the Carnot cycle, the whole of that work, put into one pound of water, can be got out again as work. This limit is the absolute zero of temperature. No lower temperature is conceivable without introducing the idea of the creation of energy. So far as human beings are concerned, this idea is as inconceivable as the idea of the creation of matter. The determination of this limit with the close accuracy necessary for a well-founded constant is to be entirely attributed to Thomson and Joule. In his 1851 paper Thomson thus succeeds in answering the question which he put to himself in his 1849 paper and he supplies a quantitative method of connecting the amount of the thermal agency necessary with the amount of work which can be performed under varying conditions.

Engineers dealing with motive powers are thus deeply in debt to Thomson and Joule for the secure position occupied by them to-day.

The brilliant work of Meyer, published so early as 1842, is held by some to have anticipated to a large extent both the work of Thomson and of Joule. Undoubtedly Meyer formulated true ideas and carried his generalizations through a wide range. Helmholtz also very early arrived at similar conclusions to those of Joule and Thomson; but it has been thought better to discuss the work of Thomson and Joule separately in order to illustrate the transition period through which many distinguished minds were passing about that time. Undoubtedly, great credit is due to Meyer, Helmholtz, Clausius and Hirn, and Thomson himself recognized this in the most generous way.

The ideas of Thomson and Joule now form so much of the basis of all reasoning upon motive-power engines that there is some little danger to the present generation of forgetting what they owe to these two great men. To appreciate the step made by them it is necessary to consider the position of motive power produced by heat at about the middle of the last century. At that time many attempts had been made to displace the steam engine as a heat engine by air engines in various forms—both engines heated externally and those heated internally, now known as internal-combustion engines. Papers read at the Institution of Civil Engineers in 1845 and 1853, and the discussion of those papers by eminent men of the day, supply an accurate measure of the knowledge possessed by the engineer of the principles of action of his heat engines. Many distinguished names occur in these papers and discussions, including James Stirling, Robert Stephenson, Sir George Cayley, Charles Manby, James Leslie, C. W. Siemens, Hawksley, Pole, W. G. Armstrong (afterward Lord Armstrong), Edward Woods, E. A. Cowper, D. K. Clark, Benjamin Cheverton, Goldsworthy Gurney, George P. Bidder, Professor Faraday, Isambard K. Brunel, Captain Fitzroy and F. Braithwaite. At the date of the later of these discussions Brunel had already designed the Great Eastern, in 1852, with her engines of 11,000 horse-power. Armstrong was a Fellow of the Royal Society, and had started the Elswick Works and invented the Armstrong gun. Robert Stephenson was at the height of his fame. He was then a member of parliament, president of the Institution of Civil Engineers and a Fellow of the Royal Society. Siemens was a young man, but was busy on the regenerative furnace; he had considered regeneration as applied to steam engines, although his work on the air engine was still to come. All were distinguished men in their day, and their opinions may be taken as representing the very best scientific knowl-

[1] Presidential address delivered to the Engineering Section of the British Association for the Advancement of Science, Dublin, September 3.

edge of the leading engineers of the day. The first of the papers to which I refer is called "Description of Stirling's Improved Air Engine," by James Stirling, member of the Institution of Civil Engineers. It was read on June 10, 1845, with Sir John Rennie, the president of the institution, in the chair. The engine described was the later form of the well-known Stirling air engine, invented by the Rev. Dr. Stirling, a Scottish clergyman, in the year 1815. The development considered was the invention of the reader of the paper, a brother of Dr. Stirling. The main improvement consisted in the use of air at a greater density than the atmosphere, and the engine at that date had so far succeeded that two had been used at the Dundee Foundry Company's works, one giving about twenty-one horse-power and the other about forty-five horse-power. Practically, therefore, some success had been attained. Mr. Stirling claimed that the twenty-one-horse-power engine consumed fifty pounds of coal per hour, which is about two and one-half pounds per horse-power per hour. This was an extraordinarily good result for the time. At present, however, we are not interested in the practical result, but only in the opinions of the engineers of the day as to the fundamental principles of heat engines.

It is clear from the paper that the theory of the regenerator was entirely misunderstood. It was imagined that with a perfect regenerator no heat would be required to perform work. This is evident from Mr. Stirling's answer to Sir George Cayley. Sir George Cayley described his engine, which was of the internal-combustion type, acting with solid fuel under constant pressure, and showed that, owing to dust and heat in the cylinder and valves, his experiments proved abortive. He stated, however, that his engine had consumed six and one-quarter pounds of coke—equal to nine pounds of coal—per horse-power. To this Mr. Stirling answered: "It must be remarked that Sir George Cayley in following an entirely different object had overlooked the great leading principle of repeatedly using the same heat," and "he was of opinion that, except on that principle, the air could not be economically used as a moving power." Another speaker, Mr. Cottam, said: "It was evident that, if it was practicable to arrive at the theoretical condition of the absorption of all the caloric by the thin laminæ during the upward passage of the air, and the giving it out again during the downward passage, there would not be any loss of heat." Robert Stephenson did not appear to understand Stirling's air engine at all, because he made the following remarks: "He understood the process to consist of heating the air in a vessel, whence it ascended to the cylinder between numerous thin laminæ, by which the caloric was absorbed, to be again given out to the descending air. Now it appeared to him that, though the ascending process was natural and easy, the reverse action would require a certain expenditure of power, in the depression of the plunger." This remark clearly showed that Stephenson, notwithstanding his eminence as an engineer, at that date had not appreciated the essential conditions of the hot-air engine.

In the year 1853 the subject of the air engine again came up before the Institution of Civil Engineers, interest being excited evidently by the building of the large engines of the hot-air ship Ericsson in America, the engines having air cylinders of no less than fourteen feet in diameter. Four papers were read in this year: "On the Use of Heated Air as a Motive Power," by Benjamin Cheverton; "On the Caloric Engine," by Charles Manby; "On the Principle of the Caloric Air-Heated Engine," by James Leslie, member of the Institution of Civil Engineers, and "On the Conversion of Heat Into Mechanical Effect," by Charles William Siemens, associate member of the Institution of Civil Engineers.

Cheverton evidently considers, from his paper referring to Stirling and Ericsson, that "both parties also rest the efficiency of their engines on the repeated use of caloric. They contend that in recovering from the ejected hot air the caloric which gave it superior tension, and employing it in heating the injected air, 'it is made to operate over and over again.' Mr. Ericsson aspires to embody a new principle in motive mechanics—no less, to use his own words, than 'that the production of mechanical force by heat is unaccompanied by the loss of heat,' except such as arises from radiation, or other practically unavoidable waste." Cheverton rejects this idea, but, strangely enough, does not appear aware of the work either of Carnot or of Joule. He comes to the conclusion, however, that "caloric, doubtless, is in all its aspects a manifestation of force, and unquestionably, as a mechanical agent, of a dynamic force, and therefore is directly amenable to the third law of motion." He appears to think that heat is accompanied with molecular activity, but is puzzled by what he accepts to be a fact, that in the steam engine the whole of the heat of the steam as it comes from the boiler is found in the condenser. With regard to the steam he says: "Undoubtedly, in respect to the materiality of caloric, if it be material, it is transferred intact to the condenser, yet in its passage it may have parted with force, which it can not communicate again." He comes to the conclusion that the change may take place not in the quantity, but in the intensity of heat. Here he resembles Carnot; but it appears to him impossible to arrive at any useful theory of the heat engine, because he states: " . . . for every investigation leads to the conclusion that the effect of caloric is independent at least of the chemical, if not also of the physical, constitution of bodies. But economy of fuel is a different question from the economy of caloric; it is altogether a practical matter, and can only be determined by experiment; for this, and, indeed, most other points of practice, are too intractable to come within the grasp of the most powerful calculus." In the discussion a communication was read from Sir George Cayley, in the course of which he states, with regard to the regenerator: "There can exist no doubt of the effective reapplication of heat to an almost unlimited extent by this beautiful invention, due originally to Mr. Stirling, and now carried out to a greater extent by Captain Ericsson." Sir George Cayley discussed the difficulties of Ericsson's engine, but he accepts the principle that heat may give work and yet be used over and over again practically undiminished. Armstrong did not express himself upon the theory at all but he was doubtful as to the advantage of the air engine compared with the steam engine, although he believed that it was practicable to recover and use over again a large proportion of the heat applied, and he thought the balance of economy, so far as heat was concerned, would be found in favor of air. Siemens agreed to some extent in the advantages of a regenerator, but he showed clearly that expansion doing work was accompanied by a diminution of temperature, and stated that this heat had to be replaced by the fire. Bidder was of opinion that "no theoretical advantage was obtained in using heated air instead of vaporized water as a motive power, and it was incapable of being applied practically with as much convenience." It is most interesting to note that Dr. Faraday joined in this discussion. He said very little, and I will give his remarks complete. Dr. Faraday said: "Twenty years ago he had directed his attention to this question, and from theoretical views he had been induced to hope for the successful employment of heated air as a motive power; but even then he saw enough to discourage his sanguine expectation, and he had, with some diffidence, ventured to express his conviction of the almost unconquerable practical difficulties surrounding the case, and of the fallacy of the presumed advantages of the regenerator. He still retained his doubts as to the success of the innovation, and feared the eventual results, even of Captain Ericsson's spirited and ingenious efforts." Brunel considered the use of the regenerator to be an entire fallacy, and did not believe that the power derived from the expansion of air by heat could be used effectively and then be recovered and used again. Mr. Hawksley considered that the machine involved a mechanical fallacy and that the regenerator produced no mechanical effect whatever. Mr. Rendel was the president at the meeting which dealt with Mr. Cheverton's paper, and, in view of the great difference of opinion on the subject, he stated that "he would not have the meeting arrive at a hasty or erroneous conclusion on the question of this engine, and he therefore suggested that Mr. Siemens should draw up a paper on the subject, and that the members should collect, for a future meeting, all the information within their reach, in order to bring about the calm and deliberate discussion of the question." This resulted in the further meeting of May 17, 1853, when papers were read by Manby, Leslie and Siemens. The paper by Manby consists of the summary of a discussion by M. Galy-Cazalet, which took place in Paris in 1853. M. Galy-Cazalet comes to the conclusion that the regenerator involves a fallacy, and he concludes: "There appears to be at present so much doubt of the utility of the regenerator that it would be wise to abandon its use for a time, and by trials with a more simple form of caloric engine establish the fact either of the superiority or of the inferiority of heated air in comparison with steam as a motive power." Mr. Leslie, on the contrary, in his paper upholds vigorously the accuracy of the principle of the regenerator or economizer. He comes to the conclusion that it is based on true principles and is attended in practice with real economy of heat, and consequently of fuel. In this conclusion he is doubtless correct; the regenerator is useful and does economize heat. But Leslie goes much further than this; he appears to support Stirling in the fallacy that the regenerator may be made indefinitely useful. Stirling states:

"And thus it appears that by applying air successively to a series of bodies regularly increasing in temperature, and moving alternately from one end of the series to the other, it may be heated and cooled ten times, with an expenditure of caloric which would barely have heated it once, if it had been applied at once, to the hottest body—*i. e.*, beyond the series. It is evident, also, that if the series had been composed of twenty points, or bodies, having a difference of temperature of five degrees, the air might be heated and cooled twenty times at no greater expense of caloric. Nay, it is evident that by multiplying the members of the series indefinitely air could be heated and expanded and made to do work at no appreciable expense. But let no mathematician be alarmed with the idea of a perpetual motion, or the creation of power. There are many enemies to contend with in the air engine besides friction, which alone prevents perpetuity in some mechanical motions. We have no means, without consuming a part of our power, of applying the air so closely to the apparatus as to make it absolutely assume the temperature of the bodies to which it is applied. There is, therefore, a loss in the very act of heating and cooling."

Leslie comes to the conclusion that Stirling is right, but that an air engine without a regenerator would be a much less effective and economical application of heat than the steam engine. Leslie gives some interesting particulars of the later air engines of James Stirling. He states that an engine of forty-five horse-power was started in March, 1843, at the Dundee Foundry; that in December, 1845—two years and nine months after starting—one air vessel gave way, and in May, 1846, another failed, and in January, 1847, a third failed. This information was supplied to him by David Mudie, one of the lessees of the foundry.

(To be concluded.)

Explosion of the Gas-Bag Balloon at the Franco-British Exposition.

At the investigation, in the Hammersmith's coroner's court, to discover the reason for the explosion of the Lovelace gas balloon which occurred at the Franco-British Exposition some weeks ago, interesting information, says the *Electrical Engineer*, London, September 11, concerning the liability of sparks from electrical connections was brought out. The airship was kept in a tent open at both ends and with two openings on each side for ventilation. The interior of the tent was illuminated by electric lamps. A continuous wire ran along the poles and incandescent lamps were suspended from this wire. The wires were conducted through the ground to prevent short-circuiting, and the additional precaution of using cutout plugs had been taken. The envelope of the balloon was seventy-five feet in length and sixteen feet in diameter, cylindrical, and had a net over it for the purpose of suspending the machinery. An electric fan was used to circulate the air in the bag when the gas had expanded through the heat of the sun and to expel the foul air from the tent. The condition of the bag was tested by blowing air in by means of the fan for the detection of the presence of holes. In his evidence before the coroner, the owner of the air-ship, Captain Lovelace, stated that after the explosion he had examined the electric fuses and also the cutout plugs, and they were all right. The fan was driven by means of a wire run to a lamp socket. There was a switch on the fan, and unless the fan were turned over there would be no sparking. The assistant balloonist, in his evidence, said that when the bag was about two-thirds full of hydrogen gas, and for the purpose of distending it, another assistant sat on the ground and held the neck of the bag over the electric fan. The flames from the burning balloon, rushing down the neck, set fire to his clothing. Another witness stated that he saw the balloon being filled by the electric fan. Expert witnesses testified that the electrical arrangements were excellent, and that sufficient precautions had been taken so that if the tent were blown down the current would have been shut off. The fan was of good make, and was of a kind that frequently sparked. There was sometimes a spark in the brushes, but there was always a small spark at the switching off. If there was dust in the fan there would be some likelihood of sparks. The spark, though very minute, if formed in an atmosphere of hydrogen and oxygen, would be sufficient to cause an explosion. The jury, after some deliberation, returned a verdict to the effect that the deaths were caused by burns through the accidental explosion of the gas bag due to the use of an electric fan for pumping air into it. It added a rider to the effect that it considered the use of the fan to have been dangerous under the circumstances.

Breakdown of Electrical Machinery.

The report of M. Longridge, chief engineer of the British Engine, Boiler and Electrical Insurance Company, always forms interesting reading, and from the abstract of this report, published in the *Electrician*, London, we have been pleased to extract the following paragraphs:

The rate of breakdown was 1 in 11.7 among steam engines and 1 in 11.1 among gas and oil engines, as compared with 1 in 8.1 and 1 in 12.4, respectively, last year. It is interesting to observe that in both types of engine the valves and valve gear are believed to have failed more frequently than any other part, and that whereas the percentages of failures due to this cause in the twenty-four years previous to 1906 were twenty-one per cent for steam engines and 32.5 per cent for gas and oil engines, these figures stand at twenty-eight and 43.3 per cent, respectively, for the year 1907. Also in the case of gas and oil engines the next highest percentage of failures—*viz.*, only 13.5 per cent—was attributed to cylinders and cylinder ends, thus showing apparently that the weak point of this type of engine is its valves.

The chief engineer's remarks on this subject are as follows:

"The increase in the number of breakdowns of steam engines traceable to failures of valve gears is probably the result of increase in speeds and number of parts. The reduction in the number of breakages from spur gearing is the natural consequence of the substitution of rope and direct driving for the older system of transmission. The steady increase in the number of broken cylinders and pistons is due principally to the use of steam at temperatures and pressures higher than the parts can safely bear. The reduction in the number of main shafts broken is remarkable and inexplicable.

"In gas and oil engines the increase in breakages of valves and valve gears is not satisfactory, and demands the serious attention of makers of these engines. If all side shafts were fitted with ring lubricators and levers made of wrought iron or good cast steel the percentage in the table would be reduced. The reduction in broken cylinders and pistons is encouraging and marks the progress which is being made. Connecting rods proved less destructive than usual, probably because of improvement in design, particularly as regards strength of bolts. Breakages of crank shafts were fewer than in 1906."

An increase is again reported in the electrical branch of the business, and the number of breakdowns of dynamos and motors in 1907 exceeded the number in 1906 by 18.1 per cent, so that insurance is proving a benefit to the users of electrical machinery. The rate of breakdown was rather lower among dynamos and rather higher among motors than in 1906. The exact figures are 1 in 18.7 among dynamos and 1 in 7.9 among motors. The corresponding figures for 1906 were 1 in 16 and 1 in 8.2. Again, as in 1906, the rate among continuous-current machines was much higher than among alternating, but, on the other hand, the average cost of each breakdown was much less, so that the company's practice of charging practically the same rates of premium for both types of machine is fully justified. The proportions in which the various parts of the machines are thought to have caused or initiated the breakdowns of 1907 are tabulated below:

Part Which is Believed to Have Failed First.	Dynamos. 1906. Per Cent.	Dynamos. 1907. Per Cent.	Motors. 1906. Per Cent.	Motors. 1907. Per Cent.
Armatures and rotors	50	35	44	38
Magnet coils and stators	11	7	14	14
Commutators and brush gear	20	34	28	30
Miscellaneous	19	24	14	18
	100	100	100	100

Starting Switches and Controllers.	1906. Per Cent.	1907. Per Cent.
Resistance coils	48	60
Contacts and switch arms	10	8
Automatic apparatus	17	18
Miscellaneous	25	19
	100	100

The causes of these breakdowns were probably as follows:

	Dynamos. Per Cent. 1906.	Dynamos. Per Cent. 1907.	Motors. Per Cent. 1906.	Motors. Per Cent. 1907.	Starters. Per Cent. 1906.	Starters. Per Cent. 1907.
Accidental	15	8	9	4	22	9
Dirt and neglect	14	25	19	28	11	16
Age and deterioration	21	23	25	23	23	27
Bad work or design	23	21	18	18	9	8
Overloading	0	0	2	1	7	5
Unascertained	27	23	27	26	28	35
	100	100	100	100	100	100

The following interesting and typical examples of breakdowns during the year have been selected from the report:

1. Protected three-phase, alternating-current fifty-horse-power motor, one year old, taking current at 500 volts and running at 750 revolutions per minute. The breakdown can be well described in the inspector's own words. "This motor," he says, "broke down and I examined it today. I found that six of the stator coils have been completely stripped and about fifteen of the rotor coils are badly damaged. I can only suppose that some foreign substance got into the machine when it was running and simply demolished all the coils which were in its path, for the case was full of small bits of copper. The rotor is damaged just in one place, and from the nature of the damage great force has been expended at that point, so I can only surmise that something has caught in the rotor winding and gone round the coils. As is frequent in such cases the driver of the machine swore that the current was switched off and the rotor at rest when the accident occurred, so he evidently knew more about it than he would tell, but I could get nothing further out of him." The motor, as stated above, was protected, but the inspector said it was quite possible for things capable of doing the damage to get in. There is little doubt that something did get in, but what it was was not, and probably will not be, discovered. There is no question of the rotor windings having been lifted by centrifugal force, as the binders were intact.

2. Four-pole, totally enclosed, series-wound eight-horse-power motor, two years old, driving a winch in a shipyard with current at 480 volts; speed, 700 revolutions per minute. The fuse, a No. 16 Standard Wire Gauge, tin wire, having melted, one of the company's inspectors was sent for to examine the motor. He found the solder all around the end connections of the armature conductors partly melted and, on taking out the armature, four coils were seen to be completely burnt out. Wedged into the space between two of the conductors and the end of the core was a piece of cinder which, no doubt, was the cause of the trouble. How it got there in an enclosed motor is a mystery. The only suggestion the writer can make is that the armature must have been set down upon it or rolled over it at some time when taken out and that movement of the conductors while the motor was running had caused it to rub through the cotton covering and short-circuit the coils.

3. Semi-enclosed, two-pole, centre-hung, shunt-wound two-and-one-quarter-horse-power continuous-current motor, taking current at 500 volts, and driving a fan in a smithy at a speed of 2,400 revolutions per minute. According to the statement of the attendant a belt of flame ran around the commutator when he started the motor. When he stopped it he found the remains of two rats wedged between the armature and the frame, but could discover no injury to the conductors. By testing, however, the company's inspector, who had been sent for, found a break in one of the end connections, close to the commutator, which had, no doubt, caused the sparking. Whether one of the rats was accountable for the breakage was uncertain.

4. Two-pole, totally enclosed, shunt-

wound, four-horse-power Lundell motor, taking current at 230 volts, and running at 1,100 revolutions per minute. The company's inspector was sent for because smoke was issuing from the joints of the carcass. He examined it, ran it, and tested the insulation without discovering any fault. He then had it opened and discovered that the smoke had come from the ignition of a quantity of oil, dust and dirt which had accumulated upon the bottom of the circular magnet coil by sparks from the brushes, and that the sparking had been caused by one of the carbon blocks getting jammed in its brush-holder. The insulation of the magnet coil was also slightly charred. This was patched up, the brush-gear put in order, and the motor cleaned and started. Since then it has given no further trouble. This is quite a typical case. Fires inside motors started by the ignition of collections of fluff and dust are not uncommon.

5. Four-pole, shunt-wound, semi-enclosed motor, about two years old, giving eighty horse-power at 500 revolutions per minute with continuous current at 500 volts, and protected by two No. 16 Standard Wire Gauge, copper wires fusing with 332 amperes, or two and one-half times the maximum current supposed to be carried by the machine. The fuse melted and, on examination, two of the armature coils were found burnt. The remaining coils were saturated with oil and very dirty. The insulation of the commutator segments was also burnt close to the spokes through oil and dust settling between the spokes and short-circuiting them. This insulation, instead of being carried up a short distance, say, one-quarter inch or so, between the spokes, ceased at the ends of the bars, leaving very narrow wedge-shaped openings between the edges of the spokes to hold oil and dust. The machine was so damaged by dirt and neglect that the armature had to be entirely rewound, and the commutator rebuilt and reinsulated. It was only accepted for insurance about eleven months previous to the breakdown, and was then in good condition. It seems, however, that it had then just had the benefit of a thorough repair in consequence of a similar breakdown at the end of its first year's work.

6. Two-pole, continuous-current, shunt-wound motor-transformer working in a substation of a lighting supply, receiving forty-four amperes at 1,080 volts and transforming to 110 volts. Normal speed, 470 revolutions per minute. When started from the central station on the evening of the breakdown the armature gained sufficient speed to break one of the steel binders at the high-tension end and spread the conductors until they jammed themselves fast between the pole-pieces. On examination it was found that one end of the shunt winding had slipped out of its terminal. One of the attendants who had cleaned the machine in the morning declared that the wire was then in place, and suggested that it must have been shaken out of the terminal by vibration when the machine was started. It is far more likely that he pulled it out with the duster or waste he was using, for the wire had simply been slipped under the binding screw, and not bent around or over the terminal block. The case is mentioned because the number of shunt wires broken or pulled out of their terminals proves that such wires ought to be better protected and more efficiently secured than they generally are.

7. Four-pole, compound-wound dynamo, three years old, giving ninety amperes at 250 volts when running at 850 revolutions per minute. The commutator contained 153 segments insulated, with one exception, by mica plates. The exception had micanite. The two coils in connection with this segment were burnt out and had to be replaced. The cause was a short-circuit across the micanite insulation, produced by carbon dust and oil which had penetrated into the micanite. The other segments were quite as dirty, but the mica plates between them had kept up the insulation. The company's experience undoubtedly is that pure mica is to be preferred to micanite or made-up mica for insulating commutator bars.

8. Seven-horse-power, three-phase motor of foreign manufacture driving the hoisting winch of an overhead crane with alternating current at 190 volts. The three leads to the slip-rings were fused. On examining the rotor it was found that the core plates had been treaded upon the shaft and a ring shrunk on at each end to hold them. There was no key or feather to prevent them turning. The conductors were led over the ends of the core through a hole in the shaft, which was hollow, and out at the end to the slip-rings. This hole had sharp edges and was not bushed with insulating material. The consequence was that the rotor got loose and rocked upon the shaft, rubbing the insulation of the leads where they entered the shaft and short-circuiting them.

9. Four-pole, shunt-wound, ventilated motor, seven horse-power, fourteen and one-half amperes, 400 volts, 1,000 revolutions per minute, driving machine tools. Fuse when insured, one No. 16 Standard Wire Gauge, tin wire, subsequently replaced by a cartridge "Mordey" fuse of twenty-five amperes. On receipt of a message by telephone that the motor had broken down an inspector was sent to examine it. He found that the armature had been taken out and sent to the maker's works, whither he followed it. There he found that two of the conductors were broken, one close to the commutator lug and the other so close to the core as to necessitate lifting the coil, and as this could not be done without lifting the other coils the repair meant rewinding the armature. He also learned that the makers had been sent for some months before on account of bad sparking, and had then warned the owner that the machine was overloaded. With this information the inspector went back to the owner's works as soon as the armature had been repaired and replaced, and measured the current required to run all the machinery which the motor drove. He found it to be twenty to twenty-one amperes. The owners then admitted that they had added some machines since the insurance was effected, and promised to make inquiries as to the price of an additional motor.

The Railway Signal Association.

The twelfth annual convention of the Railway Signal Association will be held at the New Willard Hotel, Washington, D. C., October 13, 14 and 15.

On October 13 sessions will be held at 10 A. M. and at 2 P. M. The morning session will be devoted to the president's address, the report of the secretary-treasurer, and reports of standing committees. The afternoon session will be devoted to considering amendments to the constitution, and papers on electric interlocking, mechanical interlocking and storage batteries.

On October 14 a session will be held at 9 A. M. to take up a discussion of signal practice, standard design, automatic stops and cab signals, and subjects and definitions.

On October 15 a session will be held at 9 A. M., taking up automatic blocks, rubber-covered wire and manual blocks. The selection of a place for the next annual meeting and the election of officers will be consummated at this session.

LETTERS TO THE EDITOR.

State Branches of the National Electric Light Association.

To the Editor of the Electrical Review:

The editorial in your issue of the nineteenth on the Pennsylvania Electric Association becoming a state branch of the National Electric Light Association I have no doubt was inspired by the best of motives, yet I feel it would form in some minds a wrong impression, and hasten to correct same.

One might gather from reading it that the scope of the state branches of the National Electric Light Association might be restricted, or the policies dictated, by the parent body. Such is not the case. All the individuality of the state association is retained. While all the members of the state branch will be necessarily members of the national association, on the other hand, any member of the national association can be refused admittance to, or expelled from, the state branch.

The centralizing of the clerical work has some economic value, but is of minor importance in affiliating with the national. The real advantage to the state branches will be the co-operation of their committees with those of the national; the use of the greater facilities for data and guidance in preparing papers and carrying on such work as needs influence and superior council. Besides, its acts will have greater prestige if backed up with all the power of the National Electric Light Association.

The national, on the other hand, gets a larger membership, and is fulfilling its mission more thoroughly by keeping closer in touch with the whole industry at large, by closing in a lot of loose ends, becoming the connecting link between all these associations, thus increasing both its power and prestige.

L. H. Conklin.

Connellsville, Pa., September 21.

[And this is exactly what we said, or thought we said. And we are glad to publish Mr. Conklin's letter, so that there will be no misunderstanding.—Ed.]

Symbols for Physical Quantities.

To the Editor of the Electrical Review:

Now that there has been some opportunity for discussing this question, may I be permitted to summarize the arguments that have been raised for and against the creation of new symbols?

The most common objection is, "They are like Chinese characters; we could never remember them." But there will be no necessity to remember them. How many of us can remember what symbol Rankine uses for kinetic energy? Is it not sufficient for us if we see it when we refer to his book? Every considerate writer to-day gives a list of the symbols he uses. If all writers used the same symbols we should soon become familiar with those with which we are most concerned, and for the rest, we could refer to the list just as at present.

Some objectors do not see why the letters we have at present are not sufficient. Let them try to make a list of symbols for the 200 physical quantities for which symbols are wanted. After they have made up a list to satisfy themselves (if such a thing is possible) let them try to convince some one else to adopt that list.

There are about twenty letters such as m for "mass" t for "time," etc., upon which there is almost universal agreement. One or two dozen more stand a fair chance of being agreed upon. Beyond these there is hopeless confusion, simply because all the good letters are exhausted.

As to the difficulty of printing new symbols, it is of interest to know that twenty-five of the leading technical journals of the world published an article containing five new symbols given as examples without any difficulty. Several of them have expressed the view that there is no difficulty from the printer's point of view. The types supplied to them—which, by the way, cost two cents for thirty—were all of one size, and yet each paper used for the text of the article its usual standard type. The publisher of the *Elektrotechnische Zeitschrift* thinks that there would be no difficulty in arranging with a type founder to make matrices, from which all printers could be supplied with type. Each printer would keep in stock those types which commonly occurred in his paper, and could get others on short notice. About thirty new symbols would be sufficient for articles on electrotechnical science.

Two papers have objected that the symbols can not be set up on a linotype machine. It is, however, usual at the present time to set up mathematical expressions by hand.

Several critics have pointed out that the new symbols should be simple and bold in outline, so that they can not be easily mistaken for one another. This, of course, is an important matter to bear in mind.

I agree with M. Galliott that the name of the symbol should be, where possible, the name of the physical unit represented. Where the name of the unit can not be employed, a word of one syllable might be chosen, as for instance, "stroke" for the length of a piston stroke.

Some critics say that the number of symbols required would be too great. As to that, we can make just as many as convenient. The symbol became universal almost as soon as it was printed. Let us have a few more as good as that one; we are badly in need of them.

Jules Walker.

Hale, Cheshire, England, September 19.

The Edison Rate Decision.

To the Editor of the Electrical Review:

In your editorial on the Edison Rate Decision, you say that the Massachusetts Gas and Electric Light Commission has gone squarely on record against the modified Wright demand system used by the company.

I do not interpret the decision this way at all. The recommendations of the board are three:

First, that the company should establish a maximum rate of twelve cents.

Second, that it should not make any special rates in the form of personal discounts.

Third, that it should not make any special rate to municipal customers, as such.

All the company's other rates are tacitly approved, though the hope is expressed that ultimately the maximum rate may be made low enough so that the various long-hour and wholesale discounts made by the company for various classes of service, may no longer be necessary.

The latter, as you will note, is what the lawyers call *obiter dictum,* as with most of the criticisms made by the board on the Wright demand system.

The board states that it is impossible to compute exactly the cost of supplying individual customers, and that it is desirable that all these costs should, for the small customer, be averaged into a uniform rate, but speaks with approval of the differential rates on the Wright demand and wholesale basis, as developing business that enables the rate to the small customer to be lower than it would be if these systems were not in use.

If you will look back through various other decisions of the board you will find that they have been along much the same line; that the board would like to see a uniform flat rate and has in many cases recommended a uniform flat rate as a maximum. Except when recommending a uniform flat rate, as a maximum, the board's remarks have invariably been *obiter dicta* and there are numerous cases on record where the board has clearly recommended differential rates, sometimes on the basis of wholesale and sometimes on the basis of long-hour.

It is obvious that this must be the case. For instance, the Boston arc lights are to-day being supplied at a price of approximately $120 a year for a use of approximately 2,000 kilowatt-hours a year.

On the basis of the twelve-cent rate as recommended by the board for the Boston Edison Company, the Boston Edison Company would be entitled to charge the city of Boston, approximately $240 per year per arc lamp. Can any one imagine the board endorsing such a price for street arc lamps in Boston, or justifying an order for a lower price on anything else than the principle of the Wright demand system?

BOSTON.

September 21.

A New Scale for Incandescent Lamp-Measuring Instruments.

The ingenuity which German manufacturers exercise in their efforts to develop the use of electric light is evidenced by a new scale put on the market by the firm of Nadir, Berlin, says *L'Electricien* (Paris). This scale makes it possible to read directly, in tenths of pfennigs (one pfennig equals one-quarter cent), or even in smaller fractions, the cost price per hour of operating any type of lamp. The same apparatus, which thus gives to the inexperienced consumer more tangible and definite information than any explanation regarding electrical units, also makes it possible to read the consumption in watts and amperes. The standard instrument is applicable to 220-volt circuits, where the current costs ten cents a kilowatt-hour.

Magnetic Club Anniversary.

The twentieth anniversary of the Magnetic Club will be celebrated at the regular fall dinner, to be held at the St. Denis Hotel, New York city, on November 18. On this occasion it is expected that delegates from the Telegraphers' Mutual Benefit Association will be in attendance as guests, as has been the custom for the past fifteen years.

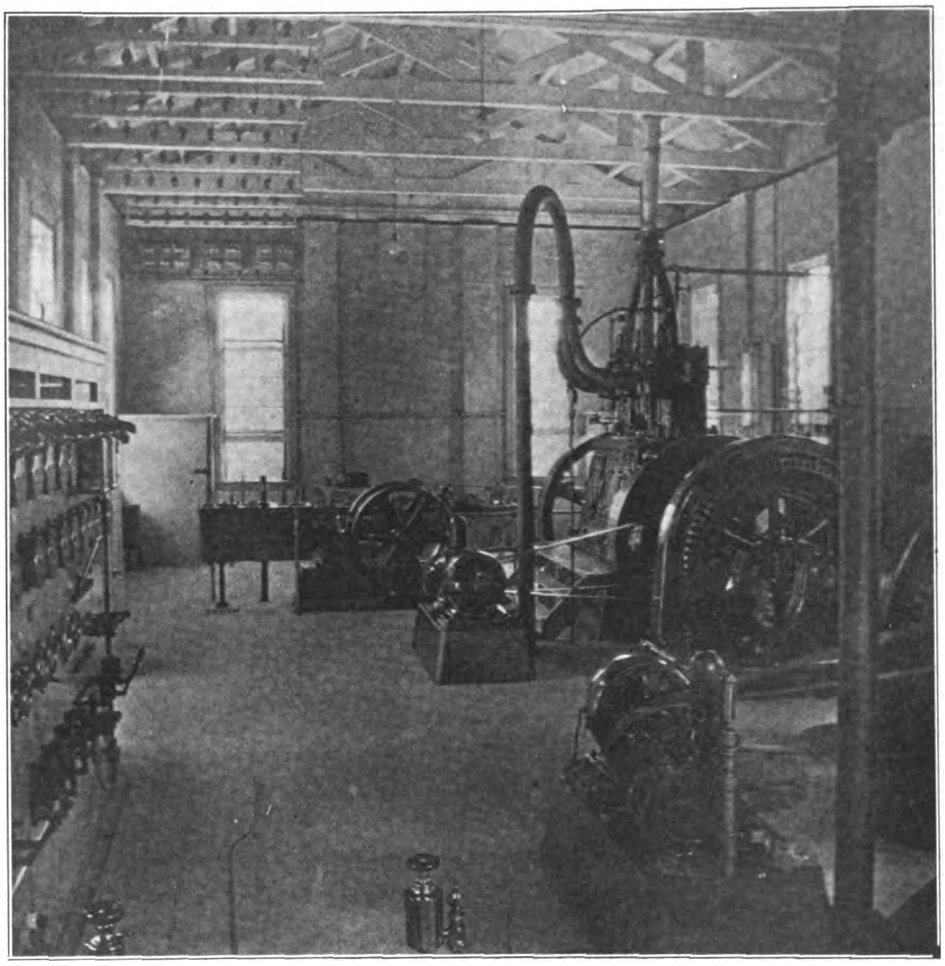
Electric Plant at Coeymans, N. Y.

The Atlantic Light and Power Company, Coeymans, N. Y., was organized in response to a popular demand for better lighting service than that formerly furnished by the Upper Hudson Electric Company. As a municipal plant was not legally possible, the leading citizens of Coeymans, Ravena and New Baltimore organized this company. It has so satisfactorily fulfilled its purpose as to very nearly drive its competitor from the field in these villages (about twelve to fourteen miles south of Albany), and has the moral support of the inhabitants of Coxsackie where the competing plant is located.

The Coeymans plant supplies street and commercial lighting in Coeymans, Ravena and New Baltimore, and lights the station and yards of the West Shore Railroad at Ravena. The street-lighting system consists of over two hundred forty-candle-power tungsten lamps on a series circuit, which are carried on a contract at $20 per lamp per year. The railroad uses twenty-one arcs and 200 incandescents on multiple circuits. The present commercial lighting load is about 200 tungsten lamps, which the company furnishes to consumers at cost, and about 1,500, fifteen-candle-power incandescents. The lighting rate is twelve cents per kilowatt-hour with a sliding scale of discounts.

The power service has not yet been developed as the plant has been in operation only since February 29, 1908. Preparation has been made on the switchboard, however, for a power circuit. The power rate will be from ten cents down to two and one-half cents per kilowatt-hour.

The power plant contains two duplicate eighty-five-kilovolt-ampere sets, making a total capacity of 170 kilovolt-amperes. It is intended, however, that only one set shall be used at a time, the other being kept as a spare. In case of an increase of the load beyond the capacity of one set, duplicate additional sets will be installed. This provision has secured many customers for the concern as it assures continuous service. The fact that the Crocker-Wheeler generators used are easily paralleled obviates the sudden fluctuations which were had with the old service when throwing the load from one generator to another.



ENGINE ROOM, ELECTRIC LIGHT PLANT, COEYMANS, N. Y.

The power-house consists of a brick and cement structure thirty-two feet by sixty-six feet and eighteen feet high at the eaves. The roof is of wood, covered with corrugated iron, and the floor of cement.

The generating sets consist of Crocker-Wheeler generators coupled direct to Diesel oil engines. The engines, each rated at 120 horse-power and having three cylinders, twelve inches by eighteen inches, were built by the American Diesel Engine Company, of New York. They burn crude oil, which is injected into the cylinders by means of compressed air at a pressure of 900 pounds. For this purpose each engine has belted to it an Ingersoll-Rand nine and one-quarter by three by ten two-stage compressor. Cooling water is circulated by a Pyramid four by five pump, belted to each set.

Two 7,500-gallon oil tanks are located about thirty feet from the building. These are buried in the clay soil to exclude water due to sweating. In addition a 10,000-gallon tank is provided at the railroad, from which the oil is carried to the storage tanks in a tank wagon.

A 14,000-gallon cooling tank is installed at the rear of the building. This is of wood, supported on a concrete foundation. The water is delivered as a spray at the top of a series of wooden steps down which it is allowed to drip to the tank.

The generators are thirty-two-pole, eighty-five-kilovolt-ampere, 2,300 - volt, two-phase, sixty-cycle machines, at 225 revolutions per minute. They were built by the Crocker-Wheeler Company, of Ampere, N. J., and are of the same general type as the larger machines built by the company, which operate particularly well in parallel with each other or with machines of other types. The winding of the revolving field consists of strip copper wound on edge, which affords radiating surface for each turn of the winding, thus insuring cool running. The ventilated type of core and housing also insures thorough circulation of air. The use of magnetic wedges in the core slots is a feature of these generators. It permits the use of form-wound and pre-insulated coils and solid pole-shoes.

The exciter belted to each generator is a Crocker-Wheeler Form I, 6.5 kilowatt, compound-wound generator, running at 1,100 revolutions per minute.

The switchboard is composed of six panels of blue Vermont marble, ninety inches high and with a total length of about twelve feet. The panels are Crocker-Wheeler type 12. The first two panels at the left are combined generator and exciter panels. The next two are feeder panels, each containing two single-phase circuits. Of these, one circuit is provided for commercial lighting in each of the villages of New Baltimore, Coeymans and Ravena, and the fourth circuit supplies the railroad lighting. Each of these circuits contains a Crocker-Wheeler single-phase feeder regulator, capable of regulating the voltage of the circuit ten per cent above or below the bus-bar voltage. The fifth panel contains three 150-light series incandescent systems for street lighting, with Wood regulators situated behind the board. Integrating wattmeters are provided on this panel, to check up the cost of the street and commercial lighting.

The pole line is of such height that the wires are suspended above the lines of the telegraph and telephone companies and above the lines of the old lighting company, some of which still remain. All lines are provided with lightning arresters at the switchboard, at the first pole and at various points along the lines. All guy wires are provided with strain insulators to protect pedestrians, and pole transformers are grounded. Street lamps are permanently suspended from the poles on six-foot and eight-foot arms of one-inch pipe, from the ends of which the lamps are insulated by means of glass petticoat insulators in Philadelphia fixtures, with General Electric sockets and receptacles.

The cost of fuel and lubricant for the engines is very low, not exceeding forty gallons of fuel and one and one-half gallons of lubricant per day; the station output being about sixty horse-power for ten hours and very light for the other fourteen hours.

The president of the company is John N. Briggs, of Coeymans, and the consulting engineer for the plant is H. B. Sweet, of Utica, N. Y.

BOOK REVIEW.

"Electrical Contracting." Louis J. Auerbacher. New York. McGraw Publishing Company. Cloth. 156 pages. 5½ by 8½ inches. Illustrated. Furnished by the Electrical Review for $2.

In this book the author has gathered together a goodly amount of very practical information, especially for the wireman and contractor. While it is a good thing to be possessed of considerable technical information in undertaking to carry out the work on the excellent lines which the author has laid down, the instruction is given in so clear and lucid a manner that the book will be found of great value to the man on the street who is desirous of making a minor installation. Mr. Auerbacher has had a great deal of experience in the field as a workman, foreman and employer, and his capability is reflected in the presentation which he has made in the present volume.

Meeting of the American Association of Electric Motor Manufacturers.

The fall meeting of the American Association of Electric Motor Manufacturers took place at Frontenac, Thousand Islands, N. Y., September 9, 10 and 11. During the meeting the following papers were presented, with a view to bringing forth discussion, thus enabling the various committees to incorporate in their reports recommendations for the adoption of uniform practices in the manufacture of electric motors, to the end that the highest quality of electric motors may be manufactured by the members of this association:

"Ratings and Guarantees on Direct-Current Motors," by J. M. Hipple. Presented by W. T. Hensley.

"Ratings and Guarantees on Alternating-Current Motors," by C. S. Reno.

"Ratings and Guarantees on Variable-Speed Motors for Elevator Service," by W. J. Warder, Jr.

"Freight Traffic," by W. B. Everest.

The various committees appointed at the former meeting have collected considerable information of value for dissemination among the members of the association.

At this meeting W. H. Tapley was regularly installed as the permanent secretary of the association, J. C. McQuiston, who has acted as temporary secretary since the formation of the association, retiring.

The association has provided permanent headquarters in the Engineering Societies Building, 29 West Thirty-ninth street, New York.

The next meeting will be held about the middle of January, 1909.

A considerable amount of business was transacted during the three days of the meeting, but time was found, however, on Thursday afternoon, September 10, for recreation, there being three contests: one for golfing, one for bowling, and the third for fishing. The golfing trophy, a cup, was won by Charles Robbins, of Pittsburg; the bowling prize, a silver cup, was won by W. S. Kemp, of Brookline, Mass. The prize for the largest fish caught—a rod, line and reel—was captured by F. M. Kimball, of Boston.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

MEXICAN TELEGRAPH COMPANY.

The Mexican Telegraph Company reports for the quarter ended September 30 (partly estimated) as follows: Traffic receipts, $160,000; operating expenses, $42,000; net earnings. $118,000; interest accrued, $26,000; total income, $144,000; less Mexican Government's proportion of earnings for current quarter, $7,500; balance, $136,500; to provide for October dividend, $71,752; surplus, $64,748; previous surplus, $2,559,850; total surplus, $2,624,598.

CENTRAL & SOUTH AMERICAN TELEGRAPH COMPANY.

The Central & South American Telegraph Company reports for the quarter ended September 30 (partly estimated) as follows: Traffic receipts, $365,000; operating expenses, $165,000; net earnings, $200,000; interest accrued, $4,500; total income, $204,500; amount required for October dividend, $143,565; surplus, $60,935; previous surplus, $1,279,133; total surplus, $1,340,068.

BROOKLYN RAPID TRANSIT.

Gross earnings of the Brooklyn Rapid Transit Company since the beginning of the new fiscal year on July 1, show a decline of between six and seven per cent compared with the same period last year. Comparison is being made, however, with record-breaking earnings, the September quarter in 1907 being the biggest in the company's history. Practically all of the falling off in gross has been in beach traffic, upon which the company has never been able to make any show of net earnings, so that net earnings for the current quarter are not likely to fall materially behind those of last year.

MINNEAPOLIS GENERAL ELECTRIC COMPANY.

The report of the Minneapolis (Minn.) General Electric Company for the month of July and twelve months ended July 31, is as follows: July gross, $73,889; expenses, $32,025; July net, $41,864; charges and taxes, $32,400; July surplus, $9,464, as compared with $10,666 for July, 1907. Twelve months' gross, $961,506; expenses, $435,638; twelve months' net, $525,868; charges, $354,422; twelve months' surplus, $171,446, as against $219,518 for the preceding year.

SEATTLE ELECTRIC COMPANY.

The Seattle Electric Company, of Seattle, Wash., reports as follows for the month of July and twelve months ended July 31: July gross, $366,481; expenses, $209,950; July net, $156,531; charges and taxes, $87,515; balance, $69,016; sinking fund, $7,344; surplus, $61,672, as compared with $77,205 for the same period of 1907. Twelve months' gross, $4,381,787; expenses, $2,592,139; twelve months' net, $1,789,648; charges and taxes, $944,087; balance, $845,561; sinking fund, $88,451; surplus, $757,110, against $784,517 for the preceding year.

GALVESTON-HOUSTON ELECTRIC COMPANY.

The report of the Galveston-Houston (Tex.) Electric Company for the month of July and twelve months ended July 31, shows as follows: July gross, $93,374; expenses, $52,004; July net, $41,370; charges and taxes, $17,476; balance, $23,894; sinking fund, $2,609; July surplus, $21,285, compared with $26,968 for July, 1907. Twelve months' gross, $1,063,622; expenses, $624,497; twelve months' net, $439,125; charges and taxes, $208,063; balance, $231,062; sinking fund, $31,305; twelve months' surplus, $199,757. This compares with a surplus of $190,796 for the preceding year.

RAILWAYS COMPANY GENERAL.

The Railways Company General (New York) annual report for the fiscal year ended June 30, 1908, is as follows: Total income, $167,071; net profit, $5,679; previous surplus, $280,203; net surplus, $285,882, comparing with $280,203 for the preceding year.

The balance sheet as of June 30, 1908, is as follows: Assets—Cash, $37,874; due from subsidiary companies, $292; bonds of subsidiary companies and capital stock subsidiary companies, $675,754; other securities owned, $155,818; furniture, fixtures and sundry securities, $507; notes receivable, $128,136; total, $998,382. Liabilities—Capital stock, $700,000; accounts receivable, $12,500; net surplus, $285,883.

President T. D. Rhodes says: "While the showing would seem to compare unfavorably with that of previous years the board feels that under the financial conditions prevailing during the period covered, the company is most fortunate in the actual returns made."

TOLEDO RAILWAYS AND LIGHT.

The Toledo (Ohio) Railways and Light Company's report for August and eight months compares as follows: August gross, $212,318; expenses, $113,811; August net, $98,449; other income, $136; total income, $98,585; charges and taxes, $71,879; August surplus, $26,706, comparing with $34,930 for August, 1907. Eight months' gross, $1,641,930; expenses, $907,923; eight months' net, $734,007; other income, $3,011; total income, $737,018; charges and taxes, $563,766; eight months' surplus, $173,252, as against $198,248 for 1907.

NORTHWESTERN ELEVATED RAILROAD.

The Northwestern Elevated Railroad Company's report for the year ended June 30 shows as follows: Gross, $2,463,188; expenses, $965,118; net, $1,498,070; charges, taxes, etc., $1,147,183; surplus, $350,887, which compares with $347,578 in 1907 and $280,499 in 1906, and is equal to seven per cent earned on the $5,000,000 preferred stock. The rate of operating expenses to earnings (excluding loop net earnings) was 50.22 per cent. The ratio of operating expenses, loop account and taxes to earnings (excluding loop net earnings) was 66.64 per cent. President Starring, of the Northwestern Elevated, tells of the satisfactory purchase of forty coaches now in service and twenty combination motor-cars ordered from the Pullman Company for this fall's delivery. The company's total capacity is 28,800 horse-power, or sixty-seven per cent increase. The Ravenswood extension is completed and a satisfactory contract made with the St. Paul, under Chicago and Evanston ordinances, to operate the Evanston division for thirty-seven years. The Sunday business shows big gains. Total passengers carried for the year numbered 37,419,286, a daily average of 102,238. The average daily increase was 17,245, or 20.29 per cent.

Galvanic Battery.

A recent patent, says *Centralblatt für Accumulatoren und Galvanotechnik*, was issued for a galvanic battery in which an increase of capacity and a decrease of internal resistance is attained by replacing the negative electrode by metal shavings placed in closest proximity to the positive electrode. The latter is surrounded in the usual way by a layer of powdered or kerneled material for depolarization. A ring of zinc with a zinc strip, forming the pole, is embedded in zinc shavings. The battery is filled with a solution of NaCl, which furnishes in the chemical process a soluble zinc salt, so that a bright metal surface is always maintained.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Copper Production and Industry in Russia.

The copper production of Russia in the year 1907 amounted to 962,354 poods (one pood being equal to thirty-six pounds) and was greater than that of any preceding year. In 1906 the production was 639,000 poods.

The increase was principally brought about by the mines in the Urals, which almost doubled their output; in fact, from 260,288 poods in 1906 it rose to 436,918 poods in 1907. The next largest producers were the mines in the Altai and Caucasus Mountains and in the Kirghese steppes.

Taking into account the import, the consumption of copper in Russia during 1907 may be estimated as 1,122,000 poods. The price fell continually during the whole year; from twenty-three rubles a pood (for copper ingots) at the beginning of January it descended to fourteen rubles in December.—*Translated and abstracted from L'Elettricista (Rome), August 1.*

Thomshavn to Lokken Electric Railway.

The first single-phase line in Norway, running between Thomshavn and Lokken, is described by A. C. Kelly. The railway is situated about twenty miles west of Trondhjem, from which town a steamer now runs twice daily in connection with the railway. The line runs inland a distance of about seventeen miles. The water-power station is located at Skjenald Fossen. This station supplies power for lighting to Thomshavn and the villages on the line of the railway, to the mining machinery at Lokken, and to the railway itself. The railway load is supplied from a substation at Thomshavn, which contains a motor-generator plant for transforming the 15,000-volt, fifty-cycle, three-phase supply to 6,600-volt, twenty-five-cycle, single-phase current, which is delivered direct to the overhead trolley wire. The Westinghouse single catenary system of trolley suspension is employed, carried on bracket arms on wooden poles. The rolling stock at present consists of three locomotives, one saloon motor-car, four passenger vehicles and twenty-one freight vehicles. Each locomotive weighs twenty tons and carries four motors mounted on two bogies. The high-tension current is collected by a pantograph bow collector mounted on the roof of the locomotive, and passes by an insulated cable to an automatic circuit-breaker, and then to the transformer, which is suspended inside of the cab. The whole of the high-tension apparatus is enclosed in an earthed metal screen. Several tappings are brought out from the low-tension end of the transformer and are connected to the two hand controllers, one at each end of the cab. The four motors are arranged permanently in two groups, with two motors in series in each group. The motors are of the Westinghouse single-phase, series-compensated type, having a rating of forty horse-power for one hour. The pinions have fourteen teeth, and the gear wheels seventy-six teeth, the diameter of the driving wheels being thirty-three inches. The locomotives are capable of exerting a tractive effort of 6,500 pounds at ten miles per hour and a maximum tractive effort at starting of 8,000 pounds. The saloon motor-car, which has been provided for the use of the directors of the company, is a fine specimen of the car-builders' art. It is thirty-nine feet four inches over the headstocks, and eight feet six inches wide at the waist rail, and weighs, in running order, 22.8 tons. The interior is divided into a vestibule and driver's compartment at each end, and two saloon compartments, separated from each other by a short passage, from which a lavatory opens. One saloon compartment is provided with a writing table and swinging arm-chair, and the other is furnished with cross-seats and a central gangway. The body is framed with oak and sheathed with teak. The floor has been made as sound-proof as possible. The body is carried on a substantial underframe of rolled steel which, in turn, is supported by two swing bolster trucks. One of these trucks is equipped with two forty-horse-power motors similar to those used on the locomotives. The interior of the car is upholstered throughout in crimson buffalo hide, the woodwork being of special figured oak. The ceiling is covered with panels of artistic design relieved by narrow gold lines and delicately tinted border. The floor, which is made up of two thicknesses of tongued pine, is covered with felt and cork carpet, on top of which is laid a heavy Axminster carpet. Electric heaters and electric lighting are, of course, provided throughout the car. The car was built by the United Electric Car Company, Limited, of Preston, England.—*Abstracted from the Tramway and Railway World (London), September 3.*

A New Variable-Speed Single-Phase Motor with High Starting Torque.

A modification of the repulsion type of single-phase commutator motor has been developed by H. C. E. Jacoby for fulfilling the requirements where a motor has to have a variable speed, together with a high starting torque. In this motor commutation difficulties are reduced to a minimum by eliminating, in a simple manner, the chief source of commutator troubles inherent with this type of motor. When an ordinary continuous-current winding connected to a commutator is employed in alternating-current work the coil undergoing commutation is in such a position that it encloses the whole magnetic flux, which, being alternating in character, introduces a considerable electromotive force in the short-circuited coil. This electromotive force is out of phase with the main rotor current and causes large surging currents to flow in the coil. Attempts have been made to reduce this short-circuit current by inserting resistances between the windings and commutator bars. In order to obtain sparkless commutation it is necessary that an electromotive force shall be provided in the short-circuited coil of just sufficient value to reverse the current. This is generally done in continuous-current motors by the use of carbon brushes, which, by introducing a gradually increasing contact resistance at the leaving bar, produce a drop of potential across the contact. By a suitable choice of carbons and constants excellent results are secured. In the new motor the rotor winding is so arranged that the coil short-circuited by the brush encloses little or no magnetic flux—that is, it is parallel to the transformer flux. The consequence is that commutation is brought under similar conditions as obtain in continuous-current motors. This is accomplished, furthermore, without complicated connections. The rotor coils are wound across a particular fractional pitch, and the brushes are placed in a position so that the short-circuited coils are parallel to the transformer flux. With this arrangement there are zones on the rotor in which the current flows in opposing directions in adjacent wires. At first sight it would appear that this method of winding would result in considerable loss of torque, and if it were employed on a continuous-current motor the resulting torque with equal currents would be less than half what it would be with an ordinary winding. In this case, however, it is claimed that this mode of winding actually increases the resulting torque. In the first case, by eliminating the heavy currents in the short-circuited coils, a troublesome source of back torque is eliminated. The effects of the currents in the rotor conductors causes a displacement in phase of the magnetic flux in a portion only of the polar face, and to obtain the best results it is necessary that the coils doing motor work should be designed with shortened step to suit this. It is claimed that with this winding equally good commutation is obtained with any brush position between maximum and minimum torque. This makes it possible to govern the speed of the motor by shifting the brush position only. The fact that the friction of the brushes causes the brush rocker to tend to revolve in the direction of rotation makes it necessary to exert only sufficient force to overcome the friction of the brushes, and the slightest deviation from this amount causes the brushes to advance or recede. It is stated that tests taken on a five-horse-power motor at 900 revolutions per minute, on a single-phase circuit, operating at 200 volts, fifty cycles, showed the machine to have a full-load efficiency of eighty-five per cent, and a half-load efficiency of seventy-seven per cent; a power-factor of 0.85, and a starting torque of one pound per 100 volt-amperes at one foot radius.—*Abstracted from Electrical Engineering (London), September* 10.

A Rotary Converter for 2,000 Amperes.

The rotary converter does not enjoy the same favor in Europe as in America; nevertheless it is superior to the motor-generator from the triple point of view of efficiency, expense of maintenance and cost price. On the other hand, it possesses the advantages and disadvantages of synchronous motors without, however, quite equaling the latter in regard to the increase of the power-factor by the over-excitation of the electromagnets. The almost general adoption of a frequency of fifty periods per second in alternating-current lines, which is a little high for a rotary converter, is perhaps the reason for the limited success of these machines. However, in view of the scarcity of actual applications, the details of two identical rotary converters installed recently by the Felten-Guilleaume-Lahmeyer Company in the works of the Chemische Industrie Gesellschaft may be of interest. These two machines, each of 800 kilowatts, have eight poles and a regular velocity of 750 revolutions per minute, which corresponds to a frequency of fifty periods per second. They are fed by three-phase, alternating-current at seventy to eighty volts, and deliver on the direct-current side 2,000 amperes at 110 volts. The movable secondary is 310 millimetres in length and 700 millimetres in diameter. The continuous current is collected by eight rows of six brushes bearing on a commutator 450 millimetres in diameter and 400 millimetres in width, consisting of 168 segments. The position of the brushes is regulated once for all, as the machine works without sparking under all loads. The arrangement for supplying current on the alternating side consists of three copper rings, 100 millimetres wide and 400 millimetres in diameter, on each of which bear nine pairs of brushes. The winding of the secondary is comprised of 168 coils arranged in slots containing four conductors each. The stationary indicator carries eight poles with massive extensions, which are the seat of parasitic currents, having the effect of killing the pendulum movement (pumping) when the converters work in parallel. This construction is simpler and cheaper and just as effective as providing the laminated pole-pieces with compensating windings. It need scarcely be stated that the pole extensions are ventilated in order to prevent overheating. Two cylindrical frames surround the machine completely. Its ventilation and cooling are assured by a ring of vanes fastened on the shaft between the collector rings and the secondary. Fresh air is drawn in at the height of the rings, traverses the converter and is finally blown out over the commutator and brushes. It is well known that, although it is not impossible to start the converter by the alternating current, it is undesirable to do so on account of the heavy flow of current thereby produced, and for this reason an auxiliary asynchronous motor of fifteen horse-power has been arranged at the end of the shaft for starting the machine. It has only six poles, in order to be able to bring the converter to the speed of synchronism in spite of the slip, and is itself started by means of a regulatable resistance in the primary circuit fed by three-phase current at 220 volts from a special transformer.—*Translated and abstracted from L'Electricien (Paris), September* 12.

The Senlecq-Tival Method of Phototelegraphy.

A method of transmitting photographs to a distance has been introduced by Messrs. Senlecq and Tival. This method is distinguished from those of Korn, Carbonelle and Belin by the fact that the actual transmission is a matter of a few seconds instead of thirty or more minutes. The Senlecq-Tival process starts with a bichromate gelatine photograph. This is impregnated with a metallic powder in such a way that the variations of light and shade in the picture correspond with variations in electric resistance of the conducting surface of the picture. A variable resistance is made to cause the current from a constant pressure local battery to vary. These current variations are recorded magnetically on a steel wire, as in a telegraphone. The magnetic record can then be stored away for any desired length of time, and can be employed to reproduce the current variations in a suitable circuit when required. The speed at which the magnetic picture on the steel wire can be transmitted is considerably greater than that at which it can be impressed on the wire in the first case. The receiving instrument consists essentially of a sensitive galvanometer, the deflections of which are magnified by a lever arrangement. The galvanometer actuates a small, thin film screen, which is shaded off from complete opacity to complete transparency by a microphotographic process. In this way the light falling on a rotating disc from a Nernst lamp is varied in intensity in accordance with the deflection of the galvanometer. The disc through which the light passes is perforated with holes lying on a spiral and running from the edge of the disc toward the centre. If the disc in the receiving station rotates synchronously with the telephone drum in the transmitting station, the variations in illumination finally received on a photographic plate correspond with those in the original photograph. It is not stated whether any actual working results have been obtained with this process. It is claimed, however, that if it were possible to reduce the time of transmission to, say, one-tenth of a second, owing to the persistence of vision it would be possible to dispense with the photographic fixing of the received picture, and to view the picture direct on the screen while it was being produced by the rapidly moving spot.—*Abstracted from the Electrical Review (London), September* 7.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Moloney Variable-Voltage Transformer.

The accompanying illustration shows a practical variable-voltage transformer manufactured by the Moloney Electric Company, St. Louis, Mo. This instrument fills a long-felt want in the electrical world, and was designed to meet the demands for a transformer of this kind. The transformer has two rotary dials, one of which increases or decreases the voltage in ten-volt steps. The other dial increases or decreases the voltage in one-volt steps. With this arrangement any voltage from one volt to 150 volts can be secured in one-volt steps.

This type of transformer can be used on the primary (low-tension side) of a high-tension transformer, and will give an increase or decrease of voltage on the high-tension secondary according to the ratio of the high-tension transformer.

Moloney Variable-Voltage Transformer.

This type of variable-voltage transformer is now being used by the largest laboratories in the country, and is a necessary auxiliary to the equipment of every central station using alternating current. It is an almost indispensable aid in properly testing lamps, transformers, meters, cables, etc.

The Columbia Meter.

The Columbia Meter Company, Indianapolis, Ind., has placed on the market an integrating wattmeter, an illustration of which is shown herewith. This meter is of the motor class, being equipped with commutator and brushes. All parts are made by tools, rendering each interchangeable, and giving a light, stiff construction and a good appearance to the meter. The armature is of the open-coil type, having three coils of the same size and shape, symmetrically arranged around the shaft and connected with a three-part commutator. The full current flows through the coils, giving the full effect of the shunt current.

Owing to the small number of commutator segments, a considerable reduction of commutator diameter and brush friction is secured.

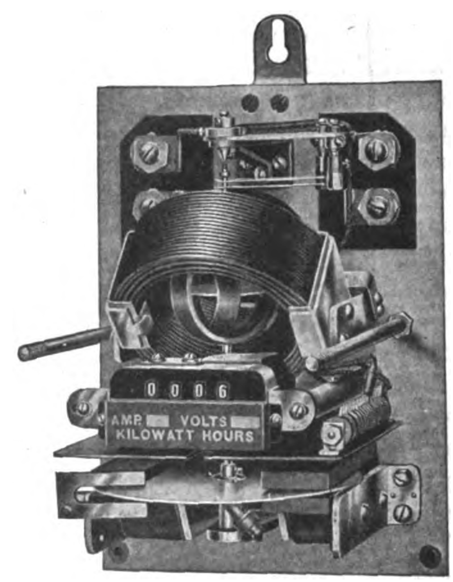
The meter has one series coil, which is placed in an inclined relation with the armature, giving a symmetrical proportion and design. The shunt resistance is a small spool on one side of the meter, easy of inspection and accessible for adjustment or repair. The shunt loss is about two watts at 100 volts.

The two damping magnets are placed at the bottom of the meter, and are interchangeable, and may be taken off and replaced in a few seconds, always going back in the same position. The damping magnets are not moved in calibrating, but a light and easily adjustable armature regulates the damping by shunting more or less of the magnetic flux around the disc. These magnets are protected by a light iron shield between them and the series coil.

The meter is provided with cyclometer counting register, reading in direct kilowatt-hours. The compensating coil is stationary and is regulated by a small rheostat on one side of the meter. The meter has a removable pivot of a grade of steel which experiment has proved to affect the jewel very slightly.

The brushes are of wire, and the brush-holders are easily detachable and in a position for easy inspection and adjustment.

In order that the meter may be sensitive and accurate on low load, it is overcompensated by the compounding coil, made to run fast on low load. If an accuracy of three per cent is desired on fifty watts, the meter is adjusted three per cent fast, thus giving the necessary accuracy as desired. When in service, as the friction increases by long-continued use, the meter will correct itself to a certain extent and show a better agreement between the constants at high and low loads. The adjustment is made by an iron screw, which is magnetized by contact with one of the damping magnets. Three iron studs, fastened to the damping disc, are attracted more or less by the magnetized iron screw. If the screw is adjusted so that a balance is obtained between the rotation of the disc by pressure only, when over-compensated, and the attraction of the magnetized iron screw and studs on the disc is effective, the meter will not rotate, but will start on the smallest load put on it, depending on the adjustment of the screw. This leaves the meter in a very sensitive condition.



Type A.B. Columbia Meter, High-Torque Form for Large Sizes Only.

With the meter so adjusted, it will run fast on low load, and this over-speed can be made of any percentage by the screw adjustment.

Foreign Trade Opportunities.

The Bureau of Manufactures, Washington, D. C., announces the following foreign trade opportunities:

Bids will be received until November 2, by the Direccion General de los Ferrocarriles del Estado, San Eugenio, Chile, for the supply of three 300-kilowatt generators and other equipment for a 900-kilowatt station.

The Ministry of the Interior, Cairo, Egypt, will receive bids until October 29 for the necessary equipment for the installation of electric light in the town of Zagazig. A guaranty equal to ten per cent of the amount of the bid will be required.

The Directoria Gerál de Obras e Viação, Rio de Janeiro, Brazil, will receive bids until October 14 for the supply of material and for construction work upon the Oeste de Minas Railway. In addition to the railway construction work there will be the erection of buildings and offices and the installation of the telegraph line, and the supply of machinery, motors, turntables, etc. A deposit will be required with tenders on this project.

A New Twenty-five-Watt Tungsten Lamp.

The accompanying illustration shows the latest addition to the line of tungsten incandescent lamps for standard lighting circuits (100 to 125 volts) that is being placed on the market by the General Electric Company. This is a twenty-five-watt, one to one-and-one-quarter-watts-per-candle lamp made in a practically identical bulb to that used for the ordinary sixteen-candle-power carbon lamp. The illustration shows the exact size of the lamp, which has the same diameter and base and approximately the same length as the familiar sixteen-candle-power unit.

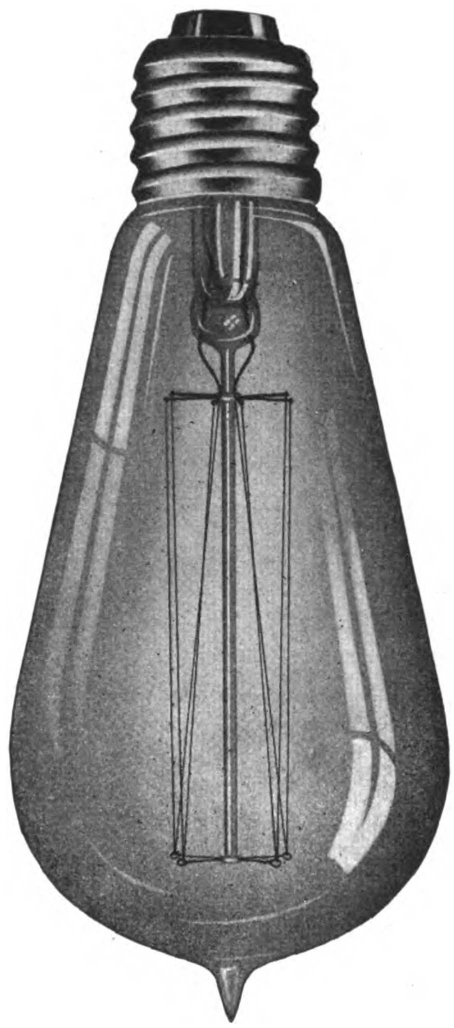
This lamp will burn in any position and its size adapts it for use in any shade or fixture suitable for the sixteen-candle-power carbon lamp. It can be substituted, therefore, lamp for lamp, in all present installations.

At one and one-quarter watts per candle the twenty-five-watt lamp gives twenty candle-power or twenty-five per cent more light than the ordinary sixteen-candle-power lamp. The energy consumed is one-half that of the best sixteen-candle-power carbon lamp and considerably less than one-half the energy consumed by a sixteen-candle-power carbon lamp of similar life—800 hours.

The General Electric Company, as previously announced, has been greatly increasing its manufacturing facilities and is now prepared to manufacture this lamp, together with the forty, sixty, 100 and 250-watt lamps, at the rate of 35,000 lamps total output per day.

Ample stocks of the larger lamps are carried at the main lamp sales office in Harrison, N. J., and at the various local sales offices throughout the country. The stock of the new twenty-five-watt tungsten is at present somewhat limited, but the factory capacity is ample to maintain a reasonable delivery on all ordinary orders.

As the lamp will burn in any position and can be substituted in the regular course of renewals, it will undoubtedly find a large market among isolated plants with the accompanying saving in the coal bill and the opportunity of doubling the number of units and nearly trebling the candle-power with the same equipment.



Twenty-five-Watt Tungsten Lamp.

It should also be gradually introduced on the circuits of central stations as rapidly as customers can be educated to appreciate its advantages.

Standard Tungsten Low-Voltage Lamps for Battery Service, and Tungsten Miniature Lamps.

The Buckeye Electric Company, Cleveland, Ohio, has developed a line of standard tungsten low-voltage lamps for battery service and tungsten miniature lamps for industrial and decorative service. The advantages of these lamps over the carbon-filament types of miniature and low-voltage lamps are not generally understood. About sixteen types are now standardized and the line is rapidly being increased.

These low-voltage tungsten-filament lamps are peculiarly adaptable to automobile and motor-boat service. They are safer, cleaner, more economical and operate more conveniently than either oil or gas lamps, which have had a monopoly of this field. A number of automobiles equipped with the new lamps have demonstrated that the latter give a large volume of light just where illumination is most needed. They are being used with great satisfaction for headlights, side lights and tail lights. These lamps are operated on ignition storage batteries, on low-tension ignition magnetoes or ignition generators. There is very little cost involved in changing over from the gas lamps or oil lamps to the use of the electric lamps. The lamps are used with special parabolic reflectors, which will give any required distribution.

For automobile and motor-boat work the six-volt lamp is generally the standard. Four-volt and eight-volt lamps are giving satisfaction, and these lamps can be secured in sizes ranging from two to twenty-four candle-power. The lamps operate at approximately one watt per candle.

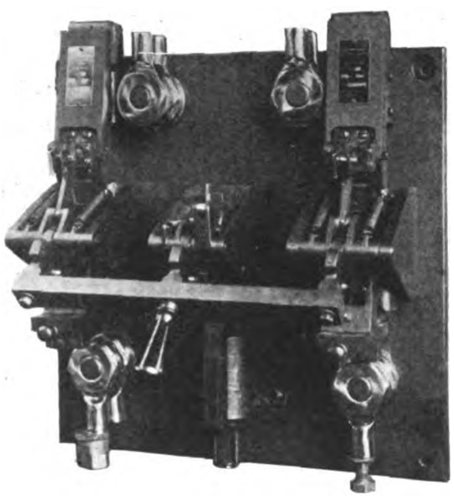
These lamps are also adaptable to train-lighting service, and effect a saving of two-thirds of the current, the best results being obtained with lamps operating on thirty-volt circuits. The breakage is not any greater than that involved with carbon-filament lamps when the thirty-volt sizes are used. Train-lighting lamps are being designed in various types in sizes from twelve to forty-eight candle-power, and in bulbs from one and one-half inches in diameter to three inches in diameter, operating at from one to one and one-quarter watts per candle.

For dental and medical use the low-candle-power miniature tungsten lamps present an entirely new outlook to the operator. It will be hard to secure a better proposition for the dentist or medical practitioner, as these lamps may be operated on dry batteries or small storage batteries, and burn approximately three times as long on a dry battery as a carbon lamp of equal candle-power. The tungsten lamps also operating at lower temperature are decidedly advantageous in dental and medical work.

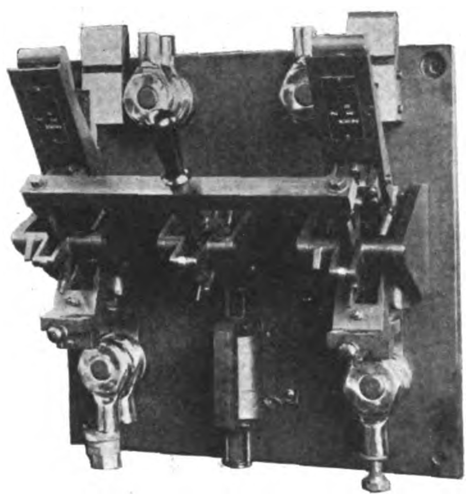
The tungsten miniature lamps, especially in the low-voltage forms, are adaptable to, and will be largely used for, pocket flashlights, for decorative theatrical work, and for Christmas-tree decorations and other novelties.

Special Application of Standard Circuit-Breakers.

In the development of new applications of machinery of various kinds conditions often arise which call for special apparatus or certain applications of old apparatus. Standard apparatus, if properly designed, can be readily adapted to suit these special conditions, with slight changes, and the better the design the more special applications it will fit in on. A notable example of this is shown in a recent application of circuit-breakers, illustrations of which are shown herewith. In this case a large mining company desired a circuit-breaker which would open the circuit of a motor on overload, which could also be opened from a distance by the operator at the machine and which could absolutely be held open by the operator at the machine regardless of the man in charge of the motor. Inasmuch as an absolute interlocking of the machinery was necessary, no chances could be taken of the motor being started when men were working about it.



Circuit-Breaker in Closed Position.



Circuit-Breaker in Open Position.

The illustrations show this breaker in the open and closed positions and illustrate clearly the flexibility of the standard design of the type "CC" circuit-breaker, manufactured by the Westinghouse Electric and Manufacturing Company. This breaker consists of two single-pole breakers and a dummy pole, all closed by the same handle. Each of the single-pole breakers is equipped with an overload coil and the operation of either overload coil opens the breaker, as in the standard type "CC" design. In addition, the breakers can be instantly opened by throwing the handle up. This is a regular feature in the standard design.

In addition to these two overload coils there is placed on the dummy pole a shunt-tripping coil suitable to be left in circuit continuously. Upon closing the circuit through this shunt-closing coil, the middle pole is tripped out and this in turn trips out both of the active poles, thus opening the breaker. In addition to this the handle is locked down by an auxiliary latch in such a way that it can not be closed down until current is taken off the shunt-tripping coil, allowing the core to drop. It is thus impossible for any one to close the circuit-breaker so long as this coil is energized.

In the particular applications small knife-switches were placed at various points, each switch closing the circuit through this shunt-tripping coil. Whenever it is desired to stop the machine and hold it in a stationary position, one of these small switches is thrown in, which immediately opens the breaker and locks it permanently open until the line switch is opened. The breaker is controlled entirely from alternating-current circuits, no direct current being necessary, and it operates large three-phase motors, opening two legs of the three-phase circuit. The breaker is adapted for mounting directly on the wall, the connections being on the face of the panel.

Many other attachments and special applications of this breaker, to satisfy various special requirements, have been developed.

Trigonometric Slide Rule.

M. J. Eichhorn, an electrical engineer, of 5,759 Aberdeen street, Chicago, Ill., has developed a slide rule for solving the various trigonometric functions involved in plane trigonometry. This slide rule is applicable to both the law of cosines and the law of tangents, and other logarithmetrical functions involving the unknown side of a triangle when two sides and the included angle are given.

Two New Pass & Seymour Specialties.

The accompanying illustrations show two new devices placed on the market by Pass & Seymour, Incorporated, Solvay, N. Y. Fig. 1 shows the No. 3010 feed-through switch. This designation comes from the fact that the cord passes through the switch. The uses for such a switch are numerous, as oftentimes in certain work, such as connecting up small sewing-machine motors, stereopticons, heating devices, etc., it is desirable to connect a switch into the cord circuit instead of placing the switch at the end of the cord or using a wall switch. The device is wired by simply passing the cord into the upper bushing, connecting one wire to the terminals, and passing the cord out through the lower bushing. Only one wire is cut, the other passing straight through. This is a National Code device.

Fig. 1.—P. & S. Feed-Through Switch.

Fig. 2.—P. & S. All-Metal Key Socket.

Fig. 2 shows the No. 460 socket. This is equipped with an all-metal key, the mandrel at all times being "dead." The demand for this socket comes principally from the manufacturers of fixtures, portables and similar devices where it is desired to have a socket with a key to match the finish of the fixture. Any "P. & S." brass-shell socket or receptacle may be equipped with this key, for which a slight additional charge is made.

Current Electrical News

DOMESTIC AND EXPORT.

CAROLINA POWER AND LIGHT COMPANY FILES MORTGAGE—A mortgage from the Carolina Power and Light Company, of North Carolina, to the Standard Trust Company, of New York, has been filed in the office of the clerk of the Superior Court. The board of directors of the Carolina Power and Light Company has authorized the issue of bonds aggregating $5,000,000, payable August 1, 1938, each of said bonds to be of the principal amount of either $500 or $1,000, as the mortgagees may from time to time determine, and all of said bonds to bear interest, payable semi-annually, at the rate of five per cent per annum. This mortgage is signed by John D. Mortimer, vice-president of the Carolina Power and Light Company, and by L. L. Stanton, vice-president of the Standard Trust Company.

LONG ACRE ELECTRIC LIGHT AND POWER COMPANY APPLIES FOR REHEARING OF PRIOR APPLICATION ON STOCK ISSUE—The New York State Public Service Commission has received an application from the Long Acre Electric Light and Power Company for a rehearing on its prior application for permission to issue $10,000,000 preferred stock and $50,000,000 in mortgage bonds which was denied by the commission last June after a series of hearings. The petition for a rehearing is signed by John C. Sheehan and Graham & L'Amoreaux, attorneys for the company. It presents twenty reasons for asking for a rehearing. The last reason is an allegation that the action of the commission is null and void for the reason that the Public Service Commission law was unconstitutional. The commission has taken the matter under advice.

NEVADA-CALIFORNIA POWER COMPANY EXTENDING ITS SYSTEM—By the middle of October the third plant to be installed by the Nevada-California Power Company at Bishop Creek, Nev., will be ready for operation. This third plant has a capacity of 6,000 horse-power, which will make the total capacity of the company 17,000 horse-power. This will be ample for the districts of Bishop, Goldfield, Tonopah, Silver Peak, Millers and Rhyolite. The new mill of the Consolidated Mines Company at Goldfield will require from 700 to 800 horse-power and there are other projects in view which indicate that the company's increased capacity will be fully utilized. Next spring the company expects to equip still another plant with a capacity of 6,000 horse-power, and it is not improbable that the light and power system will be extended into Manhattan, Round Mountain and Hornsilver this fall.

MEXICAN ELECTRICAL NOTES—A contract has been closed by Manuel Cuesta Gallardo, of Guadalajara, with the Siemens-Schuckertwerke, of Berlin, for $7,500,000 of electrical machinery. The contract carries the guarantee of the Mexican Government. This was possible under the new law providing for the payment of subsidies for the irrigation of lands and the establishment of a bank for the encouragement of irrigation works and agricultural development. Mr. Cuesta expects to irrigate from 200,000 to 300,000 hectares of land with water from Lake Chapala. Current is to be supplied to the city of Guadalajara and the properties of the Amparo Mining Company by July, 1909. The first hydroelectric plant will be installed by the Berlin concern near the Totolotlan bridge on the Santiago River, about fifteen miles from Guadalajara, where the necessary hydraulic works have been completed. Two turbines, each of 4,200 horse-power, will be put in. It is estimated that the capacity of this plant can be raised to 11,000 horse-power if desired. As soon as the Totolotlan plant is completed work will be finished on the second hydroelectric plant in the cañon of the Santiago River, some distance above the Las Juntas plant of the Compañia de Tranvias, Luz y Fuerza de Guadalajara. In connection with this installation there will be a canal twenty-four kilometres long, nine metres wide and three metres deep, and a fall of 400 metres, or approximately 1,300 feet, will be secured. It is estimated that it will be possible to generate there at least 60,000 horse-power. According to present plans the plant will be ready for operation within four years. Besides sending current to Guadalajara and using it for irrigation purposes, Mr. Cuesta proposes to transmit current to Aguascalientes and other distant points. There is now demand for several thousand horse-power in Aguascalientes. A concession has been asked for the establishment of an electric plant to be operated by water power about 100 kilometres west of Durango. An English company is said to be back of the move. The object is to furnish light and power to the city of Durango. Mexico City capitalists have formed a company to install a telephone system in Guanajuato. The company has obtained the right to erect poles and already a number of local merchants and others have subscribed for the new service. Puebla is to have a second telephone system. Alejandro M. Azan is organizing a company, to be capitalized at $400,000, to install a new underground telephone system. Application has been made for a concession and, as the new company has the backing of the chamber of commerce, it is believed the concession will be granted within a few weeks. It is hoped to begin construction within two months. A metallic-circuit system will be installed with all wires under-ground. In addition to the system in the city of Puebla, the company will construct long-distance lines to Atlixco, Cholulu and Tlaxcala and establish local exchanges in those cities. The company will charge $5 a month for business telephones and $3 a month for residence telephones. It is expected the exchange will begin with 800 telephones in Puebla and 300 in the surrounding towns. The announcement is made by Mr. Azan that he has assurances that the Federal government will construct a long-distance telephone line from Puebla to the City of Mexico. This line, when completed, will be operated by the new telephone company, thirty per cent of the gross receipts being paid to the government for the use of the line.

ELECTRIC RAILWAYS.

EL PASO, TEX.—Citizens have subscribed $45,000 for building an interurban to Valley, thirty miles below this city.

FLINT, MICH.—Work on the extension of the Detroit, Flint & Saginaw electric railway from Frankenmuth to Flint will begin at once.

HOUSTON, TEX.—The Houston Electric Company intends to extend the Harrisburg line of the Houston Street Railroad down the bay shore to La Porte, Seabrook and other points.

NEWARK, N. J.—At an adjourned meeting of the West Orange town council a fifty-year franchise was given the Orange Mountain Traction Company to extend its line across Valley road.

ATTLEBORO, MASS.—The new electric car line connecting this town with Pawtucket and South Attleboro has been opened. This line is to be operated by the Interstate Consolidated Company.

FLORENCE, COL.—Engineers have been investigating the proposed line of electric railway from Turkey Creek through Florence to Cañon City. About seven miles of grading remain to be completed.

NORWAY, MICH.—A project is pending for the construction of an electric railway extending from Norway to the Spread Eagle Lakes, and passing through the village of Quinnesec and the city of Iron Mountain.

AKRON, OHIO—Application to incorporate the Turkeyfoot Traction Company, to connect Turkeyfoot Lake with Akron and Massillon, has been made by Tom L. Childs. The object is to touch the numerous lakes south of Akron.

LAWRENCE, KAN.—The city council has granted a franchise to the Kansas City & Kansas Southwestern Railway Company to construct an interurban line through Lawrence. The ordinance gives the company ninety days in which to accept the terms of the franchise.

HARRISBURG, ILL.—Promoters are contemplating connecting Eldorado, Harrisburg and Carrier Mills with an electric line. The project is backed, it is said, by the McKinley system, and W. A. Hass, of Lincoln, Ill., is having a preliminary survey of the route made.

JOHNSTOWN, PA.—A plan for the revival of the Johnstown, Ebensburg & Northern Railway project is being considered and likely to culminate shortly. This city and Gallitzin will be the terminal points and the proposed line will be thirty-two miles long and cost $1,200,000.

GOLDFIELD, NEV.—Plans are maturing for a trolley railway system for Goldfield. The directors will include George Wingfield, Denny Sullivan, T. F. Manning and Senator H. V. Moorehouse. The system will cost in the neighborhood of $125,000 and should be completed within a few months.

PHILADELPHIA, PA.—Judge Holland, of the United States Circuit Court, at Philadelphia, has issued a decree appointing John A. Riggs and George Blackenstone receivers of Philadelphia, Bristol & Trenton Street Railway Company. The plaintiffs are the Interstate Railway Company and the United Power and Transportation Company.

RED BLUFF, CAL.—The city trustees of Red Bluff have granted a franchise to the Northern Electric Company for the extension of its lines through the main street of the city. Connecting at Chico with the line now in operation, this extension will open up a rich section of the Sacramento Valley which has heretofore been only partially accessible.

MADISON, WIS.—The state railroad commission has granted the Milwaukee Light, Heat and Traction Company authority to extend its line from Waterford to Lake Geneva. There was no opposition to the request. This grant would indicate that President John I. Beggs is about to further extend the East Troy line and to further tap the Fox River Valley territory.

TACOMA, WASH.—The Tacoma Railway and Power Company has begun work on a new substation at Puyallup. The station will have an initial capacity of 500 horse-power. The building will be of brick, forty-five by fifty-five feet. The new station will furnish power for the operation of the short line through the valley and increase the efficiency of the present line.

SALT LAKE CITY, UTAH—At the session of the board of county commissioners an application for a franchise for the building of an electric line through Ogden Canyon was made by David Eccles and associates. The company asserts its desire to build the line through to the Oaks before winter sets in, and by next summer build on to Huntsville and other Ogden Valley towns.

HUNTSVILLE, ALA.—The transfer of the properties of the Huntsville Railway, Light and Power Company to the Huntsville, Chattanooga and Birmingham Interurban Railway, Light and Power Company has been effected. The new corporation has improvements in prospect, one of the first enterprises being an electric railroad to the top of Monte Sano. Electric power will be secured from the Tennessee River.

CARLISLE, PA.—Several local business men, headed by Willis E. Gladfelter, will apply shortly for a charter to build a trolley line running east along the Harrisburg, Carlisle and Chambersburg turnpike from Carlisle to Balfour, Middlesex township, Cumberland County, a distance of three miles. It is surmised that this road will connect with another running from Carlisle to Carlisle Springs, which is in projection.

UTICA, N. Y.—The stockholders of the Utica & Mohawk Valley Railway Company at their annual meeting elected the following directors: Horace E. Andrews, William K. Vandervilt, Jr., John Carstensen, Edward V. W. Rossiter, William C. Brown, Albert H. Harris, John J. Stanley, Walter N. Kernan, Charles B. Rogers, Nicholas E. Devereux and James S. Sherman. Shares to the number of 75,000 were voted.

MILWAUKEE, WIS.—The lines of the Chicago & Milwaukee Electric road are completed to and including connections in Milwaukee, and it is stated by Clement C. Smith, of the Columbia Construction Company, that cars can be operated on the system at any time. Work on the car barn and substation is well under way, as is the work of stringing wires between Milwaukee and Racine. The car barn is to cost $30,000. The site is 248 feet long and 121 feet wide.

DAYTON, OHIO—The Dayton Street Railway Company has increased its capital from $10,000 to $1,200,000. This company is constructing one of the longest city railway lines in Dayton, the route covering southeastern and northwestern Dayton, as well as traversing the central section of the city. Work of construction is being pushed at both ends, and the road will be ready for operation by the middle of November. It has been financed solely by Daytonians.

LOUISVILLE, KY.—A subcompany of the Evansville & Eastern has been incorporated to build an electric line from Rockport, Ind., east to New Albany, and across the Ohio River to Louisville, Ky. The capital stock is given at $10,000, but it is stated that an amendment will soon be filed increasing it to $1,000,000. The directors include: William H. McCurdy, of Evansville; John C. Haines, Marcus S. Sonntag, Albert F. Karges, William A. Kotch, C. H. Battin and William L. Sonntag.

CHICAGO, ILL.—The work of improvement on several sections of tracks of the Chicago Consolidated Traction Company lines has been authorized by Judge Grosscup before whom the receivership proceedings involving the company are pending. The order was entered in compliance with the petitions of the receivers, David R. Forgan and John M. Roach, who are given authority to use funds from the earnings of the lines or borrowed money. The expenditure will amount to $25,000.

KENDALLVILLE, IND.—Incorporation papers have been filed with the secretary of state by Attorney T. A. Redmond, representing a number of capitalists, for a new interurban line connecting Kendallville and Goshen through Ligonier with branches to Albion and Rome City. The capital is $10,000, which will be increased. A number of Kendallville capitalists are interested, among them being: H. I. Park, president of the Flint & Walling Manufacturing Company, and T. E. McCray, of McCray Refrigerator Company.

SEATTLE, WASH.—Stone & Webster, of Boston, have added to their extensive railway system in the state of Washington by purchasing the Seattle-Everett Interurban, a new electric line projected by Fred E. Sander and associates of Seattle, part of which has already been completed. The purchase price is not made public. It will be consolidated with the Seattle Electric Company, which operates the street electric car lines and the Puget Sound Electric Railway, the interurban line to Tacoma. The line will be extended from Everett to Bellingham, where it will form the north end of a proposed through electric line from Portland to the Canadian border in connection with the Puget Sound Electric road from Seattle.

NEW INCORPORATIONS.

COLUMBUS, OHIO—Lemoyne Telephone Company, Lemoyne. Capital increased to $10,000.

ALBANY, N. Y.—Heuvelton Heat, Light and Power Company. Heuvelton. $25,000. Incorporators: E. L. Thornton, E. F. Thornton, Chicago; A. Thornton, Heuvelton.

COLUMBUS, OHIO—Turkeyfoot Traction Company, Akron. $10,000. Incorporators: Thomas L. Childs, Charles J. Carey, Charles Esselburn, Frank E. Ream and D. W. Ruegsegger.

RICHMOND, VA.—Fredericksburg & Wilderness Telephone Company, Fredericksburg. $1,000 to $5,000. T. F. Morrison, president, Spotsylvania County; R. A. Jennings, vice-president, Orange, Va.; M. W. Thornburn, secretary and treasurer, Spotsylvania County. To operate a telephone line in the counties of Spotsylvania, Orange, Culpeper and Louisa.

SALT LAKE CITY, UTAH—The Monroe Light, Power and Milling Company, of Monroe, Sevier County. $25,000. Officers: John Manson, president; J. H. Erickson, vice-president; Jens N. Jeppson, secretary and treasurer. The concern takes over by purchase fifteen acres of land in Sevier County and other property consisting of an electric light plant and a grist mill.

PERSONAL MENTION.

MR. J. R. WILLIAMS, of Lisbon, Ohio, has assumed the management of the Bell Telephone Company's office at Meadville, Pa.

MR. PLAYER LITTLEFIELD has been appointed manager of the Knoxville office of the East Tennessee Telephone Company.

MR. F. M. HENKEL, assistant manager of the Bryan-Marsh Company, has left that company to open a branch office at 22 Fulton street, New York city, for the Tungstolier Company, of Cleveland.

MR. L. B. MARKS, consulting engineer, and MR. J. E. WOODWELL, recently engineer in the United States Government service, Washington, D. C., announce that they have opened offices in the Terminal Building, 41st street and Park avenue, New York city. Mr. Marks will continue his work in illuminating engineering and Mr. Woodwell will devote himself to power problems.

MR. E. J. KULAS, vice-president and general manager of the Tungstolier Company, of Cleveland, has just returned from a visit to the various Tungstolier branch offices at Boston, New York, Philadelphia, Pittsburg, St. Louis, Chicago, Kansas City, Minneapolis and Denver. On September 26 Mr. Kulas again left Cleveland, and on this trip will go to the Pacific Coast, where he proposes to establish branch offices in San Francisco, Los Angeles and Seattle.

MR. A. P. CRENSHAW, secretary-treasurer of the Chesapeake & Potomac Telephone Company, was the guest of honor at a dinner given in Washington, D. C., last Friday evening, in celebration of his thirty years of continuous service. Mr. Crenshaw was presented with a fine clock and was the recipient also of many personal appreciations from the officials of the company, about twenty-five of whom, from Washington, Baltimore, Philadelphia and New York, were present.

MR. H. H. CUDMORE has been engaged by the Brilliant Electric Company, of Cleveland, Ohio, as general sales manager. Mr. Cudmore has for the past twelve years been identified with electrical jobbing interests in and near Cleveland. As the product of the Brilliant Company is marketed very largely through jobbers, his knowledge and experience in the supply business will enable him to serve such customers to the best advantage. Mr. Cudmore assumed his new duties on September 1, since which date he has been on an extended trip through the East, making the acquaintance of his trade and studying business conditions.

OBITUARY NOTE.

LIEUTENANT THOMAS E. SELFRIDGE, who lost his life in the aeroplane accident at Fort Myer, Virginia, was buried with military honors at Arlington on September 25. Among the honorary pall-bearers were Major G. O. Squier, Lieutenant R. B. Creecy, Lieutenant G. C. Sweet, Dr. Alexander Graham Bell, Professor Octave Chanute, J. A. D. McCurdy, Percy Bradford, Professor Monroe Hopkins, F. W. Baldwin and W. J. Hammer.

NEW MANUFACTURING COMPANIES.

PHILADELPHIA, PA.—Harry V. Haden and Russell Klem, both of Philadelphia, are among the incorporators of the Turbine Equipment Company, of Trenton, N. J., mechanical, electrical, civil and contracting engineers, with a capital of $50,000.

SPRINGFIELD, ILL.—The International Telephone Manufacturing Company has been incorporated to manufacture telephone and telegraph devices with $60,000 capital. The incorporators are: F. M. Burmeister, H. Shafer and J. C. Burmeister, Chicago.

SPRINGFIELD, ILL.—The Arrow Electric Company, of Chicago, with a capital of $2,500, has been incorporated to manufacture and deal in electrical apparatus and appliances. The incorporators are: William M. R. Vose, Hubert E. Page and William C. McNitt.

ELECTRICAL SECURITIES.

The market is now in a fine state of seething excitement trying to follow the fluctuations of the political campaign. The slump of last week was followed by just as big a rally, and the opportunities to make or lose a dollar seem to be about even. Business, it appears, is beginning to show some improvement, entirely without consideration to campaign or stock market conditions. The long season of drought, which threatened ruin to farmers all over the country and imperiled vast forest reserves, appears to have been broken, and reports indicate that there have been heavy rains in every direction.

Dividends have been declared upon the following electrical securities: United Railways of St. Louis; regular quarterly dividend of 1¼ per cent on the preferred stock, payable October 10. Chicago Telephone Company; quarterly dividend of 2 per cent, payable December 31 to stock of record December 23. Previous dividends have been 2½ per cent quarterly. A circular sent to the stockholders also states that a stock dividend of 20 per cent on October 10 will be paid to holders of record October 3. Rochester Street Railway Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable October 1. Cincinnati & Suburban Bell Telephone Company; quarterly dividend of 2 per cent, payable October 1. Cincinnati Gas and Electric Company; regular quarterly dividend of 1⅛ per cent, payable October 1. Cincinnati Street Railway Company; regular quarterly dividend of 1½ per cent, payable October 1. New York & New Jersey Telephone Company; regular quarterly dividend of 1¾ per cent, payable October 15 to stock of record October 5. Electric Storage Battery Company; quarterly dividends of ¾ of 1 per cent on the common and preferred stocks, payable October 1. Wilkes-Barre Gas and Electric Company; regular quarterly dividend of 1 per cent, payable October 1. Bell Telephone Company of Missouri; regular quarterly dividend of 2 per cent, payable October 1. Central & South American Telegraph Company; regular quarterly dividend of 1½ per cent, payable October 1. Mexican Telegraph Company; quarterly dividend of 2½ per cent, payable October 16. Boston Suburban Electric Company; a dividend of $3 per share, payable in quarterly installments of seventy-five cents, beginning October 15. The first dividend is payable to stock of record October 5. The last previous dividend was at the rate of 3 per cent per annum and was paid October 15, 1907.

ELECTRICAL SECURITIES FOR THE WEEK ENDED SEPTEMBER 26.

New York:	*Closing.*
Allis-Chalmers common	10⅞
Allis-Chalmers preferred	32
Brooklyn Rapid Transit	45⅞
Consolidated Gas	148
General Electric	138⅛
Interborough-Metropolitan common	10⅜
Interborough-Metropolitan preferred	32
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	67½
Mackay Companies (Postal Telegraph and Cables) preferred	67½
Manhattan Elevated	133
Metropolitan Street Railway	28
New York & New Jersey Telephone	115
Western Union	60
Westinghouse Manufacturing Company	75

Boston:	*Closing.*
American Telephone and Telegraph	129
Edison Electric Illuminating	225
Massachusetts Electric	49
New England Telephone	119½
Western Telephone and Telegraph preferred	75

Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	35
Electric Storage Battery preferred	35
Philadelphia Electric	9¾
Philadelphia Rapid Transit	19¼
United Gas Improvement	86

Chicago:	*Closing.*
Chicago Telephone	146
Commonwealth Edison	107
Metropolitan Elevated preferred	42
National Carbon common	67
National Carbon preferred	108

ELECTRIC LIGHTING.

NEWARK, N. J.—Garfield is discussing the question of a municipal lighting plant.

HATFIELD, PA.—At a special election it was voted to establish an electric light system at a cost of $4,000.

REHOBOTH, DEL.—Rehoboth capital has organized an electric light company and is soliciting subscriptions.

DENVER, COL.—The Denver Gas and Electric Company is having plans prepared for a modern steel office building, six or seven stories in height.

SPRINGFIELD, MASS.—The Williamsburg selectmen have granted pole locations in the village to the Northampton Electric Lighting Company.

HAMILTON, OHIO—Contracts have been awarded by the board of public service for the extension of the lighting system to Lindenwald and East Hamilton.

IRON RIVER, WIS.—The Iron River water, light and power plant was destroyed by fire on September 17. The loss is about $10,000 covered by insurance.

McEWEN, TENN.—L. H. Hopkins has leased the electric light plant and will operate it. The plant heretofore has been running only half the night, but from now on it will be run all night.

CHESTER, PA.—The Spring Lawn water power and thirty-one acres of land near Lewisville, Chester County, have been sold to the Elk River Electric Light, Heat and Power Company for $3,000.

DELEVAN, WIS.—W. H. Tyrrell has been appointed receiver of the Delevan electric light plant in proceedings instituted by bondholders. The company was organized some ten years ago by local capitalists.

JOHNSTOWN, PA.—The city council has awarded a ten-year contract to the Citizens' Light, Heat and Power Company to furnish street arc lamps for $50 each per year, reserving the right to cancel the contract at the end of five years.

MITCHELL, S. D.—The Mitchell Power Company has awarded the contract for the construction of the new electric light plant to the Goetz Construction Company, of Yankton. Work on the building will be commenced as soon as possible.

ALBANY, N. Y.—The Public Service Commission, Second District, has authorized the Mexico Electric Company, of Mexico, Oswego County, to issue $10,000 in bonds to purchase from Edwin L. Huntington, of Mexico, the electric light plant there.

WAYCROSS, GA.—It is reported that George W. Deen, Burdett Loomis and Harley Pettibone will start work at once on an electric light plant for Waycross, and also build a street railway system, extensions of time having been granted on the franchises granted some time ago.

ALBANY, N. Y.—The Public Service Commission, Second District, has authorized the Cataract Power and Conduit Company, of Buffalo, to issue $125,000 five per cent bonds to be secured by a first mortgage dated January 1, 1907. The bonds shall not be sold at less than ninety per cent of par value.

GOSHEN, IND.—Injunction proceedings have been filed against the city of Goshen, Ind., to prevent the rebuilding of the municipal lighting plant at an expense of $45,000. The suit is based on the contention that the municipality is breaking the legal limit of its indebtedness; that the question was not submitted to taxpayers at special election.

MARLBORO, MASS.—According to a statement the Marlboro Electric Company has made a contract with the Connecticut River Power Company to furnish the Marlboro company additional power for use in operating its business in Marlboro, Southboro and Northboro. The power to be furnished by the Connecticut River Power Company will be transmitted to Marlboro from Clinton.

BATH, N. Y.—The Public Service Commission, Second District, has authorized the Citizens Electric Service Company, of Bath, to issue $75,000 bonds and to issue $50,000 common stock. None of the bonds shall be sold for less than eighty-five per cent of their par value. Ground for the company's plant has already been broken. At a meeting Charles I. Davison, village treasurer, was elected treasurer of the company, and S. J. Richard, of Buffalo, vice-president.

PHENIX CITY, ALA.—At a meeting of the Phenix City council an ordinance was read granting a franchise to the Phenix-Girard Power and Lighting Company, a new corporation which proposes to establish a steam plant for furnishing electric light and power. A franchise has already been granted in Girard. The leading spirits in the enterprise are T. W. Butts and B. A. Bass, of Columbus, and I. I. Moses and D. C. Foster, of Girard.

OMAHA, NEB.—An ordinance providing for the construction and purchase of a hydroelectric light and power plant to be owned, maintained and operated by the city of South Omaha, has been introduced in council. The ordinance involves the proposition of the Nebraska Power Company to build a plant for the city. The plant will be built at a cost of $2,500,000. The city will be permitted to pay for the plant in yearly installments out of the proceeds of the sale of light and power. The proposition has met with favor.

ST. LOUIS, MO.—It is announced that the Clayton Electric Company, composed of county capitalists, will push its application for a franchise for furnishing light in the county. The application was filed last spring, but no action was urged on the court. The action of the County Court in granting an extension of territory to electric concerns without any reservation as to the price to be charged has decided the local men, it is said. The Clayton company proposes to furnish current at a price greatly below the figures county consumers are now paying.

BERLIN, MASS.—The franchise granting the Marlboro Electric Light Company the privilege of extending its line from Marlboro to the Clinton line through Berlin, has been signed by the committee appointed by the town. By the terms of the franchise Berlin will have thirty-two electric street lights, to be distributed through the three villages and the intervening streets. They are to be incandescent lamps of forty candle-power. The cost annually will be $17.50 per light. The system is to be put in within six months.

WENATCHEE, WASH.—The Valley Power Company, of Wenatchee, reports that its new power plant will be ready for active operation by October 15. Twelve miles of the transmission line will be completed and the company expects to deliver power to Cashmere and other points along the line. Several pumping plants for irrigation will be installed and will be operated by power from this source. The company expects to extend its line down the Columbia River to Malaga and other points where power will be needed for pumping projects. The company will endeavor to secure a franchise to enter Wenatchee where it will compete with the Wenatchee Electric Company and the proposed Entiat Power Company, now asking for a franchise to enter that city.

DATES AHEAD.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 5-6.

Empire State Gas and Electric Association. Annual meeting, New York city, October 7.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Pittsburg, Kan., October 8-9.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J. October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

Railway Signal Association. Annual meeting, Washington, D. C., October 13-15.

Order of the Rejuvenated Sons of Jove. Annual meeting, Buffalo, N. Y., October 15-16.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Association of Car-Lighting Engineers. First annual meeting, Chicago, Ill., November 18.

National Society for the Promotion of Industrial Education. Annual meeting, Atlanta, Ga., November 19-21.

American Roentgen Ray Society. Annual meeting, New York city, December 28-30.

INDUSTRIAL ITEMS.

PASS & SEYMOUR, INC., Solvay, N. Y., has prepared a complete new price list and discount sheet, giving entire revised figures on its entire line. Copies may be had upon request.

THE AMERICAN CIRCULAR LOOM COMPANY, Chelsea, Mass., is distributing a folder combining with its advertising of "Circular Loom," "Electroduct" and "Lutz" metal molding, some data of campaign interest.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., has published a handsome campaign souvenir in the form of a political atlas, giving a compendium of facts and figures, platforms, biographies and portraits of the men and the issues.

THE SIEMENS & HALSKE A.-G., Berlin-Nonnendamm, has published in English a very interesting catalogue and price list, No. 56, devoted to "Testing Instruments and Accessories." The company is represented in the United States by Dr. Karl Georg Frank, Hudson Terminal Building, 50 Church street, New York city.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., announces that a large contract was signed with the firm of Guinle & Cia., Brazilian agents for the General Electric Company, for the supply of electric energy to the Central Railway of Brazil, which is known as the largest enterprise of its kind in that country, for all purposes, which will include the supply of energy as motive power, as soon as the project now pending for the electrification of a section of that railroad is decided upon. To this firm was also granted a federal concession, covering the supply of light and power to the city of Sao Paulo, which aggregates 300,000 inhabitants, and is known as the largest coffee market in the world.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has issued the second section of a new series of sectional price lists. This covers the elements, jars and tanks of the "Chloride Accumulator" for electric railway, central lighting and power, isolated lighting, interlocking switch and signal, telephone, telegraph, fire alarm, laboratory, small motor work and miscellaneous service. This price list will be known as Section A and will be followed by other sections covering the many applications of the "Chloride," "Exide" and "Tudor" accumulators. Copies will be forwarded upon application to any of the sales offices of the company. Section C, covering the "Chloride Accumulator" and "Tudor Accumulator" for car-lighting service, was issued in June.

J. G. WHITE & COMPANY, engineers and contractors, 43-49 Exchange place, New York, has begun the surveys for F. H. Buhl, of Sharon, Pa., on one of the largest irrigation projects ever undertaken, contemplating the reclamation of about 700,000 acres of arid land in Southern Idaho. The project is practically an extension of the noted Twin Falls development. Water supply for the proposed extension will be obtained from Snake River. The lands lie to the west of the Twin Falls tract beyond Salmon River and in part beyond Bruneau River. The surveys in progress include reservoir sites, the enlargement of the present Twin Falls Canal, which was developed by Mr. Buhl, to a capacity sufficient to carry the increased water supply, an extension of the main canals to cover the lands of the project, including a syphon to carry the water supply across Salmon River Canyon, which is about 1,650 feet wide and whose bed is 500 feet below the level of the proposed canal. Five surveying parties are already in the field at work on the various parts of the project.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing its 1909 general catalogue, which is a handsome volume of 1,024 pages. Unquestionably, it has been the company's aim to make this catalogue the most complete electrical supply catalogue ever issued, and one needs only to look through the catalogue to be convinced of this. Considerable space is given to the specialties for which the company acts as sales agents, namely, Columbia incandescent lamps, Pittsburgh transformers, Okonite wires and cables, G-L arc lamps and New Lexington high-tension insulators. One is naturally interested also in the extensive line of fixtures which is shown and which naturally gives some conception of the fixture department, which is the most extensive in the West. The special announcement printed on the last page of the catalogue is also interesting as outlining in a general way some of the company's plans for expansion. The company is desirous of placing a copy of this catalogue in the hands of every individual who is actively engaged in plant operations, or who has anything to do with the specifying or purchasing of electrical material.

Record of Electrical Patents.

Week of September 22.

899,024. PARTY-LINE-INDICATING KEY. Clifford C. Bradbury, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed August 3, 1907. The actuating buttons have reciprocating and rotating means for indicating position.

899,068. APPARATUS FOR DETECTING INFLAMMABLE GASES IN AIR. Arnold Philip and Louis J. Steele, Portsmouth, England. Filed September 9, 1907. Means are provided for actuating a visual signal in connection with a catalytic agent.

899,088. GOVERNOR FOR DYNAMOS. Charles L. Weichelt, Philadelphia, Pa. Filed December 11, 1907. The armature is slidably carried on a shaft which is equipped on one end with a coned pulley.

899,127. MEANS FOR PROTECTING HIGH-TENSION OVERHEAD ELECTRIC CONDUCTORS. Lucian Neu, Lille, France. Filed April 3, 1906. Inductive resistances are included in the circuit to shunt certain sections of the circuit.

899,134. ELECTRIC SIGNALING SYSTEM FOR RAILWAYS. Ara P. Rickmire, Waterloo, Iowa. Filed December 30, 1907. Current is supplied through relays and switch points, one rail forming a continuous circuit; and sectional rails are connected to a source of power through the relays.

899,145. ELECTRICAL SYSTEM OF DISTRIBUTION. William A. Turbayne, Lancaster, N. Y., assignor to Gould Storage Battery Company. Filed February 25, 1907. A multi-voltage booster system.

899,153. BLOCK-SIGNAL APPARATUS. Alexander Bevan, Providence, R. I. Filed December 3, 1906. An oscillatory shaft equipped with a target is actuated by an electromagnet.

899,189. ELECTROMOTOR CONTROLLING AND OPERATING SYSTEM FOR ELECTRIC RAILWAYS AND POWER PLANTS. Johann Sahulka, Vienna, Austria-Hungary. Filed June 1, 1907. A two-motor series-control operating system.

899,193. AUTOMATIC ELECTRICAL MEASURING APPARATUS. Daniel J. Shine, Las Vegas, Nev. Filed March 4, 1907. Resistances of relatively large and small quantities are alternately switched into circuit.

899,205. ELECTRIC SWITCH. Charles A. Clark, Hartford, Ct. Filed May 24, 1907. A quick-break snap switch.

899,209. AUTOMATIC TELEGRAPHY. Patrick B. Delany, South Orange, N. J., assignor, by mesne assignments, to the Telepost Company of Maine. Filed December 15, 1896. Means are provided for transmitting signals corresponding to perforations on a tape.

899,220. AUTOMATIC ELECTRIC SAFETY DEVICE FOR BOILERS, ETC. Charles Kausen, New York, N. Y. Filed March 13, 1908. The movement of a plunger actuates a circuit-closing mechanism.

899,226. ELECTROPLATING APPARATUS. George A. Lutz, Plainfield, N. J., assignor to American Circular Loom Company, Portland, Me. Filed June 6, 1908. Means are provided for supporting articles to be plated within a hollow insulating cylinder.

899,234. MASSAGING INSTRUMENT. Julius B. Wantz, Chicago, Ill., assignor to Victor Electric Company, Chicago, Ill. Filed October 23, 1907. A massaging member is actuated by the motor through a universal joint.

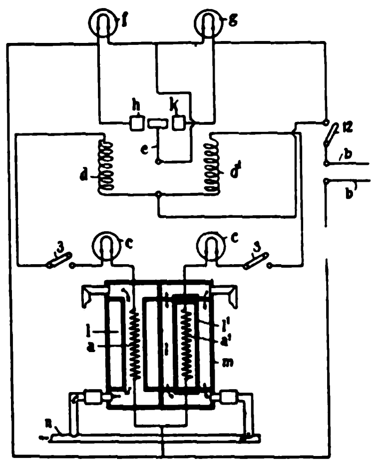
899,239. SIGNALING SYSTEM. Sewall Cabot, Brookline, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed March 10, 1906. A combination of a wireless telegraph system and a wire telegraph system.

899,240. SIGNALING SYSTEM. Sewall Cabot, Brookline, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed March 10, 1906. A combination of a wireless telegraph system and an open-circuit wire telegraph system.

899,241. SIGNALING SYSTEM. Sewall Cabot, Brookline, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed March 10, 1906. An intermediary wire telegraph system is provided with relays adapted to transmit wireless telegraph signals.

899,242. SIGNALING SYSTEM. Sewall Cabot, Brookline, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed March 10, 1906. A combination of a multiplex wireless telegraph system and a multiplex wire telegraph system.

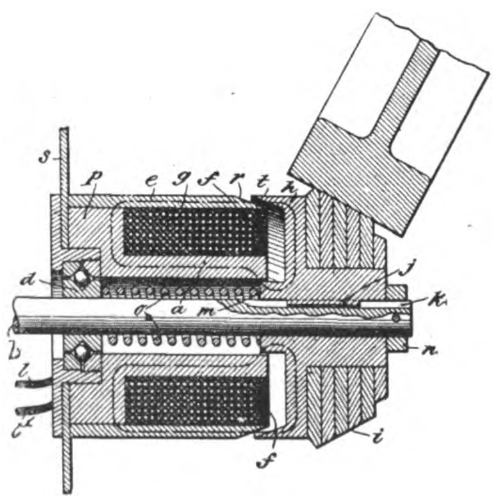
899,243. SPACE TELEGRAPHY. Sewall Cabot, Brookline, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed April 4, 1906. An electromagnetic oscillatory detector.



899,068.—Apparatus for Detecting Inflammable Gases in Air.

899,264. OSCILLATION DETECTOR. Charles E. Russell, Cambridge, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed September 4, 1906. The permeability of the magnetic circuit is varied by the electrical oscillations.

899,272. APPARATUS FOR DETERMINING THE DIRECTION OF SPACE-TELEGRAPH SIGNALS. John S. Stone, Cambridge, Mass., assignor to William W. Swan, trustee, Brookline, Mass. Filed August 17, 1906. The position of the ungrounded elevated conductors is capable of being changed relatively to the direction of motion of the electromagnetic waves.



899,088.—Governor for Dynamos.

899,278. TELEPHONE SWITCHBOARD. Charles E. Wilson, Philadelphia, Pa., assignor to Keystone Telephone Company of Philadelphia, Pa. Filed September 10, 1904. A multiple-position, manually operated switchboard.

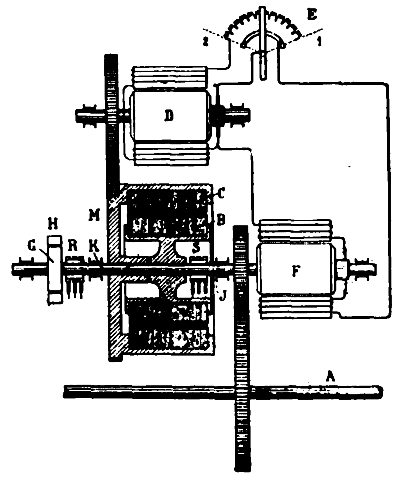
899,307. TELEGRAPH SOUNDER. Lee Kiblinger, Jackson, La. Filed November 18, 1907. Means are provided for equalizing the density of the magnetic field between the armature and different parts of the pole-pieces.

899,348. MAGNETIC ORE-SEPARATOR. Charles E. Stebbins, Iola, Kan. Filed April 17, 1908. A plurality of electromagnets are mounted upon a rotatable spider, a commutator and brushes being provided for supplying current to the magnets.

899,353. ALTERNATING-CURRENT BLOCK-SIGNALING SYSTEM. Jacob B. Struble, Swissvale, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed April 1, 1908. Relays are controlled by sectional track circuits controlling the home signals.

899,358. ARRANGEMENT OF PROTECTIVE APPARATUS. Hermon L. Van Valkenburg, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed September 29, 1906. The actuating members of a multiple switch are enclosed in fireproof chambers.

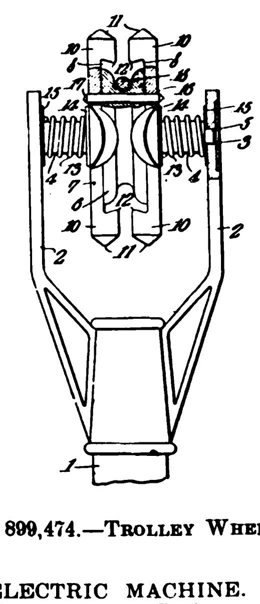
899,364. ELECTRIC SEPARATOR. Henry A. Wentworth, Lynn, Mass., assignor to Huff Electrostatic Separator Company, Boston, Mass. Filed February 3, 1908. The conductive material forms a barrier between the electrodes and is supplied to a rotating cylinder from a hopper.



899,189.—Electromotor Controlling and Operating System for Electric Railways and Power Plants.

899,370. DYNAMOELECTRIC MACHINE OF THE ENCLOSED TYPE. Alfred H. Wouters, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed March 18, 1907. The machine is enclosed in a housing having an air-receiving and an air-admission chamber.

899,379. PARTY-LINE-INDICATING KEY. Clifford C. Bradbury, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed March 11, 1907. The position of the key indicates the last set of switch springs actuated and released.



899,474.—Trolley Wheel.

899,447. DYNAMOELECTRIC MACHINE. Allan B. Field, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed November 30, 1906. A low-resistance ring, independent of the lamina and end plates, is embedded in the pole-piece at right angles to the lamina.

899,474. TROLLEY WHEEL. Joseph W. Seibert, Washington, Pa., assignor of one-half to Elias Lewis, Washington, Pa. Filed February 5, 1908. The trolley wheel is held in position by guide members, and is equipped with openings to lock the parts for a rotary movement.

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NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

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CONTENTS

CONVENTIONS AND MEETINGS.

Every once in a while it seems as though certain psychological forces had impelled those in charge of arrangements for the meetings of the various engineering societies to group their dates as near together as possible. Technical journals, both here and abroad, have often called attention to the activities of the various engineering organizations coming too closely together, and once again we are in the midst of a plethora of conventions and meetings.

From all over the country trooped the Old Time Telegraphers and the members of the Society of the United States Military Telegraph Corps to attend their annual convention at Niagara Falls. Then, down in Chattanooga, Tenn., the American Institute of Mining Engineers held forth the first few days of the month. Philadelphia, with its two hundred and twenty-fifth anniversary and celebration of Old Home Week, was the meeting place of the Illuminating Engineering Society in annual convention for two days on October 5 and 6. The Empire State Gas and Electric Association held its annual meeting in New York city on October 7, and on October 9 our own American Institute of Electrical Engineers held its first fall meeting. The New York Electrical Society opens its season with a meeting on Monday night at the New York Electrical Show, the latter running from October 3 until next Wednesday evening. Flying to the West, the Kansas Gas, Water, Electric Light and Street Railway Association held its annual meeting at Pittsburg, Kan., on October 8 and 9, and, coming again to the East, the whole week of October 12 to 16 is devoted to the conventions of the American Street and Interurban Railway Association and its affiliated organizations. The Railway Signal Association holds its annual meeting at Washington, D. C., October 13, 14 and 15, and the Order of the Rejuvenated Sons of Jove turns Buffalo upside down on October 15 and 16. The American Society of Municipal Improvements holds its annual meeting at Atlantic City, October 20 to 23, and the American Electrochemical Society closes this convention month with its fall meeting in New York city on October 30 and 31.

There are enough engineers and others interested in each particular line to make every one of these meetings a success, but there are a large number of engineers—and these happen to be very prominently connected with the electrical industry—who are interested in more than one branch of the service, and the close proximity of the dates makes it impossible to attend the meetings they would wish to even in these days of easily audited expense accounts and space-annihilating express-train service. The programmes, too, which have been and will be discussed at these meetings are of particular interest at this time. The Papers Committee of the American Institute of Electrical Engineers very wisely announces that for the coming season there will be but one paper presented at each meeting, this to be accompanied by written discussion which must be prepared in advance, and the formal reading of which will be disposed of by ten o'clock, leaving whatever time may be desired for open discussion after that hour. It is expected that because of this decision, engineers will be able to devote more time to the preparation of their papers, and that the papers will be received considerably in advance of their date of delivery. A fuller discussion will be secured, and those who attend the meetings and contribute most brilliantly to their value and importance by extemporaneous suggestions will not be handicapped and embarrassed because of lack of time and the apparent weariness of those listening.

The plans of the American Street and Interurban Railway Association and its affiliated societies, as usual, are being completed in good season, and it is expected that the conventions which will be held next week at Atlantic City will be the most successful which these progressive organizations have ever undertaken. The entire expanse of the million-dollar pier will be covered with exhibits of every character of device which appertains to street and interurban railway service.

THE REPORT OF THE PUBLIC SERVICE COMMISSION FOR THE FIRST DISTRICT OF THE STATE OF NEW YORK.

The report of the Public Service Commission for the First District of the State of New York, covering the six months from July 1 to December 31, 1907, gives us the first coherent and tangible evidence of what this important body has accomplished and of its aspirations for the future. Although we are familiar with the wealth and extent of the metropolis over which this commission holds certain sway, we can not help feeling more than impressed when a perusal is made of some of the figures presented in this report.

The commission for the first district has jurisdiction over the counties of New York, Kings, Queens and Richmond, making up the greater city of New York. The Public Service Commission for the Second District has jurisdiction over the remainder of the state. Each commission consists of five men appointed by the governor by and with the consent of the Senate. After February 1, 1909, each appointee will serve for a period of five years. The Public Service Commissions succeeded to the powers of the Railroad Commissioners, the Commission of Gas and Electricity, and the State Inspector of Gas Meters. The Board of Rapid Transit Railroad Commissioners, of New York city, was also abolished by the act. The commission for the first district thus has dual powers: on the one hand having full and complete powers of regulation over all public service corporations, and, upon the other, having the task of planning and constructing, and possibly also of equipping and operating, rapid transit lines, whether subway or elevated.

Within the first district there are sixteen gas companies, nine electric companies and three companies furnishing both gas and electricity, with 1,011,831 gas consumers and 87,745 consumers of electricity. The total capitalization of these companies on June 30, 1907, was $353,299,533.80. Their gross earnings from operations for the year were $48,363,840.29. Their expenditures for operation were $36,318,494.09. They paid, either as interest on bonds or dividends on stock, $12,370,091.57. The amount of gas manufactured reached the total of 34,656,922,800 cubic feet. The electricity produced amounted to 424,027,824 kilowatt-hours.

The cost of road and equipment of the street surface, elevated and subway railroads under the jurisdiction of the commission for the year ended June 30 was $459,802,017.89. The permanent investment, cash and other assets amounted to $164,274,208.26. The total earnings from passenger operation were $65,568,031.89.

The total number of passengers carried by all the railroads of the state was 1,630,775,156, of which 105,757,957 were carried by steam roads, and the balance by street surface, elevated and underground railroads. Of the latter, 1,249,829,568 were carried by the railroads now operating under the jurisdiction of the commission for the first district.

The commission held 179 hearings between July 18 and December 31, as a result of which 186 orders have been issued. One of the important matters to which the commission gave considerable attention concerned delays in transportation and inadequate facilities for comfortably moving the passenger traffic. A conservative estimate of the increases required of all the operating companies indicates that over 15,000,000 additional seats per annum have been added to the service in New York city under the orders of the commission.

MAGNETIC STORMS AND SUN SPOTS.

One of the departments of astro-physical science which is engaging the attention of the keenest intellects of the day is that branch which undertakes research into the phenomena which we have designated as terrestrial magnetism. It seems peculiar that the studies of one group of scientists and physicists along the lines of terrestrial magnetism have reached so many points of co-ordination with the discoveries made and announced by another group of physicists which has devoted itself to research into the phenomena of the ultimate constitution of matter and the newer theories of electricity and life.

Persuaded of the correctness of Lorentz's theory of the electromagnetic nature of light, Dr. P. Zeeman made repeated experiments to discover proofs substantiating his belief. In 1897 he was able to demonstrate that the magnetic field exerts a remarkable effect upon monochromatic light. Dr. Zeeman placed a flame from a Bunsen burner between the poles of a powerful electromagnet, and placed in the flame a bit of asbestos impregnated with a salt solution of sodium. When the flame, with the burning sodium vapor, was observed through the slit in a spectroscope, Zeeman discovered that what was ordinarily a single line appeared, when under the influence of the magnet, to be a broadened or double spectral line. Various theories were advanced to account for this, but repeated experiment convinced him that he had demonstrated an entirely new effect, and the scientific world, in acknowledging to the doctor its appreciation, designated the phenomenon as the Zeeman effect.

Last June Professor George E. Hale, formerly the director of the Yerkes Observatory, and now conducting special researches on Mount Wilson, in California, made a number of exceptionally clear photographs of the spectrum of a certain disturbed area of the sun's surface. An examination of these photographs showed that one of the lines which is usually single appeared double. Professor Hale has the reputation of being a very careful observer and a close student of astro-physical phenomena. He did not make any announcement himself, but forwarded several of the photographs, together with a statement of his deductions, to Dr. Zeeman. Dr. Zeeman's acknowledgment of this communication and his opinion concerning the importance of Professor Hale's discovery appeared in the issue of *Nature* for August 20, last. Dr. Zeeman expresses the opinion that the division of the line in question shows that the region photographed was a magnetic field. Some other explanation may later be offered for this phenomenon, but the coincidence is remarkable, and until some better authority is given, we must, perforce, be satisfied with the deductions made by Dr. Zeeman and Professor Hale.

It appears that we are rapidly tending toward some very important discoveries in the realm of terrestrial magnetism and the electromagnetic theory of light. That there is a close connection between solar disturbances and terrestrial magnetism has been the opinion of several of the greatest intellects of modern times, and possibly Professor Hale's discovery will prove another link in the chain which is binding the study of these forces together. It is true that there appears to be some material coincidence between solar disturbances, usually manifested as sun spots, and unbalancing of telegraph systems, distortion of terrestrial magnetic forces, eruptions, spasmodic and unseasonable storms and unexpected occurrences of the aurora borealis. These coincidences have not been sufficiently marked to be considered of fundamental value to the forecasters of the Weather Bureau, but much work is being done by government and private observers, tabulating such data as will possibly make future forecasting considerably more definite than it is to-day. Certainly, there seems to be material of great value in the discovery of Professor Hale and in the opinion of Dr. Zeeman. Apparently the same influence which causes the sodium line in the spectrograph of the Bunsen flame to be affected and split up affects the observed line in the spectrograph of the solar disturbance. This would seem to indicate that either there is a powerful external magnetic force acting on the sun at the time of the disturbance, or that the sun is exerting a powerful magnetic force upon some exterior object at the time. An exact knowledge of this phenomenon will help us in weaving together many of the to-day little-understood manifestations of nature, and it is to be hoped that from this new start considerable progress will soon be made.

ACCIDENT ON THE LONDON SUBWAY SYSTEM.

A special cable despatch from London, October 3, states that a breakdown of turbines in the Chelsea station caused the interruption of traffic in the entire London subway system on the afternoon of that day. As this occurred during the rush hours of the Saturday half-holiday, when everybody is trying to get home, and as it was of exceptionally long duration, it caused much distress to the traveling public.

As was but natural many of the trains stopped between stations, the despatch states, and the passengers left the trains, and by the guidance of the train crews with lanterns, reached the nearest stations. Although the congestion in the tunnels and stations was great, no one was hurt. Traffic was again resumed in the evening.

Whatever the trouble was, whether on the mechanical or electrical end, it seems strange that the cause was not located and remedied in a shorter time. In our own Metropolitan traction system, once in a while, interrupted by trouble at the generating station, the delay in traffic usually does not exceed twenty minutes.

It will be remembered that the Chelsea plant is the largest generating station in Great Britain. It contains eight 5,500-kilowatt and two 2,700-kilowatt turbo-generator sets, which feed a single main bus-bar system cut up into five sections by sectionalizing switches.

As has been advocated time and again in the pages of the Electrical Review, the wiring diagram of any station, particularly those for electric traction, can not be too flexible. Usually the feasibility of expending a few dollars for extra apparatus for emergency cases does not become apparent until large sums are lost due to interrupted operation. The foresight, in addition to these precautions, has led large railroad corporations to provide emergency connections with other generating stations so that, in case of a severe accident to one station, the various substations along the line receive current from another source.

Such interconnections between stations not only cut down the duration of delays, but also, to a certain extent, reduce the number of reserve units usually held in a single generating station. Frequently, when the trouble is on the electrical end of the plant, the reserve units can not be thrown on the line until the trouble is located and remedied. When possessing the availability of another source of power the question is a different and an easier one. When emergency power is required from such a station it takes but a few minutes to have the reserve units started, synchronized and thrown on the line. Of course the different generating stations must have separate feeders to the various substations, which is of consequent importance, as otherwise there is the possibility of attempting to send current into a not located disabled section.

Not all railway systems can rely upon power sources of another plant, if such is the case, and continuity of operation is desired, the generating plant must be provided with a double bus-bar system with several sectionalizing switches, and double feeder systems to the various substations. The feeder sections from the substations must also be run in duplicate.

The New York Electrical Show.

THE second annual electrical show held at Madison Square Garden, New York city, was opened on Saturday evening, October 3, at 8 o'clock. This show commemorates the fifty years of transatlantic communication by cable, and the passage of the first quarter century of electrical service in New York. On the opening night the visitors beheld a worthy successor to the very successful show which was held in New York city a year ago. The scheme of decoration was in entire harmony with the brilliant illumination, and the preponderance of metallic-filament lamps, together with the uniform color scheme, created an ensemble of cheerfulness which has seldom been approached in decorative lighting.

The opening exercises, which were held in the concert hall, at 8.30 P. M., were rendered entirely by means of Edison phonographs, the records being taken by the Edison Business Phonograph Company, of Orange, N. J. This is the first time that the entire exercises of a meeting of this character have been conducted by a talking machine. The records were made in different parts of the country, and the programme included an introduction by Thomas A. Edison, president of the New York Electrical Show. Mr. Edison's remarks were as follows:

"Those of us who began our labors at the operator's key fifty years ago have been permitted to see and assist in the whole modern industrial development of electricity. Since the remarkable experiments of Morse in 1844 and the unsuccessful efforts of Field in 1858, there have come with incredible rapidity one electrical art after another, so that in practically every respect civilization has been revolutionized. It is still too early to stand outside these events and pronounce final judgment on their lasting value, but we may surely entertain the belief that the last half of the nineteenth century was as distinct in its electrical inventions and results as the first was in relation to steam.

"The lesson of the jubilee of the Atlantic cable of 1858 is one of encouragement to all who would add to the resources of our race and extend our control over the forces of nature. Never was failure more complete, never was higher courage shown, never was triumph more brilliant than that which since 1866 has kept the old world moored alongside the new by pulsating cables of steel and copper—the "family ties" of the civilized world.

"When I look around at the resources of the electrical field to-day as shown in this exhibition, I feel that I would be glad to begin again my work as an electrician and inventor; and we veterans can only urge upon our successors, the younger followers of Franklin and of Kelvin, to realize the measure of their opportunities and to rise to the height of their responsibilities in this day of electricity."

Mr. Edison's introductory remarks were followed by two-minute addresses by Louis A. Ferguson, Chicago, Ill., president of the American Institute of Electrical Engineers; W. C. L. Eglin, Philadelphia, Pa., president of the National Electric Light Association; W. W. Freeman, Brooklyn, N. Y., president of the Association of Edison Illuminating Companies; E. G. Acheson, Niagara Falls, N. Y., president of the American Electrochemical Society; H. A. Lardner, New York, N. Y., president of the New York Electrical Society.

The show was declared open in a brief phonographic speech by the Hon. Charles E. Hughes, governor of New York.

Following the formal opening exercises, the proceedings in the concert hall were continued by the esperanto societies of New York and vicinity.

Among the more prominent exhibits were those of the New York Edison Company, the United Electric Light and Power Company, the Brooklyn Edison Company, the General Electric Company and the National Electric Lamp Association.

The exhibit of the Campbell Electric Company, of Lynn, Mass., consisted of bell-ringing transformers and other specialties.

The Driver-Harris Wire Company, Harrison, N. J., exhibited resistance wires and wire specialties.

The Eastern Sales Company, New York city, exhibited its instantaneous water heater.

The Edison Electric Illuminating Company of Brooklyn made a very remarkable display. The exhibit was divided into three sections, showing industrial, commercial and domestic applications of electricity. Easily understood practical working exhibits were in operation, and the visitors were afforded a clear demonstration of the advantages of using the electric service. The self-supporting tungsten campaign which the Brooklyn Edison Company has been conducting was graphically described, and the centrepiece of the mural decoration overtopping the Brooklyn exhibit, which extended clear across the Fourth avenue end of the Garden, called attention to the rapid growth of electric service in Brooklyn. The figures for the past decade were given and a promise made of a very great extension in the future.

The Edward E. Cary Company, New York city, made a display of stereopticon apparatus, using the "Fabius Henrion" noiseless carbons working on alternating current, and the Hallberg electric economizer.

The Electric Home Supply Company, New York city, had a live exhibit of electrical appliances for home use, including heating and cooking devices, Shelton vibrators and other small electrical devices.

The exhibit of the Electric Motor and Equipment Company, of Newark, N. J., was the centre of a great deal of attention, a flashing unit electric sign being shown in operation.

The Electrical Testing Laboratories, New York city, made an elaborate exhibit of stationary and portable photometers, and had in operation a 100,000-volt transformer making a spray test for insulation. Another unique demonstration at this booth was the projection on a transparent screen of the arc from a carbon arc, a magnetite arc and a flaming arc.

The Enos Company, New York city, exhibited a number of very handsome lighting specialties.

The Excello Arc Lamp Company, New York city, made a fine display of its flaming arcs and illuminated the entrance to the Garden with ten Excello lamps.

The F. Alexander Electric Company, New York city, displayed its miniature arc lamp, which is claimed to give a quality of illumination closely approximating daylight.

The Federal Sign System, New York city, exhibited its unit letter and panel signs.

The Fox Brothers Company, New York city, exhibited the "Polar," the "Radiante" and the "Radiante Economy" flaming arc and incandescent lamps.

The General Electric Company, Schenectady, N. Y., had a very handsome and complete exhibit of motor applications, and made a comprehensive demonstration of all forms of incandescent lighting for residence and industrial service. A feature which attracted much attention was a machine that applied a two-color sleeving to a pair of twisted telephone cords.

The German-American Electric Company, New York city, exhibited the Grant flaming arc lamps for alternating and direct currents.

The Goulds Manufacturing Company, New York city, exhibited electrically driven pumps.

The Habirshaw Wire Company, Yonkers, N. Y., had a very attractive reception headquarters and made an exhibit of wires and cables for various purposes.

The International Text Book Company, Scranton, Pa., made a very interesting historical exhibit and demonstration of its correspondence courses.

The Manhattan Electrical Supply Company New York city, exhibited a very comprehensive line of electrical specialties.

The Metropolitan Engineering Company, Brooklyn, N. Y., made an exhibit of its panel signs and attraction letters.

The Murphy Rectifier Company, Rochester, N. Y., exhibited a unique mechanical rectifying system.

The engineering department of the National Electric Lamp Association, Cleveland, Ohio, made its usual handsome display. Tungsten multiple lamps from one and one-quarter to thirty, and from 100 to 125 volts, were shown. The tungsten miniature low-voltage regular and meridian types of lamps were on exhibition operating in multiple at 1.25 watts per candle. A sign board was equipped with tungsten miniature lamps, and a showcase contained low-voltage lamps, operating on one and one-quarter to thirty-volt circuits. The arches of the booth and a ball surmounting the whole canopy were outlined with ten-volt frosted sign lamps. This lamp is being largely used for outlining, sign, decorative and show-case lighting. For the first time the twenty-five-watt, 100 to 125-volt tungsten lamp was shown, and was greatly admired for its adaptability to general residence illumination. The tungsten regular forty, sixty and 100-watt lamps were shown on the side arches, equipped with Holophane extensive, intensive and focusing types of reflector. The centre of the booth was illuminated with a tungsten 250-watt lamp equipped with a bowl reflector. The frosted-bulb tungsten meridian lamps in forty and sixty-watt sizes were used as pendants from the centre roof arches. On the side brackets there were mounted different kinds of Gem, tantalum and tungsten lamps, making a very pretty comparison. An attractive setting was given the tantalum forty and eighty-watt regular and meridian styles burning at two watts per candle. The engineering department of the National Electric Lamp Association is maintained by the following companies: The Banner Electric Company, the Brilliant Electric Company, Bryan-Marsh Company, the Buckeye Electric Company, Cleveland Miniature Lamp Company, the Colonial Electric Company, the Columbia Incandescent Lamp Company, Economical Electric Company, the Fostoria Incandescent Lamp Company, the General Incandescent Lamp Company, Munder Electric Company, New York & Ohio Company, the Shelby Electric Company, the Standard Electrical Manufacturing Company, the Sterling Electrical Manufacturing Company, the Sunbeam Incandescent Lamp Company, the Sunbeam Incandescent Lamp Company of Canada, Limited, the Warren Electric and Specialty Company.

The National Vacuum Company, New York city, exhibited its portable motor-driven cleaning machines.

The Numaticon Company, New York city, exhibited its sanitary method of cleaning for residence and industrial purposes.

The Otis Elevator Company, Yonkers, N. Y., made a very impressive exhibit of alternating-current and direct-current elevators for both push-button control and industrial service.

The Simplex Electric Heating Company, under the direction of Roger Williams, of New York city, made a fine display of electric heating and cooking appliances.

The Spencer Turbine Cleaner Company, New York city, exhibited its system of cleaning floors, walls, draperies, etc., by means of its compressed-air and exhaust system.

Stanley & Patterson, New York city, exhibited a very complete line of electrical devices and afforded a timely demonstration of the new Patterson wireless battery holder.

The Tel-Electric Music Company, New York city, equipped a suite of rooms with its electrical piano players.

The exhibit of the New York Edison Company was one of the most decorative features of the show. Elaborate reception headquarters were established, and a host of representatives was on hand to afford information to those seeking knowledge of the utility and desirability of electric service.

The Simes Company, New York city, exhibited a very complete line of fixtures for tungsten lamps.

The United Electric Light and Power Company, New York city, made a very comprehensive display of alternating-current apparatus. This included everything from heavy-duty elevator motors and industrial presses to incubators and brooders. In the company's historical exhibit there were shown a number of very amusing toys which acted peculiarly under the action of the alternating current. There was also in one corner of the booth an induction motor running submerged in water. The alternating-current lighting display was particularly effective, and afforded a very successful demonstration of the adaptability of the metallic-filament lamps to this service.

The Watson-Stillman Company, New York city, exhibited a fine line of motor-driven tools.

The Empire City Subway Company, New York city, made a fine exhibit of poles, cables, manholes and cable runs, and a complete welding and track-laying equipment mounted on a steel-truss truck.

The New York *Times* tendered the use of its searchlight during the show, and also maintained a wireless telegraph service in connection with the Marconi Wireless Telegraph Company. A motor-driven Mergenthaler linotype was used to compose messages as received, and these were taken hot from the machine and placed on a motor-driven printing press and distributed to those in attendance.

The Moore tube light, manufactured by the Moore Electrical Company, of Newark, N. J., illuminating the lobby of the Garden.

One of the features of the show was the historical exhibit and the prize essay competition which was conducted by the Educational Committee and the General Advisory Board in connection with the exhibition.

The show is scheduled to run until Wednesday, October 14.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on October 13 for the following electrical material: Miscellaneous cable, 11,700 feet of telephone cable, miscellaneous electrical supplies, for delivery at Norfolk, Va.; miscellaneous conductor, 8,000 feet of silk and cotton lamp cord, miscellaneous electrical supplies, and 500 porcelain tubes, for delivery at Annapolis, Md.

THE ARKANSAS ASSOCIATION OF PUBLIC UTILITIES OPERATORS.

FIRST ANNUAL CONVENTION, HELD AT LITTLE ROCK, ARK., SEPTEMBER 17 AND 18.

The first annual convention of the Arkansas Association of Public Utilities Operators was held at Little Rock, Ark., September 17 and 18. The association was welcomed to the city by Mayor William R. Duley. President D. A. Hegarty, in his opening address, called attention to the necessity of appointing a committee which could confer with the state legislative committees upon questions affecting the public utilities corporations. Mr. Hegarty also made suggestions concerning meetings of the executive committee, and, in the name of the association, thanked the associate members for their activity and the support which they had given to the work of organization.

A paper was presented by B. C. Fowles, entitled "Source of Supply of Water for Municipalities." This paper described the conditions of water supply in the state of Arkansas, and the author gave a great many practical suggestions with regard to the utilization of driven wells.

A paper entitled "Roadbed Construction and Pavement" was presented by Edwin Hardin. An abstract of this paper follows:

During the past decade the necessity for permanent-track construction for paved thoroughfares has reached the street-car companies of the South and West even in the cities of comparatively small population. Not many years since want of practical experience, with a considerable variety in both material and method to choose from, caused great diversity in roadbeds. In this way every possible manner of construction and character of material has been thoroughly tested.

However, the application of the knowledge gained by actual experience is greatly hindered in many instances by city ordinances, specifying classes of rails, roadbed and tie methods that have proved unsatisfactory. It is the want of accurate knowledge and the want of confidence in the sincerity of street-car companies on the part of the city law-makers that delay the use of methods that have proved themselves superior to all others.

This article will be confined to a brief sketch of the factors that go into building a permanent track suitable for all conditions and which has been generally accepted as the most economical in the long run.

The subgrade should have at least ten inches of ballast, with a bottom course of No. 4 crushed rock, fully six inches in depth, topped to the level for the reception of ties with finer crushed rock, and should be well tamped. The coarse rock at the bottom will assist in drainage, which is very important, and every advantage should be taken of all opportunities to run tile from the subgrade into the city drainage. On account of the necessity for drainage, no concrete should enter into the composition of the subgrade.

Tie construction is always feasible and always reliable, and the tendency is to return to ties after a trial of stringer construction—wherever ordinances do not prevent. The treated tie may now be accepted as the most satisfactory for the permanent bed, especially where paving is used. Not only are treated ties thoroughly satisfactory, but also they are the cheapest in the long run. This is particularly true where tie-plates are used, and their use always is advisable. With ties placed twenty-one inches between centres there is no necessity for tie-rods, except where especially high rails are required.

Only the standard T-rail may be considered as satisfactory for general use. This section presents the best form of rail yet devised. It has the most economical disposition of weight, is thoroughly adaptable to all conditions of traffic and rolling-stock construction, and at the same time does not require expensive factory-made curves.

The use of girder and grooved rails is now almost limited to meet requirements of ordinances enacted without regard for the valuable practical experience of recent years. Even where unusually high rails are specified, the T-rail is still the most satisfactory when considered from every standpoint.

A standard T-rail varying in weight from sixty pounds to ninety pounds, considering traffic and team travel as well as number, weight and speed of cars, will meet all conditions.

The sixty-foot rail is better than the shorter one for obvious reasons—the duration of the rail itself, smooth riding surface, ease on rolling stock and the lesser number of joints.

The bonds are one of the most important factors in construction. The protected bond is the most satisfactory and is the only bond that may be considered permanent. In placing bonds the bond terminals and the reception holes in the rails should both be thoroughly tinned. Next, the terminals should be well soldered and then allowed to cool completely before being compressed. The pressure should be applied until after the soldering because of the vast difference in the relative expansion of copper and steel. In this way only can a perfect contact be effected—one that will allow no space for the formation of verdigris, cause no undue loss in the transmission of current and not require further expense in maintenance.

The under-truss or base-supported joint has largely solved the vexatious problem of joints. In the angle-bar and fish-plate joints, with all the protection of spring nut-locks, etc., bolts will stretch with use and the unavoidable stresses will make themselves evident. With the under-truss or base-supported joint the lost motion is to a great extent taken up as it develops. The joint holds the receiving rail rigid and level, thus preventing the pounding and wear on the ends where the rails are most susceptible to wear and need the most protection.

After the subgrade and track have been completed then the entire surface of the prepared roadbed should be covered with a layer of concrete. The concrete mixture should be made of good standard quality of Portland cement in the following proportions: One part cement, three parts clean, sharp sand and five parts clean, crushed stone. This mixture should be used as wet as possible, but care should be taken that the quantity of water is not so great as to cause the cement to be washed away and wasted. When the cement has been thoroughly tamped and rammed between ties it should cover the entire roadbed to a depth of at least six inches; in fact, to as great a depth as the rail height and dimensions of paving material will permit.

The concrete should be given every possible opportunity to set. Where conditions will permit, two or three days should elapse before the paving is placed and then, if possible, a week longer before traffic is opened. This frequently is not the case, but when full ten days' time is given the cement in which to set then the very best roadbed conditions are assured.

Upon the concrete foundation there should be laid a cushion of fine, sharp, clean sand. This should be from one and one-quarter inches to one and one-half inches deep in the centre, to three-quarter inch to one inch deep at the rails, thus allowing a one-half-inch crown.

These considerations contemplate paving with blocks, brick or stone. In fact, paving between tracks, to be at all satisfactory, must be in the form of blocks because repairs will be necessary from time to time regardless of every care that may be taken. A rigid roadbed also must be guarded against.

Vitrified paving brick is the most satisfactory paving material. If nose brick are used next to the rails inside they should be laid as compactly as possible. Every tenth course should be brought to line and a one-inch expansion joint be placed every fifty feet. When the brick have been laid they should be well rolled with a roller weighing at least 1,000 pounds. This forces them to proper surface. The expansion joints should be filled with a mixture of pitch and sand and the entire surface flooded with cement grouting, thus completely filling every crack and crevice.

No matter how light the traffic may be, hard centre special track work will be the more economical in the long run and much more satisfactory in use.

The relative cost of track with material and methods as here described will compare very favorably with any other method that has been attempted when the permanency of this track is considered and the lessened cost of maintenance and wear on rolling stock are credited to the original cost as time elapses.

A paper entitled "Advantages and Disadvantages of Tungsten Lighting to Central Stations" was presented by T. R. Phillips. Mr. Phillips compared the tungsten lamp with other forms of illumination, and said that, in his opinion, the customers should be fully informed regarding the possibilities of the new lamp. He believed that this information should come from the lighting company, rather than from any outside source. If the lighting companies failed to push the new lamp, the consumer would naturally feel that the company was not in sympathy with the high-efficiency unit and was trying to hold off because of a more attractive revenue which was possible with the older forms of lamps. He thought that the tungsten lamp was very valuable in meeting competition and in getting business which was not heretofore available. He cited examples where, by the introduction of the tungsten lamp, dissatisfied customers had been retained. In one case, where a customer had an installation with a total equivalent of forty-nine sixteen-candle-power lamps, he became dissatisfied and threatened to discontinue the use of the electric service. His installation was replaced with tungsten lamps, which reduced the installation to an equivalent of eighteen sixteen-candle-power lamps. The bill was reduced from $28 to $15 per month. While this looked like a loss of revenue it amounted in the end to a loss of only $13; and, in addition, the customer was so well satisfied that he paid for the entire change in installation.

The entire session on Friday morning, September 18, was given up to a discussion of topics of interest to the public utilities operators. President Hegarty opened the discussion on the subject of charging renewals of incandescent lamps to maintenance expense. Within the last few years bankers buying the bonds of electric lighting companies in Arkansas, and trust companies, in underwriting mortgages, were insisting upon a maintenance expenditure of ten per cent in order that the property might be kept in first-class condition. In a great many installations it was difficult to meet this ten per cent charge unless the cost of renewals and similar repairs could be charged in as maintenance. This matter elicited a vigorous discussion, and the consensus of opinion seemed to be in favor of swinging the item for incandescent-lamp renewals into the maintenance charge. In some central stations the cost of free renewals amounted to two and one-half and three per cent. If this cost were charged to maintenance it would facilitate the figuring in of a ten per cent maintenance charge.

Several of the speakers were of the opinion that the renewal of incandescent lamps was practically of the same order as the trimming of arc lamps and the renewing of carbons. There was, however, a considerable difference of opinion, and it was finally suggested that the matter be referred to the National Electric Light Association at a subsequent annual convention.

Another subject which was given considerable discussion was that of public utility corporations dealing with political matters. Of course, where a municipal plant is involved it is a political issue, and some of the members deplored the fact that political interference sometimes took such a turn that the operators were unable to carry out the demands made upon them by the city council. After a lively discussion it was concluded that the opportunity for successful municipal operation was slight, because of the rotation in office. In some of the towns the matter of the municipal lighting property became a direct issue, one party favoring the continuance of the municipal lighting scheme, and the other party favoring selling the property to private individuals. One instance was mentioned of a town where a municipal electric lighting plant supplies the city lighting. On a moonlight schedule it was claimed that the operating expenses were about $39.50 per light. The corporation in this town could not meet this price because the municipal plant was not charged with taxes nor was anything set aside for depreciation.

It was unanimously voted that the present officers of the association remain in office for the ensuing year. Hot Springs, Ark., was selected as the next place of meeting, the date to be decided by the executive committee.

After extending a vote of thanks to the Marion Hotel Company, of Little Rock, and the Little Rock Railway and Electric Company, for courtesies extended during the convention, the meeting was adjourned.

The officers of the association are: D. A. Hegarty, Little Rock, president; J. E. Cowles, Hot Springs, secretary.

Fall Meeting of the New York Electrical Society.

The opening meeting of the New York Electrical Society for the season 1908-09 will be held in the concert hall of Madison Square Garden on Monday, October 12, at 8.30 P. M.

William Maver, Jr., will deliver a half-hour address on "The Dramatic Phases of the Early Cable Work," giving a succinct account of the early progress of submarine-cable laying, leading up to the making and laying of the cables of 1858 and 1866. This address will be illustrated with lantern slides showing the prominent features of this work and those engaged in it.

Through the courtesy of the Electrical Show, the members of the New York Electrical Society will visit the exhibition after the meeting free of charge, and will be welcomed at the society's headquarters in the northeast corner of the building.

Suit has been brought in Common Pleas Court in Cleveland by the Cleveland Railway Company for $220,134 quarterly rent for the street railway lines leased to the Municipal Traction Company. This rent, tendered September 30 by the Municipal Company under condition that the money be used in declaring a dividend to Cleveland Railway stockholders, was refused by the Cleveland Railway under these conditions, formal demand for its payment October 1 being made.

Seeing by Wire.

The problem of seeing by wire, which has occupied scientists and inventors for many years, seems to be in a fair way of being solved, says the *Umschau* (Leipsic), September 12, by a new method recently devised by Mr. Armengaud, the well-known president of the French Aeronautical Society. The property of selenium in changing its conductivity according to the intensity of light rays striking it is made use of in the electrical transmission of an image. In natural vision an image is produced in the eye by the different light values of an object and the problem is, so to speak, to construct of selenium an artificial retina which will receive its impressions from the electrical current variations in a circuit in which it is connected. At the distant end of the circuit the corresponding light impressions must be reproduced by the current variations; but, in order to create an image in the eye, the different light impressions must be produced simultaneously, while those transmitted by wire succeed each other. This difficulty can only be overcome by subjecting the selenium cell to all the light rays emanating from an object within one-tenth of a second, that is, within the time necessary for the retina to be affected by an image. In the receiver the last light impression must arrive before the first one is extinguished. This necessary speed in the transmission and reconstruction of an image has so far been an unsurmounted obstacle. Armengaud's method was suggested by the cinematograph, and is based on the ingenious mechanism by which the films receive their rapid, intermittent motion. He first produces, on the frosted glass plate of a camera, a real image of the object to be transmitted. Then he divides the image into small squares, the light from each of which is thrown on the selenium cell in rapid succession during definite and equal time intervals. The variation in the electric current is produced exclusively by the light emanating from the exposed square, independently of the duration and effect on the selenium cell; this is of importance. All the squares comprising an image are exposed in less than one-tenth of a second. The process is as follows: Two endless bands move in front of the glass plate in the manner of cinematographic films, one in a horizontal and the other in a vertical direction. Each of them is provided with slots at equal distances. At the point where the slots cross each other a square of the image is exposed to the light, and by the combined movement of the two bands a correct succession of the exposed squares is brought about. One difficulty was the well-known sluggishness of selenium to return to its original condition after illumination, which would cause a distortion of the succeeding light impressions, and, in order to prevent this, a series of elements are so arranged that they will be exposed to the light beam in rotation. For the retransformation of the electrical current variations into light effects Armengaud intends to utilize Belin's method together with a Blondel oscillograph and a color scale; that is, the electrical current variations are transmitted to a small mirror in a magnetic field. Light rays are made to strike the mirror and are reflected by a system of lenses to a screen, where they appear, according to the strength of the electric current, as a series of more or less strong light effects in extremely rapid succession; that is, as an image. At the present time Armengaud is engaged in practically testing his apparatus; but whatever his results may be, it appears certain that his labors indicate the solution of this difficult problem.

The Illuminating Engineering Society.

The second annual convention of the Illuminating Engineering Society was held at Philadelphia, Pa., on Monday and Tuesday, October 5 and 6. Headquarters were established at the Hotel Walton, and sessions were held on the morning and afternoon of both days. The following programme was announced:

Monday, October 5, at 10.30 A. M.—Address of welcome, Hon. John E. Reyburn, mayor of Philadelphia. Presidential address, Dr. Louis Bell—A study of the problem of street lighting in its broader aspects, especially with reference to the choice and placing of lamps in their relation to effective illumination. Report of Committee on Nomenclature and Standards, presented by Dr. A. C. Humphreys, president Stevens Institute.

On Monday, October 5, at 8 P. M., the following papers were presented:

"Modern Gas Lighting Conveniences," by T. J. Little, Jr.

"Illuminating Value of Petroleum Oils," by Dr. A. H. Elliott.

"Street Lighting Fixtures: Gas and Electric," by H. Thurston Owens.

"Structural Difficulties in Installation Work," by James R. Strong.

"Architecture and Illumination," by Emile G. Perrott.

On Tuesday, October 6, at 9.30 A. M., the following papers were presented:

"Intensity of Natural Illumination Throughout the Day," by Leonard J. Lewinson.

"The Integrating Sphere in Industrial Photometry," by Dr. Clayton H. Sharp and Preston S. Millar.

"The Ives Calorimeter in Illuminating Engineering," by Dr. Herbert E. Ives.

"Calculating and Comparing Lights from Various Sources," by Carl Hering.

"The Calculation of Illumination by the Flux of Light Method," by J. R. Cravath and V. R. Lansingh.

On Tuesday, October 6, at 2 P. M., these papers were taken up:

"Street Lighting with Gas in Europe," by E. N. Wrightington.

"Design of the Illumination of the New York City Carnegie Libraries," by L. B. Marks.

"Engineering Problems in Illumination," by Alfred A. Wohlauer.

"Intrinsic Brightness of Lighting Sources," by J. E. Woodwell.

"Some Experiments on Reflection from Ceiling, Walls and Floor," by V. R. Lansingh and T. W. Rolph.

"The Relation Between Candle-Power and Voltage of Different Types of Incandescent Lamps," by Francis E. Cady.

Electricity in Mines.

Kurt Perlewitz is the author of a series of articles in the *Elektrotecnische Zeitschrift,* August 20 and 27 and September 3, treating on the electrical equipment of the "König Ludwig" coal mines in Recklinghausen, Germany. There are several power plants operating in parallel, using reciprocating engines, turbines and waste gas engines. The latter are of the four-cycle type and use coke-oven gas. The steam for the reciprocating engines and turbines is generated by means of coke-oven gas, which passes through fire-brick-lined ducts to a bank of boilers of the combined Lancashire and return tubular type. Steam is generated under ordinary conditions at 115 pounds and 570 degrees Fahrenheit superheat. By using the lower section only (Lancashire boiler) the steam is raised to 175 pounds. The second article treats on the switch gear and transformers. The third article covers the description of power plant No. 2, containing reciprocating and gas engines. (Power plant No. 1 contains turbines.) The generators are 500 kilovolt-amperes, 5,200-volt, fifty cycles. In plant No. 2 the double bus-bar system is used, while in No. 1 the ring system is used.

Street Railway Week.

Conventions of the American Street and Interurban Railway Association, the Accountants' Association, the Engineering Association, the Claim Agents' Association, and the Transportation and Traffic Association, Atlantic City, N. J., October 12-16.

THE annual convention of the American Street and Interurban Railway Association and its affiliated and allied associations will be held at Atlantic City, N. J., October 12, 13, 14, 15 and 16. The American Street and Interurban Railway Manufacturers' Association is making great preparations for a magnificent exhibit, which will cover the entire area of Young's million-dollar pier. One hundred and fifty different companies have already been assigned exhibit space. The association booth for the registration and information of delegates and guests to all of the associations will be located at the Boardwalk entrance to the pier. The Manufacturers' association will also have a booth at the same place, which will take care of similar matters relating to the exhibitors and the members of that organization.

All of the meetings of the American association and of the Transportation and Traffic Association will be held in the Greek Temple, near the outer end of the convention pier. The Accountants will hold their two sessions on Wednesday, at the Chalfonte Hotel, and their Thursday and Friday sessions in the Aquarium Court Hall, near the Boardwalk end of the convention pier. The Engineers will hold their Tuesday and Wednesday sessions in the Aquarium Court Hall, and their Friday session in the Greek Temple. The Claim Agents will hold all of their sessions at the Traymore Hotel.

The following programme has been announced:

ACCOUNTANTS' ASSOCIATION.

Tuesday, October 13—2 to 5 P. M.—Registration and badges.

Wednesday, October 14—9.30 A. M. to 12.30 P. M.—Convention called to order. Annual address of president. Annual report of executive committee. Annual report of secretary-treasurer. Paper—"Organization of the Accounting Department of an Electric Railway and Light Company," by A. R. Patterson, general auditor Savannah Electric Railway Company, Savannah, Ga. Report of Committee on Collection of Blanks and Forms, by Elmer M. White, secretary Accountants' Association, Brooklyn, N. Y. Appointment of Convention Committee. New business.

Wednesday, October 14—1 P. M.—"Get together luncheon."

Thursday, October 15—9.30 A. M. to 12.30 P. M.—Paper—"Interline Accounting of Interurban Railways," by W. H. Forse, Jr., secretary and treasurer Indiana Union Traction Company, Anderson, Ind. Paper—"Accounting Methods of a Holding Company," by P. S. Young, comptroller Public Service Railway Company, Newark, N. J. Report of Committee on Standard Classification of Accounts and Form of Report. Report of Committee on International Standard Form of Report. Appointment of Nominating Committee.

Friday, October 16—9.30 A.M. to 12.30 P. M.—"The Effect of Electrification on the Accounting Methods of Steam Railways," by A. B. Bierck, general auditor Long Island Consolidated Electrical Companies, Long Island City, N. Y. Reports of convention committees. Report of Nominating Committee. Election of officers. Installation of officers. Adjournment.

ENGINEERING ASSOCIATION.

Tuesday, October 13—9.30 A. M. to 12.30 P. M.—Registration and badges.

Tuesday, October 13—2 P. M. to 5 P. M.—Convention called to order. Annual address of president. Annual report of executive committee. Annual report of secretary-treasurer. Appointment of convention committees. Report of Committee on Maintenance and Inspection of Electrical Equipment.

Wednesday, October 14—9.30 A. M. to 12.30 P. M.—Report of Committee on Standardization. Report of Committee on Power Generation.

Wednesday, October 14—2 P. M. to 5 P. M.—Report of Committee on Control. Appointment of Nominating Committee. Report of Committee on Power Distribution.

Thursday, October 15—9.30 A. M. to 12.30 P. M.—Exhibition of exhibits.

Thursday, October 15—2 P. M. to 5 P. M.—Inspection of exhibits.

Friday, October 16—9.30 A. M. to 12.30 P. M.—Report of Committee on Car and Car-House Wiring. Report of Committee on Operating and Storage Car-House Designs. Question box.

Friday, October 16—2 P. M. to 5 P. M.—Report of Committee on Way Matters. Report of Committee on Economical Maintenance. General business. Report of Nominating Committee. Election of officers. Installation of officers. Adjournment.

CLAIM AGENTS' ASSOCIATION.

Monday, October 12—9.30 A. M. to 12.30 P. M.—Registration and badges.

Monday, October 12—2 P. M. to 5 P. M.—Convention called to order. Annual address of the president. Annual report of the executive committee. Annual report of the secretary-treasurer. Appointment of convention committees.

Tuesday, October 13—9.30 A. M. to 12.30 P. M.—Paper—"The Organization of a Claim Department for a Small or Moderately Large Company, Including a School of Instruction as a Means of Preventing Accidents," by Francis J. Ryan, M.D., Syracuse Rapid Transit Railway Company, Syracuse, N. Y. Paper—"The Claim and Its Disposition," by Peter C. Nickel, claim agent New York City Railway Company, New York, N. Y.

Tuesday, October 13—2 P. M. to 5 P. M.—Paper—"Uniformity in Claim Department Records and Accounts," by John J. Reynolds, claim agent Boston Elevated Railway Company, Boston, Mass. Paper—"The Duties of Claim Agents and Other Officials of Quasi-Public Corporations to the Public," by Eugene R. Roberts, attorney Knoxville Railway and Light Company, Knoxville, Tenn. Appointment of Nominating Committee.

Tuesday, October 13—8 P. M.—Social smoker and entertainment. (Place to be announced later.)

Wednesday, October 14—9.30 A. M. to 12.30 P. M.—Question box. Discussion—"The Medical Side of the Prevention of Accidents." General business. Reports of convention committees. Report of Nominating Committee. Election of officers. Installation of officers. Adjournment.

TRANSPORTATION AND TRAFFIC ASSOCIATION.

Monday, October 12—9.30 A. M. to 12.30 P. M.—Registration and badges.

Monday, October 12—2 P. M. to 5 P. M.—Convention called to order. Congratulatory address by the Hon. W. Caryl Ely. Annual address of the president. Report of organization meeting. Annual report of the executive committee. Annual report of the secretary-treasurer. Appointment of convention committees. Reports of special committees. Paper—"How Can a Small Road Best Promote Traffic and Increase Its Revenue?" by Ernest Gonzenbach, general manager Sheboygan Light, Power and Railway Company, Sheboygan, Wis. Report of Committee on Training of Employés.

Tuesday, October 13—9.30 A. M. to 12.30 P. M.—Paper—"Carrying of United States Mail on Electric Railways, Its Advantages and Disadvantages, and the Compensation Therefor," by C. H. Hile, assistant to vice-president Boston Elevated Railway Company, Boston, Mass. Report of Committee on Freight and Express. Paper—"Progress to Date in Carrying Freight and Express Matter by Electric Roads—Some Mistakes that Have Been Made and Their Remedy," by C. V. Wood, general freight and passenger agent New England Investment and Security Company, Boston, Mass.

Wednesday, October 14—9.30 A. M. to 12.30 P. M.—Appointment of Committee on Nominations. Symposium—"The Possibilities of a Well-Conducted Publicity Department," by George Sabin Brush, clerk transportation department Boston Elevated Railway Company, Boston, Mass.; B. R. Stephens, general traffic manager Illinois Traction System, Springfield, Ill.; Charles E. Flagg, department of publicity Inland Empire System, Spokane, Wash.; George H. Gall, publicity manager Washington, Baltimore & Annapolis Electric Railway Company, Baltimore, Md.; Charles W. Lamb, advertising expert, Milwaukee, Wis. Report of Committee on Interurban Rules.

Thursday, October 15—9.30 A. M. to 12.30 P. M.—Paper—"The Operation of Multiple-Car Trains on Interurban Roads," by D. F. Carver, receiver Trenton & New Brunswick Railroad Company, Trenton, N. J. Report of Committee on Passenger Traffic. Report of Committee on Rules for City Operation. General business. Report of Nominating Committee. Election of officers. Installation of officers. Adjournment.

The Manufacturers' association has practically completed its plans for entertainment during the convention, and the detailed arrangements will appear in the official programme. On Monday evening occurs the annual carnival of the Atlantic City Business League. On Tuesday evening the annual reception will be held at the Marlborough-Blenheim Hotel. The amateur vaudeville performance will be given at the Savoy Theatre on Wednesday evening, two theatres have been engaged for Thursday evening and a musical entertainment occurs at the Marlborough-Blenheim on Friday evening. In addition, there will be several afternoon entertainments for the ladies during the convention week.

The Conservation and Use of Water-Power Resources.

In a previous article under the above title, in the *Engineering Magazine* (New York), October, the author, H. von Schon, proposed a plan for Federal, state and corporate action in the conservation and development of water-power resources. In the present article the extent of the influence conservation might exercise on national economic conditions is taken up. Mr. von Schon has designed power plants on some of our southern rivers within recent years where the flood-flow volume is 100 times the normal flow. The adaptation of hydroelectric installations to such conditions presents problems that can be met only by special and costly works and safeguards. Great loss of efficiencies of the generating equipment can not be avoided during the periods of excessive fluctuations of flow, while continuous output can be secured only by the aid of large auxiliary power installations. All stream flow has its origin in so much of the precipitation as is not evaporated, this term embracing the quantity of moisture absorbed by vegetation and that which evaporates. The residue of precipitation runs off the surface immediately or sinks into the ground, whence it feeds gradually into the stream channels. The ratio of surface run-off to ground-storage supply depends entirely upon the surface and subsurface characteristics. A forested area, with its deep layer of leaves, brush and humus, is a sponge which becomes saturated with water, and is a natural storage reservoir. The foliage canopy of the trees breaks the force of the downpouring rain, which reaches the ground gradually; and finally the snowfall remains in the forest to melt gradually, and then sink into the ground. Water waste, with collateral flood destructions of life and property through constantly increasing erosions of fruitful top soil, was recognized and acted upon by some of the European countries hundreds of years ago. Switzerland, in 1680, enacted a forest conservation statute. Twenty per cent of the republic's area is in conserved forests, some 2,000,000 acres. The cost of maintenance and supervision is $1.32, and the net revenue $2.25 per acre annually. Germany's forest area is 35,000,000 acres, and its system of forest preservation was inaugurated 150 years ago. France has 23,000,000 acres of forests, all under admirable preserve laws. The combined population of these two countries exceeds that of the United States by about 15,000,000. They now expend annually on forest preservation some $11,000,000, and enjoy a net revenue of about $30,000,000; while the United States forestry expenditures last year aggregated $1,400,000, and the revenue was $130,000. The total forest area of this country aggregates 600,000,000 acres, of which about 150,000,000 acres are now under federal and state forest reserve protection. The total timber consumption to-day is nearly three times the total annual new growth, and water conservation by the aid of the forests does not look very promising for the near future. Prompt relief can be had only by the storing of the largest practicable flood-run-off per cent and the distribution of this quantity during the dry season. With the conserving of the forests and the water-power resources, the country will naturally come back to the greater utilization of its inland waterways. Railroads can not keep up with the enormous rapidity of progress, and to meet the greater transportation requirements of the future, inland water transportation will have to be developed. Inland waterways and electric traction are destined to become the chief transportation methods of the future, and the development of both of these is a collateral consequence of the conservation of water and of the water-power resources.

American Institute of Electrical Engineers Catalogue of Wheeler Gift.

The bibliographical catalogue of the books, pamphlets and periodicals of the celebrated Latimer-Clark collection presented by Dr. Schuyler Skaats Wheeler to the American Institute of Electrical Engineers has just been completed and is about to go to press. This critical catalogue has been in preparation for the past six years under the direction of W. D. Weaver, with the collaboration of Brother Potamian, of Manhattan College, and a number of other authorities here and abroad. The expense of this unique work has been defrayed by Andrew Carnegie. As soon as the book comes from the press it will be distributed to the members of the Institute, who, according to the deed of gift of the library, are entitled to the catalogue.

THE DISCOVERY AND DEVELOPMENT OF THE LAWS OF THERMO-DYNAMICS.[1]—III.

BY DUGALD CLERK.

(Concluded.)

We now come to Siemens's paper "On the Conversion of Heat Into Mechanical Effect," and for the first time we find the engineer guided by an intelligible principle. Siemens discussed the material theory of heat, and accepted unreservedly the dynamical theory, for which he gives a large measure of credit to Joule. This is the first of the institution papers in which I find the name of Joule. Siemens mentions Carnot, Clapeyron, Holtzman, of Mannheim; Joule, Helmholtz, Meyer, Rankine and Professor Thomson. Curiously enough, although Siemens mentions Carnot and the other philosophers who dealt with the Carnot principle, including Thomson, he does not appear at this date—May 17, 1853—to have realized himself the effect of the law of Carnot upon the theory of the heat engine. He clearly appreciated the first law, and gives the mechanical equivalent of heat as determined by Joule at 770 foot-pounds, and by Thomson's formula as 772 foot-pounds, but in his discussion of the principles of the heat engine he is of opinion that a perfect engine is ideally possible giving 770 foot-pounds for each Fahrenheit heat unit employed. This is clear from a table found on page thirty-three of the paper, which I reproduce:

SIEMENS'S TABLE OF 1853.

Description of Engine.	Theoretical Performance in Foot-Pounds.	Actual Performance in Foot-Pounds.	Actual Performance in Pounds of Coal per Horse-Power per Hour.
A Boulton and Watt condensing engine, low pressure	51.8	29	8
The best Cornish engine	158.8	82	2.38
Combined steam and expansive-ether engine	150	75	3.09
The expansive-air engine	91	35	6.63
Stirling's engine	130	65	3.57
Ericsson's engine	196	65	3.57
A perfect engine	770	385	0.60

He apprehends the mechanical equivalent of heat, but he still appears under the impression that if heat be added to a certain upper temperature and expansion take place until the original temperature is reached, then he has a perfect engine indicating the full result of Joule's mechanical equivalent. He sees, however, that the old theory of the regenerator is quite wrong. He states:

"The cause of the failure of Mr. Stirling's engine in practice may apparently be traced chiefly to insufficiency of heating surface, occasioned apparently from misapprehension of the principle involved, it having been thought that the same heat would serve over and over again to produce power, and that the necessary expenditure of heat consisted only in the mechanical loss by imperfect action of the respirative plates, which were approached to each other to the utmost limits consistent with an unobstructed passage of the air. By the aid of the dynamical theory of heat it has been shown that there is another and far more important expenditure of heat which should have been provided for."

Siemens, in the discussion, rightly upheld the regenerator as useful, but saw that there were limitations to its use. Mr. Hawksley contended that the regenerator was useless. Mr. Pole considered that the regenerator was useful, but he did not definitely adopt the mechanical theory of heat. He stated:

"It must be allowed that the general action of caloric in producing power was still involved in much obscurity. The heat was often considered in reference to its quantity only, but it was certain also that its intensity performed a very important part; and it had even been surmised that power might be obtained by the reduction of intensity alone, without any change of quantity."

Armstrong concurred with Siemens and Pole. He believed in the utility of the regenerator, limited as described by both. Edward Woods certainly understood Siemens to have given 772 foot-pounds as the efficiency of an ideal heat engine, because he stated that this showed there was still great room for improvement in engines. E. A. Cowper had clear ideas. He said:

"Steam, or gases, in expanding, and so giving out power, lost heat. Part of the sensible heat became latent in the production of power, and this heat could only be recovered by expending the power already produced in again condensing the steam back to its original bulk, when the latent heat again became sensible."

This discussion, then, puts us in the position of engineers at the date of the last meeting referred to—May 17, 1853. Of all the distinguished engineers who spoke, Siemens alone had thoroughly apprehended the value of Joule's results, and understood the full bearing of the mechanical equivalent of heat. He had not, however, understood Carnot's reasoning on the Carnot cycle, or Thomson's deductions from Carnot. He was under the impression that heat added in any way to a working fluid, raising the temperature, could be entirely converted into work by a sufficient expansion. He had not appreciated that, even if expansion be carried far enough to reduce the temperature to the original temperature before heat addition, yet complete conversion of the entire mechanical equivalent was impossible. When so able a man as Siemens had at this stage only reached partial enlightenment, it was evident that much hard work and clear thinking required to be done before a well-founded theory of heat motive power could be obtained. The data for such a theory were accumulating; and one of the most interesting circumstances connected with these Institution of Civil Engineers' papers was a communication from M. Regnault to Colonel Sabine, treasurer of the Royal Society, dated April, 1853, which was read at the meeting, in which Regnault stated that:

"He was about to publish immediately a series of elaborate experimental researches on various subjects connected with the effects of heat on elastic fluids, the results of which would solve many questions long in dispute, and by means of which engineers might accurately calculate the effect of a given amount of fuel, in whatever way it was applied. M. Regnault communicated in anticipation that he had arrived at the number 0.237 for the specific heat of air at constant pressure, and at 0.475 for that of steam under atmospheric elasticity, the specific heat of water being taken in each case as unity."

True to his word, Regnault produced his admirable investigations and succeeded in solving many problems; but he did not settle the questions to the extent he had hoped. Even at the present time doubt arises as to the very values he gave for the specific heat of air and steam. The problem proved much more difficult than he had anticipated, and for modern-engine purposes it can not be considered as wholly solved now—fifty-five years later.

This description of the position of the hot-air engine, as shown by the opinions of eminent engineers, is most useful as proving how much practical men were in need of the work of Thomson and Joule. It is not surprising that, of all the engineers present, Siemens appeared to be alone in thoroughly grasping the new ideas. Thomson's own conversion from

[1] Presidential address delivered to the Engineering Section of the British Association for the Advancement of Science, Dublin, September 3.

the material theory of heat to the dynamical theory was not complete until 1851, and although he had then succeeded in reconciling the ideas of Joule and Carnot, it is not to be wondered at that engineers two years later had not quite succeeded in grasping the combination of the two laws. This combination, however, supplied engineers with a new and accurate standard of measurement for studying and improving upon their heat engines, and they were by no means slow in grasping the help thus offered them by the abstract scientific man. The broad laws of thermodynamics have placed the theory of the heat engine in a position of certainty which was much needed. It would be a mistake to assume, however, that even the determination of the mechanical equivalent of heat and the second law of thermodynamics expressed in terms of an absolute thermometric scale had solved all the difficulties of the engineer desiring to determine the efficiency of his heat engines. Thomson, Joule, Rankine and their great Continental colleagues, it is true, settled once and for all the broad laws of thermodynamics, but the Carnot cycle is a cycle which is, as has been repeatedly shown, an impossible one in practice. Accordingly, actual engines have to operate upon imperfect cycles. The theory of these imperfect cycles has been worked out mostly during the last twenty-five years, although Rankine made a beginning in dealing with the theory of the Joule air engine. For the first time he showed the existence of what might be termed a cycle of constant efficiency in the case of the Joule air engine. Assuming constant specific heat for the working fluid, he calculates the efficiency of what we now call a constant-pressure air engine between certain limits of temperature, and he gives the efficiency of the fluid where U = energy exerted, and H_1 = heat received, and r = ratio of compression and expansion:

$$\frac{U}{H_1} = 1 - \frac{1}{r^{0.408}};$$

that is, he indicates in this formula that the thermal efficiency is independent of the maximum temperature as long as that maximum temperature exceeds the temperature of adiabatic compression. He makes no statement, however, that this engine is within a certain range independent of the maximum temperature—that is, that increasing maximum temperature does not increase efficiency. Subsequent work has shown that, on a simple assumption, such as constant specific heat, many engine cycles exist of a practicable nature having high theoretical efficiencies where the theoretical efficiency depends on one thing only—the ratio of compression. Some misunderstanding has arisen with regard to these imperfect cycles, and it has even been thought that such imperfect cycles would be contrary to the second law of thermodynamics. Lord Kelvin himself was of this opinion in 1881. I vividly remember a conversation I had with him at the Crown Iron Works, in Glasgow, over the results I had obtained from one of my early gas engines. I had then come to the conclusion that the Otto cycle, as ordinarily operated, was a cycle of constant efficiency, and I explained this to Lord Kelvin. He had not followed such cycles, and his view then was that no such cycle could exist, because he thought it was contrary to the second law of thermodynamics. Some idea of this kind has been held by many scientific men and has prevented the minute investigation of imperfect cycles of different kinds because of the feeling that the whole question of efficiency was entirely settled by the nature of the temperature limits—that is, by the maximum and minimum temperatures at the disposal of the engineer. It is true that these values, as has been shown, must always determine the extreme limit of possible efficiencies between certain temperatures, and in cycles of constant efficiency the particular efficiency of the cycle is always less than the efficiency of a Carnot-cycle engine working between the same limits of superior and inferior temperatures. The investigation, however, of these imperfect cycles is much more difficult than the broad investigation of the general thermodynamic laws because it requires accurate knowledge of the properties of the working fluid dealt with under conditions rendering observation extremely difficult. The modern internal-combustion motor is the successor to the air engine so fully discussed by eminent engineers of fifty-five years ago; and the forebodings of even so eminent a man as Faraday as to its ultimate success have proved unfounded. Great difficulties have been encountered and many discrepancies have had to be explained, but a minute study of the nature of the working fluid has rendered it more and more possible to calculate the efficiencies to be expected under practical conditions. At the present time we can deal with almost any cycle or any working fluid with some fair approximation to an accurate result. Much work, however, is required before all problems of the working fluid can be said to be solved with regard to any heat engine. Indeed, it may be said that under modern conditions of the use of steam even the properties of the working fluid—steam—have not yet been satisfactorily determined. The mere question of specific heat, for example, of steam and its variations of temperature and pressure is now under review, and important experiments are in progress in Britain and on the Continent to determine those properties. The properties of the working fluid of the internal-combustion motor are also the subject of earnest study by many Continental and British investigators. Notwithstanding all the perplexities involved in the minute study of the imperfect heat-engine cycles, we are in a very different position to-day compared with the engineer of 1853. We know all the broad laws as to the conversion of heat into work or of work into heat; and, numerous as are the problems yet to be solved, we at least profit by the guiding light set out for us by Kelvin, Joule and Rankine.

Proposed Extension of Electric Railway in Tokyo.

Consul-General Henry B. Miller, of Yokohama, reports the following notice of a proposed extension of electric railway in Tokyo, Japan, which should be of interest to American manufacturers of electrical railway materials:

It is stated that the Keihin Electric Company has practically succeeded in obtaining from London capitalists a loan of 1,000,000 yen ($996,000) wherewith to build a line from Aoyama terminus of the Tokyo Railway to Shingawa. Official permission was obtained some time ago, and the only question that remained was that of finance. The loan is to carry six per cent interest and the company will receive ninety-one yen ($86.27) per bond. It is said that this company intends to double its Omori Shingawa line with a view to the probability that the fisheries section of the proposed Japanese exhibition will be established at Haneda.

Another Swiss-Italian Tunnel.

Dispatches from Geneva state that a company of international financiers has received permission from the Swiss and Italian governments to bore another tunnel through Mount Blanc. On the Swiss side it will start at Martingly, and the Italian outlet will be near Courmayeur. The distance between these points is about twenty-eight miles. It is estimated that the work will take three years, and cost about $14,000,000.

ELECTRICITY IN THE PRODUCTION OF SPELTER AND SULPHURIC ACID.

THE PLANT OF HEGELER BROTHERS, DANVILLE, ILL.

The plant of Hegeler Brothers, smelters of zinc and manufacturers of sulphuric acid, is located in Vermillion County, Illinois, about four miles from the centre of the city of Danville. It is located in the midst of the Danville coal field. The coal under the extensive factory property has never been touched and Hegeler Brothers have acquired extensive coal rights under adjoining property.

The factory is designed for the production of spelter and for the manufacture of sulphuric acid. The ore is mainly purchased in the Joplin fields and brought to the plant in a concentrated form. The anthracite screenings must, of course, be brought from the East, but the bituminous coal which is used so largely in the process is at hand.

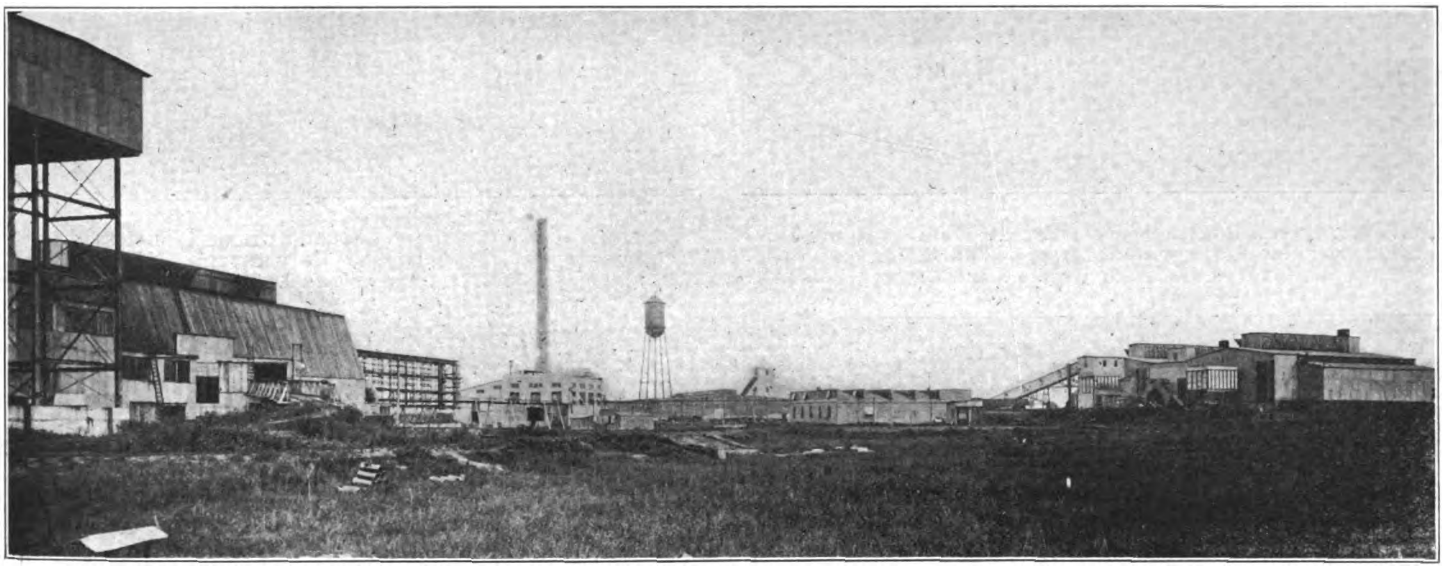
The owners of this plant were both connected, for many years, with the Matthiessen & Hegeler Zinc Company, at La Salle, Ill. This latter plant was the first manufactory of spelter and of zinc plate in this country. E. C. Hegeler, who brought the processes from Germany originally, and who is still at the head of the La Salle plant, is the inventor of practically all the modern processes for the manufacture of zinc. He developed the Hegeler calcining kiln which entirely revolutionized this part of the process.

The Danville plant includes many of the features which were developed in the plant at La Salle, but also embodies many improvements designed by Julius W. and Herman Hegeler.

The power plant is located near the centre of the buildings and comprises a boiler room and engine room, the latter of which is built of reinforced concrete with concrete roof supported on steel trusses. From the power plant live and exhaust steam are carried to the pottery building where they are used for drying; compressed air is taken to the various buildings, exhaust steam is run to the repair shop for heating purposes and the great quantity of the exhaust is carried to the acid works where it enters into the manufacture. The main exhaust line to the acid works is on eight-inch spiral pipe insulated with magnesia and protected by a form of ready roofing which protects the covering from the weather. This line is carried in part on "A" frames shown in one of the illustrations, on which frames are also carried the cross-arms for power distribution.

The boiler room at present contains two Stirling boilers, each of 250-horse-power capacity, equipped with Green chain-grate stokers. The plan contemplates the ultimate installation of four additional boilers of the same size and type. There is no use of waste heat in this plant. The chimney is of radial brick and was built by the Heine Chimney Company. It has an inside diameter of seventy-two inches and a height of 150 feet. The boiler room contains a Cochrane open feed-water heater and two centre-packed Platt Iron Works duplex feed pumps. There is no coal-conveying machinery, the fuel being brought into the boiler room on an elevated track and shoveled by hand into the stoker hoppers. Ashes are discharged into the hoppers below the boiler-room floor in a tunnel running the length of the boiler house. From this tunnel they are removed by means of horse-drawn trucks running on tracks.

The electrical equipment in the engine room consists of two three-phase, sixty-cycle National Brake and Electric Company revolving-field alternators operating at 150 revolutions per minute and delivering current at 440 volts. This voltage is maintained for all power service. For lighting service voltage is reduced to 110 at different points on the job. These generators have a capacity of 300 kilowatts and 200 kilowatts, respectively. The engines driving the generators are of the Ball Engine Company's simple four-valve type, the larger of the two machines having valves in the heads and the smaller valves in the barrel. The exciters are belted to pulleys on the engine shafts. The air equipment consists of two steam-driven Ingersoll-Rand machines, the main compressor having compound steam and two-stage air with a capacity of 500 cubic feet per minute at 100 pounds pressure. The reserve machine is of the straight-line type with a capacity of 250 cubic feet. The engine-room floor is approximately eight feet above the boiler-room floor, and the basement of the engine room contains the pump for water supply, traps, oil separators, drains, etc., and the oil filters. The supply of clean oil for the plant is contained in a steel tank suspended at the ceiling of the engine room. Oil is delivered into this tank from the filters by means of two duplex Warren steam pumps with cylinders three inches by two inches by three inches. From this tank oil is delivered through a system of piping to every bearing in the power plant; from each bearing oil drains to a



GENERAL VIEW OF HEGELER BROTHERS' PLANT, DANVILLE, ILL., SHOWING A PORTION OF THE ACID TOWER, THE KILN, POWER PLANT, POTTERY BUILDING, WATER TANK, REPAIR SHOPS AND FURNACES.

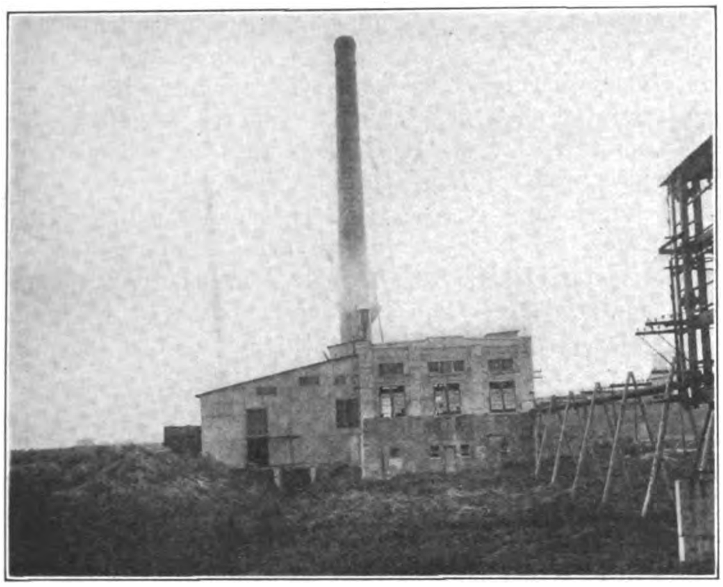
filter in the basement. All cylinder oil for steam and air cylinders, including the pumps, is handled by means of force feed lubricators, independently operated.

The switchboard, which was built by Lounsbery & Eaton, of Chicago, is of simple construction. It is built of blue Vermont marble and is equipped mainly with Westinghouse indicating and integrating instruments. The switchboard is mover outside of the power plant being a gasolene engine in the repair shop which is capable of running the machinery therein and of furnishing light to the shop through a one-and-one-half-kilowatt generator.

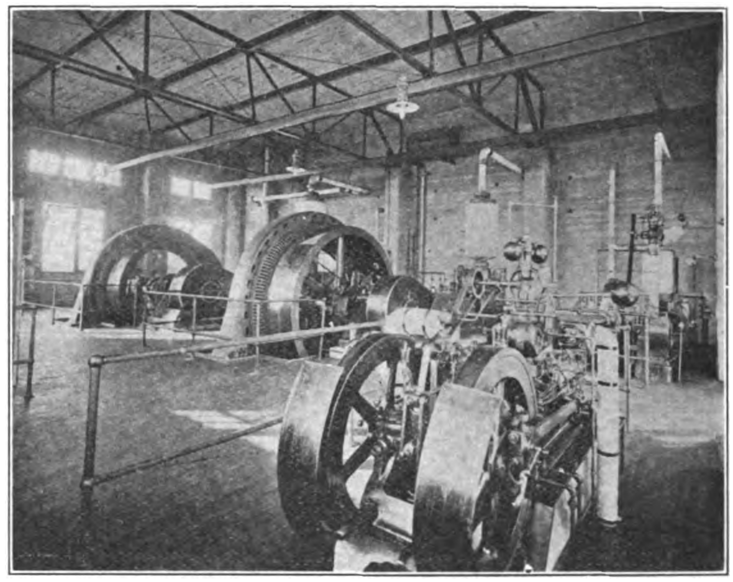
The motors throughout the property are of the General Electric type K pattern and are of varying capacity from five horse-power to seventy-five horse-power. The largest motor is used in the pottery building in the manufacture of retorts

The principal contractors on this work were as follows:

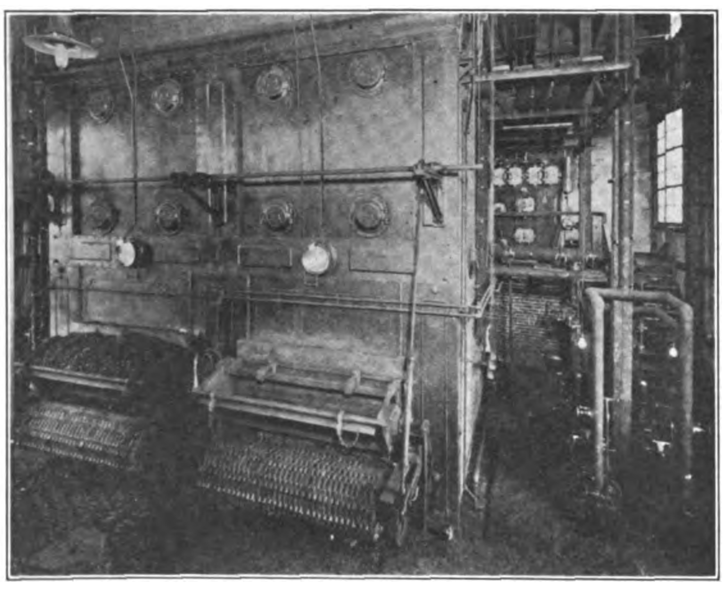
Boilers—Stirling Company (B. & W.). Pumps—Platt Iron Works Company. Chimney—Heine Chimney Company. Lightning protection—Carl Bajour. Engines—Ball Engine Company. Generators—National Brake and Electric Company. Switchboard—Lounsbery, Eaton & Company. Wiring—Freeman, Sweet & Company. Motors—General Electric Company. Steamfitting—Thomas & Smith.



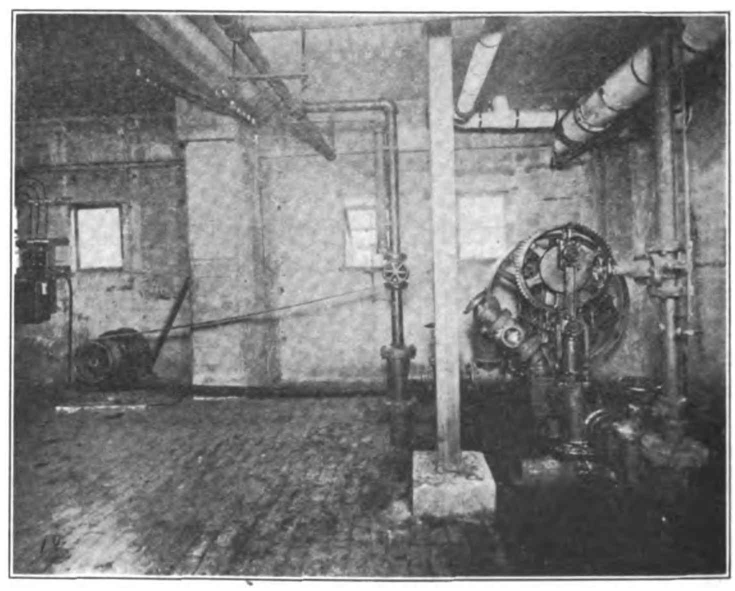
Side View of the Power Plant. Engine Room at Right and Boiler Room at Left of Picture. The Steam and Air Lines Running to the Acid Works Are Shown



View in the Engine Room. Straight-Line Compressor in the Foreground, 200-Kilowatt Unit in the Middle of Room, and 300-Kilowatt Unit at the Left.



Front of Boilers, Showing Stokers; Feed Pumps and Heaters to the Right.



Motor-Driven Triplex Pump Supplying Water to the Elevated Tank.

equipped with a Tirril voltage regulator. A noticeable feature of the plant is the small steam piping. Each engine and compressor is provided with a large receiver separator while the largest steam line in the installation has a diameter of four and one-half inches.

All power is generated in one building which is somewhat contrary to the usual practice in smelting plants. Motors are used for all machinery both in and outside of the power-house, the only prime and condensers for the furnaces. There are two fifty-horse-power motors used in supplying air to the furnaces.

The acid works, which is one of the largest buildings shown in the general view, consists of a large steel structure which is almost entirely filled with another building made entirely of lead. This building contains very little power, one application being a drive to a fan which handles acid fumes and which is built, with the exception of a portion of the shaft, entirely of sheet or cast lead.

Pipe covering—Western Roofing and Supply Company. Feed-water heater—Harrison Safety Boiler Works. Steam and oil separators—Harrison Safety Boiler Works.

The masonry work of the plant, including all building and foundations, was done by the owners. The design of the factory as a whole and in nearly all details was the work of Hegeler Brothers. The power plant and power transmission was done by W. L. Fergus & Company, Chicago.

RECENT ADVANCES IN STEAM TURBINES.[1]

BY GERALD STONEY.

Two years ago I had the privilege of reading a paper on "Steam Turbines" before this section at the York meeting, but in view of the very rapid development of the steam turbine, both on land and for marine propulsion, it may possibly be excused if the same subject is once more brought before you. On land the progress of the steam turbine is to be seen in all directions, and one thing which is especially remarkable is the rapid increase in size. Eight years ago the largest one made, which was considered an immense machine at the time, was for only 1,000 kilowatts, and now there are large numbers ranging from 5,000 kilowatts to 8,000 kilowatts running and under construction. Steam turbines of large size may be roughly divided into two classes, as the Laval turbine with a single reaction wheel requires gearing and is impracticable for large sizes. These two classes comprise, firstly, the Parsons turbine, in which there is both action and reaction, and the expansion takes place equally in the moving and fixed blades, and secondly, those in which the whole of the expansion takes place in the fixed blades, the velocity of the steam being taken up without expansion by the moving blades. This latter class can then be subdivided into those in which, at each stage, there is only a single row of moving blades as in the Rateau and Zoelly turbines, or one in which there are several rows of moving and fixed blades in each stage, which take up the velocity without any additional expansion, as in the Curtis. There are again various combinations, consisting of mixtures of one or more classes, but none of these have as yet been manufactured to any large extent. The oldest type, and one which is more in use than any other, is the Parsons, but in America the Curtiss has been manufactured in large numbers, and on the Continent the Zoelly, Rateau, and A.E.G., although both in America and on the Continent the Parsons has taken a leading position.

Hand in hand with the development of the steam turbine has gone the development of the various machinery to be driven by it, and in this direction electrical machinery has been prominent. For many years continuous-current turbo-dynamos were looked at askance by engineers on account of commutation troubles, for it is easy to see that the ordinary constants applicable to slow-speed dynamos to secure sparkless commutation are far exceeded when the speed is raised to that of turbine-driven dynamos. On this account it was early seen that some sort of compensating winding to improve the commutation and compensate for the reaction of the armature was necessary. Commutating poles alone have not proved satisfactory in practice, there being nearly always considerable difficulty in securing good commutation with them, and, as a consequence, commutating poles combined with compensating windings—the commutating poles giving the reactance voltage necessary for commutation and the compensating winding compensating for armature reaction—have been adopted by many firms. But even better commutation can be secured by a compensating winding alone, in which the ampere-turns of the compensating winding exceed the ampere-turns of the armature to such an extent as to give a commutating field in the gap between the pole-pieces. Such compensating winding is generally chiefly concentrated on the pole-pieces, and is made with from two to two and one-half times the number of ampere-turns of the armature, in order both to compensate for leakage and to give a good commutating field; and since this method of compensating has no iron commutating pole, it has the advantage that there is no self-induction to cause time lag at sudden changes of load; and, as the field of the gap between the poles is entirely in air it instantly responds to changes of current in the compensating winding, and thus the sparking found when there is a sudden change of load with commutating poles is avoided, and the risk of a flash-over largely reduced. Also, since there is no iron to become saturated, the commutating field is always strictly proportional to the load, and thus the trouble due to saturation, causing sparking at some loads and not at others, is avoided. This advantage is specially prominent where the dynamo is required to give varying voltages and to commutate at any of them without outside adjustment of the compensating windings by diverters or otherwise. The adoption of these devices has made it possible to make turbo-dynamos of large size, and now as much as 1,500 kilowatts is put into a single armature, whereas before such compensating devices were adopted 500 kilowatts was the maximum, and even then the commutation was anything but satisfactory.

In turbo-alternators there is practically now—except for small sizes and low voltages—one standard pattern—that is, a revolving field rotating inside a stator. In the stator there is little variation in design, except in regard to the ventilating arrangements, which have to be very ample on account of the comparatively large quantity of heat to be removed from a small volume. One point which has received great attention in recent years is the staying of the end windings of such alternators, it having been found that, owing to their great length, when a "short" took place the stresses on the winding were such as to break the insulation and cause disaster. The amount of these forces has been vastly more than was ever anticipated, and if the windings are not thoroughly stayed, such movements may be set up as to cause disaster. In the rotors there are two prominent types, the barrel and the salient pole, and much discussion has ensued as to the advantages of the one or the other. After considerable experience of both, on the whole I may say that at present I prefer the salient-pole type. Ample ventilation is much easier to provide for, and improvements made in protecting and supporting the field-coils of this type of rotor have resulted in a design giving great reliability with the maximum use of the space available. One improvement has been enclosing every coil in a tight sheath of sheet steel, so that any movement which may take place, due to centrifugal force, is between the steel sheath and the body of the rotor, and thus the insulation is protected from any rubbing which might cause it to be cut through and, consequently, break down. Voltage regulation of alternators is also of considerable importance, as owing to the inductive load required by induction motors there is a heavy demagnetizing effect on the rotor and consequent drop of voltage when the load rises. Several methods have been proposed for compounding alternators, most of them requiring a separate commutator or moving contacts altering the resistance of the exciter or main windings, but a method of compounding alternators has recently been brought out which is being largely used with good results. In this apparatus the current supplied by the machine is made to act on the exciter field system in such a way as to reduce the leakage, artificially increased in the first instance, and so raise the voltage of the exciter and increase the excitation of the alternator, so that any desired amount of compounding required can be obtained. This arrangement has been recently de-

[1] Paper read before the British Association at Dublin.

scribed in a paper before the Institution of Electrical Engineers.

The other applications of the steam turbine, such as driving air-compressors and pumping water, have also been largely extended during the last few years, and especially prominent in this direction has been the application of turbo-blowers to blast-furnace work, some having been recently installed for as much as 50,000 cubic feet of air per minute at ten pounds to fifteen pounds pressure. In this connection it may be mentioned that a very usual size, which is for about 20,000 cubic feet, weighs about twenty-five tons, and that an ordinary reciprocating blower of equal capacity weighs about 450 tons, or about eighteen times as much as the turbo-blower.

In many parts of the country reciprocating engines are running non-condensing, and it has now been found that the exhaust steam from them is of great value. Such exhaust steam can not be practically utilized by reciprocating engines on account of the huge size and volume of the cylinders required, but it is quite otherwise with the steam turbine, where the large volumes of the low-pressure steam are exactly what are required for the highest economy. These considerations have led to the introduction of exhaust-steam turbines, taking steam at atmospheric pressure and exhausting into a condenser. When it is remembered that there is as much power in the steam from atmospheric pressure down to twenty-seven and one-half inches as there is from 150 pounds down to atmospheric pressure, it is easily seen that the power of a non-condensing plant can be doubled by the addition of an exhaust-steam turbine and condenser, and in cases where there is not a supply of cooling water improvements in cooling towers have enabled them to be put up both cheaply and well. In this connection the use of intermittent supplies of exhaust steam, such as that obtained from engines running intermittently, as in rolling mills or winding engines at collieries, has received a great impetus by the utilization of thermal accumulators, in which the intermittent supply of steam is alternately condensed and re-evaporated, so that a constant flow is obtained for use in the exhaust-steam turbine. And yet another refinement has been introduced by the use of mixed-pressure turbines, in which there is a low-pressure part sufficiently large to give full power when working with exhaust steam, and if the supply of this fails a high-pressure part is brought automatically into action using steam direct from the boilers, and thus there is economical running, whether the reciprocating engines supplying the exhaust steam are working or not.

In all turbines the question of vacuum is a very important one, and various improvements have been made in condensers to enable higher vacua to be obtained. The importance of this will be seen when it is remembered that in the average steam turbine one inch of vacuum is equivalent to from four to seven per cent of steam consumption—or, in other words, it may be taken that for every three degrees Fahrenheit by which the temperature, due to the vacuum, is reduced a gain of steam consumption of one per cent is made. In this connection increase of circulating water is very important. A very usual amount is about thirty times, but if this increased to forty-five the gain in consumption is four per cent, and if increased to sixty-five times a further gain of two per cent is made. As a rule extra circulating water can be pumped without much difficulty, the extra power required for this being very small, but generally the temperature of the inlet to the condenser is fixed by the supply of water available. The great desirability, then, in a condenser is to obtain the temperature due to the vacuum as close as possible to that of the water leaving the condenser, as, of course, the maximum vacuum possible is that due to the temperature of this water. In ordinary condensers it is generally found that this difference amounts to twenty degrees to twenty-five degrees Fahrenheit, and among the various arrangements to reduce this may be mentioned dry-air pumps, and also the arrangement of baffles and pumps in the "Contraflo" condenser. But a method which has been very satisfactory in practice is what is called a "vacuum augmentor," which is simply a small jet of steam drawing the air and vapor from the condenser, and delivering it through a small auxiliary condenser to an ordinary air-pump, so that while there may be, say, a vacuum of only twenty-seven and one-half inches at the air-pump, twenty-eight and one-half inches or twenty-nine inches may be attained in the main condenser. Such an appliance is especially valuable when, as is often the case on board ships at sea, the system has considerable air leaks. With this arrangement the difference between the temperature of the water leaving the condenser and that due to the vacuum can be reduced to about five degrees or six degrees Fahrenheit, and this when condensing up to twelve pounds of steam per hour per square foot of condenser. As will be seen, this shows an economy in the turbine of some six per cent in steam consumption above an ordinary condenser, and when it is remembered that the steam jet of the augmentor uses only about 0.6 of one per cent, or only one-tenth of the steam consumption gained, it is easy to see that a great benefit is derived from the use of such an arrangement.

In marine work the development of the steam turbine also is very rapid. Two years ago the great express Cunarders Lusitania and Mauritania were only in process of construction; now they have proved themselves to be the fastest liners afloat, and it is pleasing to note that the turbines of these great ships have proved most satisfactory on service. It was a great step from the 8,000 horse-power of a cross-channel steamer, which was the largest that had been made at the time these boats were designed, to the 65,000 horse-power of these express Cunarders, and reflects great credit on the courage and foresight of the Cunard company, and also on the various contractors, designers and engineers engaged that they have made such a great step in advance without, as many people prophesied, building another couple of Great Easterns. More mistakes have been made in going from a small to a large thing in engineering than in anything else, but the various pitfalls which awaited those responsible have been successfully avoided. It is also interesting to note that the turbines proved themselves to be very economical, a consumption of 12.77 pounds per shaft horse-power having been attained as an average of the whole voyage across the Atlantic with about 150 pounds pressure at the entrance of the turbine, and a vacuum of 28.3 inches, barometer thirty inches. At present all cross-channel steamers in hand are being fitted with steam turbines; the whole of the ships in the Admiralty programme have also turbine engines, and every one knows what a success the Dreadnought and the Indomitable are, they being respectively the fastest and most powerful battleship and cruiser afloat.

Hitherto the link supplied between the steam consumption in a marine engine and the horse-power developed, which is represented by the indicated horse-power, has been missing in a turbine, but the introduction of the torsion meter, which measures the horse-power passing through a shaft by the amount of torsion caused, has supplied this missing link most satisfactorily. The introduction of this has been chiefly due in this country to the enterprise of Messrs. William Denny & Brothers, of Dumbarton, and on the Continent to Mr. Frahm, of Messrs. Blom & Voss, of Hamburg, both of whom on slightly different lines have worked out torsion meters which have proved very satisfactory in practice. This has enabled the various losses between the power in the steam and the power required to propel the ship to be even better located than they are in the case of a reciprocating engine where the indicated horse-power does not take into account the friction of the engine.

The steam turbine up to the present has been almost entirely used for ships of seventeen and eighteen knots and above, and, in fact, it may be generally said that about fifteen knots is the lowest speed of vessel at which the turbine can satisfactorily compete with the reciprocating engine as regards economy. The difficulty of the problem lies in the fact that at low speeds the screws have to be made to revolve at small revolutions, and at the same time the horse-power required is moderate, and thus the turbines have to be very large and heavy, and, besides this, the blades are so short that the loss by leakage is excessive. These considerations have led to the combination of a reciprocating engine for the high-pressure part of the range where the volume of steam is small, and where the reciprocating engine is working exactly under the conditions for the best economy, and a turbine for the low-pressure part of the range where the volume of steam is large, and where, therefore, the turbine is working under the very best conditions, and such an arrangement gives advantages over either the turbine or the reciprocating engine for moderate speeds, and, in fact, it is anticipated that an extra economy of about fifteen per cent can be attained in this way. The advantages of such an arrangement were first pointed out by Mr. Parsons in 1894, but has only recently been put into practice. Many various arrangements and combinations are possible, but that which appears to be most generally favored is to have twin reciprocating engines, each driving their own screws, exhausting into a single turbine driving a centre shaft. The reciprocating engines exhaust at about atmospheric pressure, and the turbine used the expansion from that pressure down to the vacuum of the condenser, which may be twenty-eight inches or twenty-eight and one-half inches. For maneuvering or going astern the reciprocating engines are used. At present two large Atlantic liners are being built with the above arrangement for the Atlantic service, but it may be mentioned that the destroyer Velox, made in 1903 by the Parsons Marine Steam-Turbine Company, Limited, for the British Admiralty, was the first ship fitted with such a combination, she having small reciprocating engines which were coupled on to the main turbines for cruising speeds, and at such speeds she proved exceedingly economical. At high speeds the reciprocating engines were disconnected from the main turbines, which were alone used.

It may be mentioned that eight years ago there were only 25,000 horse-power of marine turbines afloat; two years ago there were 800,000 horse-power, and now there are over one and three-quarters millions completed and under construction.

In this short paper I have endeavored to give an idea of the exceedingly rapid progress of the steam turbine and its applications. Whether in future the progress will be equally as rapid is difficult to say, but so far as can be seen at present there is no sign of saturation in the curve of progress.

Brooklyn Edison Forms State Branch of the National Electric Light Association.

A meeting of the employés of the Edison Electric Illuminating Company of Brooklyn, N. Y., was held at the Edison Club Rooms, Johnson Building, Brooklyn, on Monday, September 28, preliminary to the formation of a company branch of the National Electric Light Association, in pursuance of the Henry L. Doherty amendments to the constitution of the national association made at the spring convention in Chicago, Ill.

This preliminary meeting, which was attended by about eighty employés, was presided over by W. F. Wells, general superintendent of the company, who explained the individual and co-operative benefits to be derived by membership in the national association through the company branch.

It was pointed out that this was an opportunity for self-improvement and for broadening through association with others in various branches of the industry, and that it could not fail to be of service in personal development and in bringing about recognition of talent within the ranks of the Brooklyn organization. Mr. Wells stated that membership would be entirely a matter of choice and that positively no pressure whatever, other than moral suasion, would be brought to bear upon employés to induce them to join. W. W. Freeman, general manager of the company, also addressed the gathering and indicated that membership in the company branch would help to keep employés posted as to up-to-date practice in the different departments of electrical activity and would tend to make their services more valuable to themselves and to the company.

On Friday, October 2, an organization meeting was held, Mr. Wells presiding, and the following officers for the company section were elected: President, G. S. Knight; vice-president, D. D. Sharkey; secretary, E. A. Baily; treasurer, Irving Bugg. Executive committee: W. J. Walsh, G. E. McMullen, E. W. Kells, C. A. Graves, W. Uckele, C. W. Simpkins, G. Valentine, H. B. Pope, E. B. Rannells, G. S. Knight, D. D. Sharkey, W. W. Freeman, and W. F. Wells, *ex officio*.

The men are enthusiastic over this enterprise and already 136 have become members. Ambitious plans are being laid; several meetings will be held during the year and possibly a company publication will be issued to keep the members in close touch with the national work, and a local question box established, supplementing the *Bulletin* of the National Electric Light Association.

First Fall Meeting of the New York Section of the Illuminating Engineering Society.

The first autumn meeting of the New York section of the Illuminating Engineering Society will be held on Thursday evening, October 15, at 8.15 o'clock, in the Engineering Societies Building, 33 West Thirty-ninth street, New York city. A committee, consisting of Dr. A. H. Elliott, Norman Macbeth and E. F. Tweedy, will review the papers and discussions presented at the annual convention. Through the efforts of this committee it is hoped that those members who are unable to attend the convention will receive first-hand information concerning everything of significance and moment which transpires at the convention.

Improvement in Electric Meters.

An attachment for ordinary measuring instruments, as watt-hour or ampere-hour meters, for indicating at any moment the energy or current consumed by a plant, is described by Elpidio Paparella in *L'Elettricista* (Rome) for August 15. The device will operate as a wattmeter when attached to a watt-hour meter, and as an ampere-meter in connection with ampere-hour meters. It is applicable to all motor-meters, in which, as is well known, the velocity of the rotating part is at all times proportional to the power or to the current. In such meters there is always a movable metallic disc which, in the case of direct current, is rotated by a small motor, and in the case of alternating current usually by a rotary magnetic field. In all cases a braking effect is exerted on the rotating part by permanent magnets, which induce eddy currents in the disc, exercising on the same a resisting action rigorously proportional to the velocity. For this reason the magnets themselves are subjected to a pull which tends to drag them along in the direction of rotation of the disc. The invention consists in utilizing this reaction on the magnets for indicating the power in watts or amperes consumed at any given moment by a plant, in which watt-hour or ampere-hour meters are installed. To attain this purpose it is only necessary to make one or more of the brake magnets movable and to counterbalance the displacement effect on the magnet by means of a spring. The tension of this spring suitably indicated by a dial will then show the watts or amperes consumed at any moment. But the permanent magnets are large and heavy, and it would be difficult to construct a sensitive movable system out of them; therefore only a part of the magnetic circuit is made movable—that nearest to the disc; that is, the polar portion of the magnet, where the magnetic effect has its centre. In some alternating-current meters the disc is rotated by electromagnets generating a rotary magnetic field. These electromagnets receive a pull in a direction opposite to the movement of the disc, and in such meters the electromagnets or their polar portions may be used instead of the permanent magnets for measuring instantaneously the watts or amperes consumed, in the manner described. If the hand of the indicator is provided with a pencil bearing on a cylinder moved by clockwork, the instrument may be made into a recording watt or ampere-meter. The device will be economical, as it combines two instruments in one. It may also be used as a substitute for the Wright maximum demand indicator, which only indicates the maximum consumption during a certain time, but not the frequency and duration of any excessive consumption of energy.

Tungsten in the United States.

The demand for tungsten ores and products during the first nine months of 1907 was much greater than that of 1906, prices were high, mining and prospecting were both actively carried on, and as a result the output of the United States was increased from a total of 928 short tons of concentrates carrying sixty per cent of tungsten trioxide in 1906 to 1,640 short tons in 1907, while the value rose from $348,867 in the earlier to $890,048 in the latter year.

The principal tungsten minerals are wolframite, a tungstate of iron and manganese, and scheelite, a tungstate of calcium. Both minerals, like tin ores, occur, as a rule, in quartz veins cutting rocks containing much silica, such as granite and rhyolite, but some apparent exceptions to this rule are found, as, for instance, in New Mexico, where hübnerite and a small amount of scheelite occur with pyrite and lead minerals in a vein cutting limestone; and at Nome, Alaska, where scheelite is found in the gold placers in a region of schists several miles from the nearest granite outcrops. The greater part of the American tungsten product in 1907 came from the mines in Boulder County, Col., which reported an output of 1,146 tons of wolframite valued at $573,642.74. In California, which was the second state in order of production, the output was in the form of scheelite, as was also most of that from Montana. The total scheelite reported was 414 short tons. Small amounts of tungsten ores were also produced in Washington, Nevada, Arizona and probably in New Mexico. No ore is known to have been produced in South Dakota, although much prospecting and some development work was carried on.

In other countries besides the United States the production of tungsten was notably increased during 1907. The output of Australia (including Tasmania), amounting to 1,643 tons, was, however, the only one that exceeded that of this country. Reports of production from South Africa, New South Wales, and the northern territory of Australia, show marked increases. Spain, New Zealand, Austria and Germany, whose combined production during 1906 was 463 short tons, have not made public their figures of production for 1907, but it seems probable that there will be, in each case, an increase.

Concerning the probable future of tungsten, F. L. Hess, of the United States Geological Survey, from whose statistical report for 1907 the foregoing paragraphs have been abstracted, makes the following statement:

"Tungsten deposits are usually pockety; that is, the ores occur in lenticular masses or shoots in veins. Those occurring at the surface are often quickly and easily mined, and it may then require all the profit made from the first-exposed ore body to locate another one. However, the veins carrying tungsten minerals are generally of deep-seated origin, and, generally speaking, other ore bodies will probably be found in depth, although, as in mining for other minerals, the expense of search may be out of proportion to the size of the pay shoots.

"In Queensland the deposits exposed on the surface have been largely exploited and the production has, in the face of rising prices, fallen greatly since 1905. In England, Spain, Portugal, Austria, Germany, Bolivia and the Dutch East Indies tungsten and tin ores occur together, and the working costs are thus lowered. Magnetic separators are increasing the production of tungsten ores in England.

"Tungsten is of widespread occurrence, but the individual deposits can hardly be said to be large. In times of high prices there are many deposits which can be worked that will be idle at lower prices, and, considering the great decrease in value of tungsten ores in the last three months of 1907, it seems probable that the output for 1908 will be much less than in the previous year."

An interesting and important part of Mr. Hess's report is his brief description of the tungsten minerals and some simple tests by which they may be identified. These tests are such as can be made by any prospector who can obtain hydrochloric (muriatic) acid, a test tube, a teacup or a water glass, and a little tinfoil, a piece of zinc, a bit of solder, or even a scrap from an ordinary tin can. Copies of the report, which is published as an advance chapter from "Mineral Resources of the United States, Calendar Year 1907," may be obtained by applying to the Director of the United States Geological Survey, Washington, D. C.

The Paris Metropolitan.

Extensions to the Famous Subway System in the French Capital.

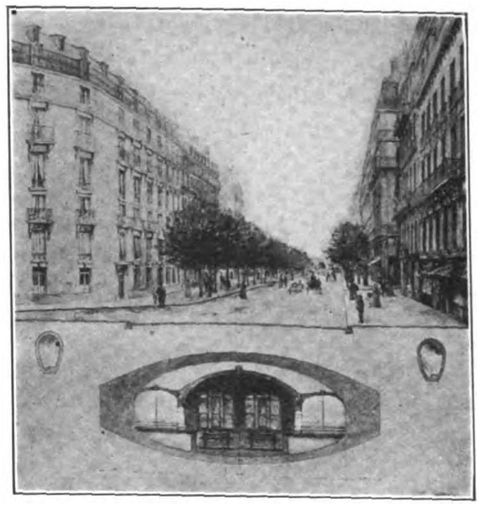
SINCE the system of electric subways was first commenced in Paris not many years ago, it has been greatly favored by the public, and this is seen not only in the figures which show the annual traffic and the receipts of the different lines, but also by the fact that the Metropolitan Company, which controls the subway, has applied to the municipal council at successive periods for an increase in the concessions. These were granted, according to the decisions of a special committee which was appointed for the purpose and known as the Metropolitan Commission. The last of these concessions was granted in December of last year, providing at the same time for the probable construction of five other sections of subway. The number of lines which is covered by these concessions is considerable, and when the whole of the underground construction is finished the city will be covered by a vast network of lines, not less than seventy miles in length, which will reach nearly all the different quarters and will afford exceptional facilities for transportation. Taking into account the transfers which are made at all the points where the lines cross, passengers can pass quickly and comfortably from one part of town to another. The use of the subway affords a decided advantage over the surface cars in that the latter are hardly ever heated during the winter season, while there is always a comfortable temperature in the subway. Again, a passenger is certain to be able to reach his destination in case he is obliged to make a transfer, as the subway cars are scarcely ever filled to the required limit. In France there are only a certain number of passengers carried on a given car or omnibus, and if the latter is full, one is obliged to wait for the next one. At intermediate points during the hours of heavy traffic, especially from six to eight o'clock, all the cars are likely to be full, so that in many cases one may wait indefinitely, and on some of the lines it is practically impossible to make the transfer. Such is not the case with the subway lines, and even during the most crowded periods one can always secure a place after waiting a short time. The cars, it is to be remarked, pass at three-minute intervals, but in the future it is possible that this may be reduced to two minutes.

THE FORM OF CONSTRUCTION IN A NARROW STREET—PARIS METROPOLITAN SUBWAY.

At the present time the work of constructing the different lines of subway is well advanced. As regards the lines which are finished and in actual operation, these are four in number, comprising the east-west section, or original Metropolitan line, the north semi-circular section and the corresponding south semi-circular line, which we have had occasion to illustrate. There has been recently opened a new section which joins on to the south line at the Place d'Italie and then crosses the Seine and runs in a northerly direction, ending at the North Railroad depot. These four lines are entirely finished and represent about twenty-three miles of subway. There are also two new lines which are nearing completion. On one of these, which runs from the Place d'Italie to the Cours de Vincennes, almost all the work is finished but the roadbed and tracks. It includes an overhead part of considerable length. As to the second line, it is entirely in subway and runs from the Avenue de l'Opera to the Place du Danube.

There are two other lines of subway which have a special interest from the work which is carried out in order to run the tunnel under the Seine. The other sections of the Metropolitan are taken across the river upon three bridges lying in different parts of the city, but these are not, however, in the central district. As the use of bridges was not allowed in the central portion of town, the lines were obliged to proceed in subway under the Seine. One of these lines starts in the northern part of the city at the Clignancourt Gate and runs in a southerly direction across town, ending at the Orleans Gate. Where this section of subway crosses under the Seine the tunnel was formed by sinking a series of caissons in the river bed having the standard section of the tunnel. This work has been described in a preceding article[1] and will not be referred to at present, except to say that all the caissons have been sunk in the Seine down to the proper level and this part of the work is well advanced.

Of particular interest at this time is a piece of work which is being carried on at a point somewhat farther down the Seine. This is the crossing point of what is known as the North-South line of subway. It runs across town from the Versailles Gate, in the southern district, to the Place Jules Joffrin, which lies in the northern quarter. It is entirely under ground and in general has adopted the tunnel section which is in use on the other lines. What distinguishes this line from the others from an administrative standpoint is that it lies outside of the regular Metropolitan system, and is operated by another company, which secured the concession from the city several years ago, so that the North-South Subway Company, as it is called, has no financial connection



STANDARD FORM OF CONSTRUCTION ON THE NORTH-SOUTH LINE OF THE PARIS METROPOLITAN SUBWAY.

[1] ELECTRICAL REVIEW, October 12, 1907.

with the Metropolitan system. As the tunnel section and rolling stock are the same as for the above, arrangements have been made so as to effect the transfers from one of these roads to the other at all the crossing points.

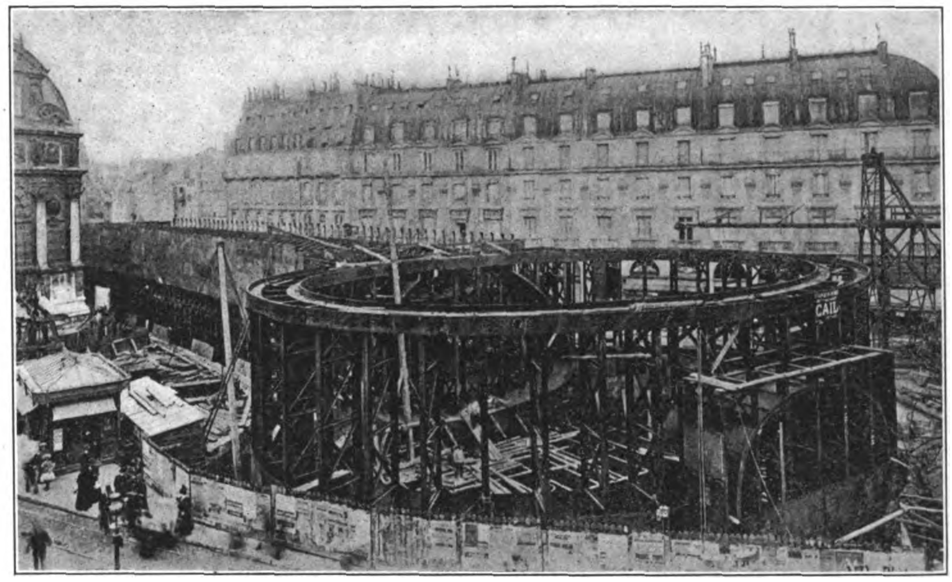
What is to be remarked about the North-South line is the method which is adopted for passing under the Seine. M. Berlier, who was active in the formation of the new company, had the method of compressed-air shield adopted for this work, and the tunnel is accordingly formed of sections of iron rings, which are joined together as the shield advances under the river bed, so as to form a tube which contains one of the tracks, and is about fifteen feet in diameter.

A line of road which has now been entirely completed and is running at the present time is known as Section No. 5. It starts at the Place d'Italie, crosses the Seine and ends at the Northern Railroad depot. At the former point it joins on to the line know as No. 2-South. The No. 2 line and the portion of the No. 5 section lying on the south bank of the Seine form a continuous semi-circular line which is known as the South Semicircle. However, as Section No. 5 not only runs for a long distance on the other side of the Seine, but was also constructed at a later period than the No. 2 line, it is generally considered apart from the latter.

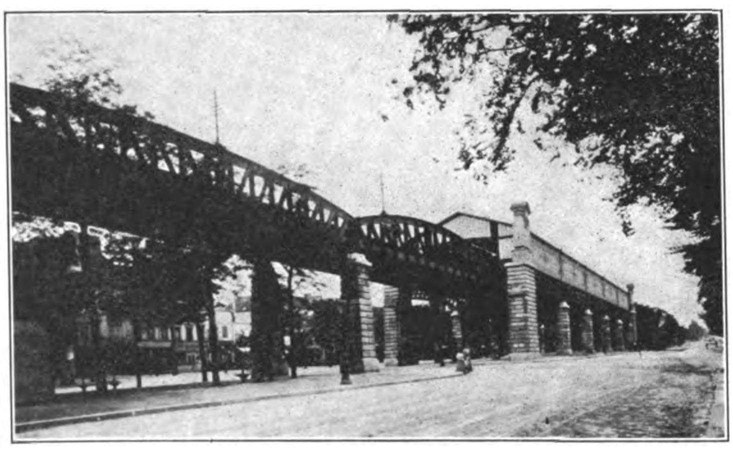
At the North Railroad depot and the East depot, which lie not far from each other, there is quite a complicated series of tunnels and stations in order to provide for the crossing at different levels of the different lines—Nos. 4, 5 and 7. Line No. 5 makes a curve in a semi-circle and passes underneath the station and Line No. 4, and passes in a southerly direction to the Seine. It crosses the river upon an iron bridge which was specially built for the purpose. On the other bank is the Orleans Railroad depot, and it was decided to take the Metropolitan line, which after leaving the bridge is run upon an overhead structure, directly through the building of the depot. This was carried out by making a breach in the walls at the height of the second story, and the tracks are supported here by a single bridge truss, 150 feet long. Passengers descend from the train and reach the ground level of the depot by a staircase.

After passing the depot the line continues overhead, the structure consisting in general of a series of ironwork trusses supported upon masonry pillars or iron columns. Masonry pillars are also used to support the overhead stations. The trusses are usually seventy-five feet long, and the bottom line is seventeen feet above the ground. The total length of the present section is 4.2 miles, and it has fourteen stations, these being either overhead or underground, and about 1,680 feet apart. About $5,000,000 was the outlay for the construction of the present line.

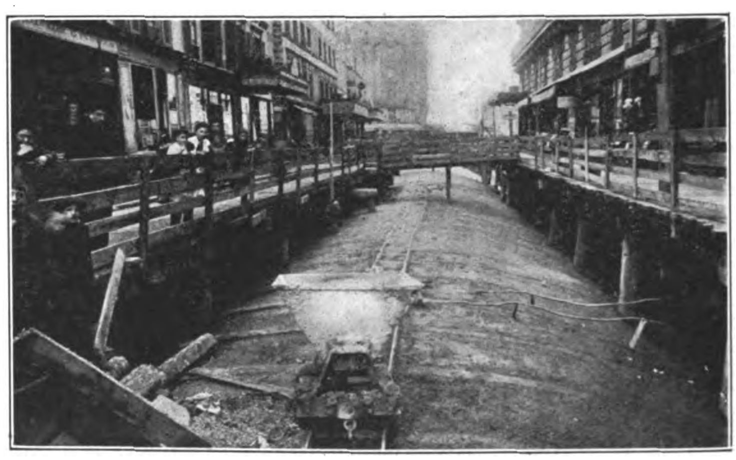
One of the lines (No. 6) which will be the next to be completed is built partly underground and partly overhead. The line runs from the Place d'Italie to the Cours de Vincennes, and crosses the Seine upon a bridge, or rather upon a viaduct which is built on the top of the existing bridge at Bercy in order to accommodate the new line. The beginning of the present section at Place d'Italie forms the continuation of the No. 2 line. Its total length is 3.4 miles of double track and 423 metres of single track at the loops. It begins as an underground line at the Place d'Italie, but comes to the surface shortly after and mounts upon an overhead portion, which it follows until reaching the viaduct upon the Seine. At the opposite bank it passes again in subway



Paris Metropolitan System—The Elliptical Caisson for the Station at Place St. Michel.



Paris Metropolitan System, Showing the Overhead Construction.

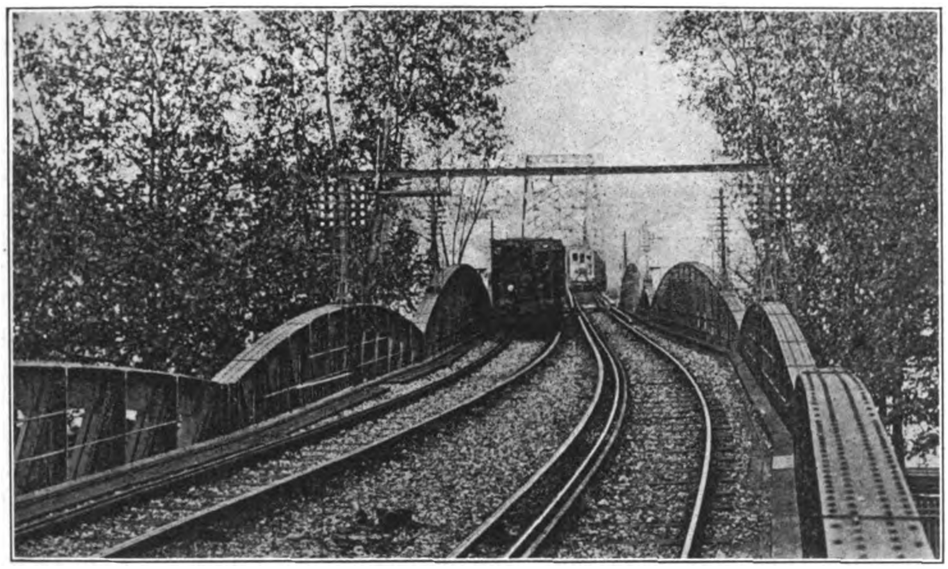


The Paris Metropolitan Subway Showing the Arch of the Roof in Armored Beton.

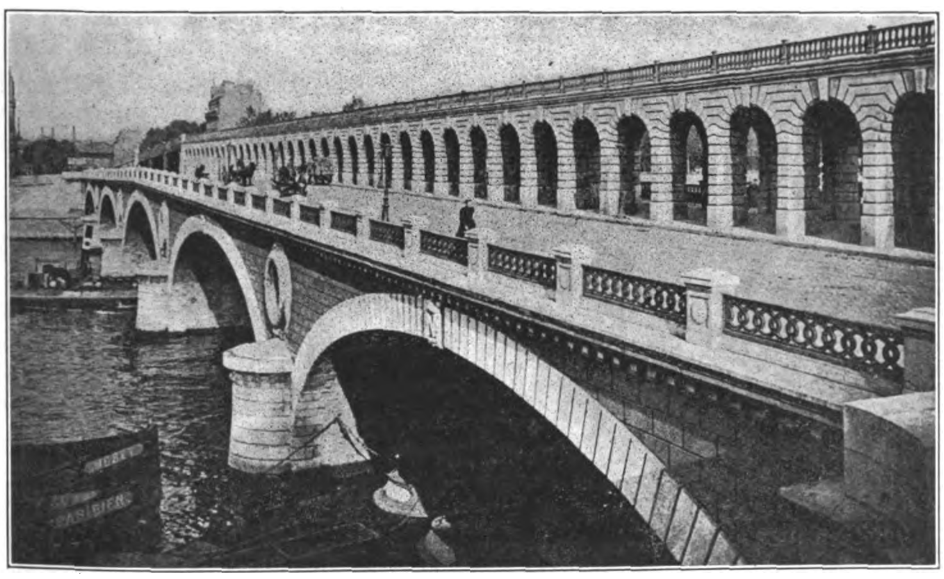
and continues in tunnel as far as the terminus at the Place de la Nation. On the overhead part there are thirty-one bridge truss sections of 22.5 metres average length, and in most cases they are supported upon iron columns. Over the whole line there are ten stations, some of which lie on the overhead portion. The entire construction is finished at the present time, and it only remains to lay the roadbed in order to complete the line.

An interesting series of tables, showing the traffic and income from the system now in operation, has been drawn up by one of the leading engineers of the Metropolitan company, M. Bienvenue. In this way he is able to make some calculations as to what will be the probable amount of traffic over the completed subway system. It is found that the line which runs along near the right bank of the Seine, and known as the No. 1 subway, crossing the city from end to end, showed a traffic for the year 1906 of 42,000,000 passengers carried.

M. Bienvenue estimates that the distance on either side of the subway line within which the population is likely to use this means of communication is 400 metres, or 1,320 feet. Taking the density of the population along this zone and the number of passengers actually carried on any particular line, he is able to establish the relation between the two and so have a very good basis for calculating what will be the probable traffic on any one of the projected lines. The total length of the system is 71.3 miles and the number of passengers which will be carried annually over the whole of the subway is estimated at no less than 395,000,000. This is a large figure, but it is a conservative estimate based upon the above calculations, and indicates the great extent to which the subway will be patronized by the population when it finally covers the different quarters of the city.



Paris Metropolitan System, Showing the Viaduct and Bridge on the Road from Place d'Italie to Lancry.



The Bercy Viaduct over which the Tracks of the Paris Metropolitan System have Been Laid.

A word may also be said as to the receipts from the system of lines which is now in actual operation, comprising 23.6 miles of subway. With a total traffic of 165,000,000 passengers carried during the year 1906, the gross receipts were $5,750,000 in round numbers. The net profit after deducting all expenses is found to be near $1,500,000, which is a very good figure and shows that the affairs of the Metropolitan company are in a flourishing condition. This figures out at $65,000 per mile of subway.

National Association of Cotton Manufacturers.

The semi-annual meeting of the National Association of Cotton Manufacturers was held at Saratoga, N. Y., September 29 and 30. On the afternoon of September 30 the members of the association were the guests of the General Electric Company at Schenectady, N. Y., luncheon being served and an opportunity given to witness the latest developments of the applications of electricity for the transmission of power, illumination and transportation. The ladies of the party did not visit the General Electric works, but were entertained by a committee of Schenectady ladies at the Mohawk Golf Club.

Among the technical papers presented and discussed at this meeting were the following: "Low-Pressure Steam Turbines," by Charles B. Burleigh, Boston, Mass.; "The Textile Mill Power Plant," by Lewis Sanders, New York, and "Measurements of Power and Its Transmission," by William O. Webber, Boston, Mass.

The Textile Exhibitors' Association, which is composed of manufacturers of textile machinery throughout the United States, held its annual meeting in connection with the semi-annual meeting of the National Association of Cotton Manufacturers. The exhibitors authorized the executive committee to prepare for an exhibit of textile machinery in April, 1909, in Boston, Mass. The following officers of the Textile Exhibitors' Association were elected: President, George O. Draper, Hopedale, Mass.; vice-president, F. H. Bishop, Boston, Mass. Executive committee: H. W. Butterworth, Philadelphia; M. H. Merrill, Boston; E. F. Hathaway, Boston, and S. A. Corey, Boston.

Electrical Notes from Great Britain.

(From Our British Correspondent.)

By the time these lines appear in print the electrical exhibition at Manchester, for which manufacturers and the trade generally have been preparing for some time past, will be in full swing, for it opens on October 2 and closes on the 31st of the same month. The executive committee has among its members gentlemen representing all kinds of electrical organizations and interests, including the National Electrical Manufacturers' Association, the Electrical Contractors' Association and the Municipal Electrical Association. Lord Derby is the president and Sir William Preece is among the vice-presidents, the others being the chief municipal representatives of the Manchester and Salford corporations. The Institution of Electrical Engineers has not thought it beneath its dignity to have representatives on the committee. The Lancashire Electric Power Company, which has everything to gain from increased electrical enlightenment among the power-users of Lancashire, is also fully concerned in the scheme. As in the case of the electrical exhibition at Olympia in 1905, the profits, if any, are not to go to private exhibition promoters, but are to be divided between various interests, including charitable organizations and a return to exhibitors. Although the number of exhibitors and the size of their exhibits have been very satisfactory, it is too early to say whether or not exhibitors are likely to get anything like the same percentage return on their "stand" payments as they received when the Olympian results were secured. In the present case there was no suitable building available in Manchester, and so a special one has had to be erected, necessarily at great cost. The management and the executive staff have the benefit of the practical experience obtained at the London Olympia show to guide them in securing success, and to a very large extent history will repeat itself at Manchester so far as semi-popular attractiveness is concerned, but there will be the important difference that the exhibits appealing to the power-user will predominate. Manchester is a city of great manufacturing industries, textile and engineering chiefly, but it is also the centre or heart of a very large industrial area wherein these particular departments of manufacturing, as well as mining works, are pre-eminent, and it is to be expected that every electric light and power supplier within what may be described as the sphere of influence of the exhibition will be benefited by so striking a demonstration of electrical capabilities and applications, as it is bound to awaken interest during the entire month of its run. These various electricity suppliers are co-operating heartily to produce a combined effort, calculated to effectively arouse this interest. Naturally enough, it must follow that if they are rewarded the manufacturer and seller of motors and all electrical material, the electrical contractor who puts in the installations, and indeed the electrical industry of the district, and perhaps of the country generally, must also feel the benefit from this important feature of modern publicity.

The issuance of the notices concerning the annual dinner of the Institution of Electrical Engineers reminds one that the summer and autumn vacation of this body is about to end. Last year the session commenced without a presidential address owing to the illness of Lady Kelvin detaining Lord Kelvin in Scotland. This year, no doubt, we shall get back to the usual method of procedure and have an inaugural address some time in November from the president for the 1908-9 session, W. M. Mordey.

At the autumn meeting of the Iron and Steel Institute, which was held at Middlesbrough from September 28 to October 2, there were several papers read of interest to electrical men. C. H. Merz contributed one on "Electric Power Supply"; C. Koettgen and C. A. Ablett one dealing with "Some Results of Experience with Electrically Driven Rolling Mills"; S. O. Cowper-Coles dealt with "The Production of Finished Iron Sheets and Tubes in One Operation," while among sundry other contributions was one by Professor W. A. Bone relating to "Gas-Producer Practice."

One of the principal subjects under consideration at the annual conference of the Municipal Tramways Association, held at Nottingham from September 23 to 25, was "Some Through-Running Problems and Their Solution," introduced by H. E. Blain, the corporation tramway manager at West Ham. One of the recent important instances of through running involving serious problems was that of the Leeds to Bradford service, where the systems of the two cities are laid to different gauges of track. The introduction of a special truck paved the way for the establishment of a through tramway connection which had been long needed but repeatedly deferred. It is now announced that an agreement has been arrived at between the Leeds and Bradford municipal corporations, which own and operate the systems, for through running, and in view of the current interest in the matter the terms agreed upon may be indicated. Each authority will run an equal number of cars, and the surplus mileage will be paid for by the undertaking in which it is run, on the basis of working expenses. The latter expenses are settled according to a fixed basis which will include the wages of motor men and conductors, the cost of cleaning and oiling cars, cost of uniforms and badges, and maintenance of cars and compensation. The charges will be on the basis of the average cost per car-mile as shown in the last published accounts. Each authority will be entitled to all receipts taken in its own area, but all through fares will be divided equally up to an agreed number; above this number the division will be in the ratio of the route-mileage traversed on each system, approximately five and one-half miles for Leeds and four miles for Bradford. The general managers will control the traffic arrangements of the respective areas, and employés will abide by the regulations in force in the district in which they are working. If there are any matters in dispute between the two municipalities at the end of the first year's working, these are to be referred to an arbitrator who has the approval of both parties or to the board of trade.

Among the other items in the programme of the Nottingham convention were: A presidential address by J. Aldworth, the Nottingham Corporation tramway manager, and a couple of papers on ticket check and the treatment of incapable tramway employés.

Some years ago much interest was evoked in trackless trolley systems as a result of experimental work of the kind that had taken place in Italy and other Continental countries. A paper on the whole subject was read before the Bradford meeting of the British Association by J. G. W. Aldridge, and there were proposals put before Parliament which aroused hopes of such a system of cars being run to serve some routes in, we believe, a Gloucestershire district. For some reason or other nothing was done, and so far as actual work was concerned the system was practically forgotten. Interest has now, however, been revived, and the prospect of something being done is far more hopeful than it was seven or eight years ago. Several municipal corporations have recently sent deputations to the Continent to investigate as to what the experience accumulated there has to say to them as a guide, and they have returned very favorably impressed with the suitability of trackless trolley cars for use in some of their outlying districts where at present the traffic is insufficient to justify big expenditure upon tramway-track work. The deputation from Manchester, after an investigation of the system in Germany, is recommending its trial on one of the suburban roads not yet served by tramways. It is stated that whereas the working expenses on Manchester trolley tramways amounted to 7.07 pence per car-mile last year, the figure for a trackless trolley line would be only 5.38 pence per car-mile, showing a substantial saving, but, needless to say, the figures are estimates and therefore are received with much reserve. Manchester has experimented with omnibuses of the petrol type, and expressed its disgust by ordering their removal from the streets. This happened some time ago. It has now resolved to permit another trial for three months with steam 'buses. Dublin also has a trackless trolley scheme under consideration, the route suggested being from Donnybrook to the seaside resort, Bray. F. Douglas Fox, who is associated with the concern which is endeavoring to introduce the trackless trolley system in England, read a lengthy paper on "General Urban and Interurban Transportation and Railless Traction" before the Dublin meeting of the British Association in September. After producing statistics of the working costs, etc., of a number of English electric tramways, he proceeded to show the economy anticipated with railless systems. He stated that by this method electricity had entered the field of highway transportation with much more likelihood of favorable competition with both the tramway and the light railway.

The railway department of the board of trade has just issued its report on the fire that occurred last July on the City & South London Electric Railway, near Moorgate Street station. It appears that though the fire was not completely extinguished, other trains were allowed to pass, creating a draft which needlessly prolonged it. The origin of the fire is uncertain. The evidence of the electrical engineer pointed to leakage of current sometimes occurring between the power rail and the running rail through iron and carbon dust accumulating on the sleepers and insulators, this dust and the upper surface of the sleepers catching fire. The board of trade report says that this may have been the cause, or possibly sparks from the locomotive shoes ignited the dust. The reporters refer to the extremely dirty state of the tunnels, some of the dirt being dangerous; oil dripping takes place in some parts and pieces of waste have been found on fire. The smoke danger in such tubes, however, is believed to be worse than the actual fire danger, and the recommendations which the reporters make for preventing these troubles as far as possible are as follow:

1. Considerably greater attention should be given to cleanliness; dust should be more carefully removed.
2. A liberal use of whitewash would enable any accumulation of dust to be detected.
3. The filling up of the inverts, particularly of the large tunnels, should be carried out.
4. No electric wires or cables should be carried below or between the sleepers, but they should be neatly arranged along the sides of the tunnels, and all crossing of cables should be overhead.
5. The use of wood should be eliminated as far as possible; the planking and the wooden platforms should be replaced by slate or granolithic slabs.
6. On discovery of a fire, all traffic should be stopped in that section until the fire is completely extinguished.
7. Prompt notice should be given to the fire brigade.

The Metropolitan and District Railway companies are introducing further improvements in their electric train services. During the hours of heaviest traffic the main-line service between Gloucester Road and the Mansion House stations will be increased from thirty to thirty-four trains per hour; at lighter times twenty-six instead of only twenty-two trains per hour will be run. Some of the three and five-car trains will have an additional car at busy times, and more express trains between the city and suburbs will be introduced; the nine-car train, claimed as the record multiple-unit train of the world, is to be lengthened by a further car, making its length 500 feet, and a second like train is also to be run.

An exhibition which is receiving a good deal of attention at the present time is the International Rubber Exhibition, opened at Olympia on September 14. Specimens of rubber in the rough and in all stages of manufacture are on view, having come from all the rubber-producing countries of the world. Interesting exhibits there are of various classes of machinery employed in the manifold operations necessary in dealing with the rubber itself and in manufacturing rubber articles.

Some discussion is taking place just now concerning the discharge of a number of employés of the National Telephone Company, the figure being put at 1,000 for the whole of the United Kingdom. It will be remembered that the company's undertaking is to be taken over by the government in the year 1911 upon terms which were agreed upon between the parties after prolonged negotiations several years ago. The reason given by Mr. Franklin, the company's chairman, for the dismissals is that in the closing years of the company's business (there are only three years to run) there must be "some limitation of expenditure" of "capital which would not be productive within the period of the license," and for which only a depreciated value might be paid by the government. What the company wants is a definite understanding with the government that any money it spends on behalf of the period subsequent to 1911 shall be recouped to it without loss. Every one will hope that in the interests of the extension of the telephone service of the kingdom some such understanding will be speedily arrived at.

It is announced that Robert Nelson, of the well-known firm of Merz & McLellan, consulting engineers, has been appointed by the government to be his majesty's electrical inspector of mines. The office is an entirely new one.

On September 18, at the Hotel Cecil, London, a demonstration was given of Hans Knudsen's apparatus for the wireless operation of a linotype keyboard from a distance, and for the transmission of photographs. A. H. BRIDGE.

London, September 26, 1908.

Electrical Notes from Europe.

(By Our Special Correspondent.)

FOR some time past the French Government has been taking an interest in the matter of wireless telephony, especially from a military standpoint, and three officers of the navy, Lieutenants Jeance and Colin and Engineer Mercier, have been engaged with a system of wireless telephone apparatus at the Eiffel Tower, in Paris, which, it will be remembered, is under the control of the War Department. This apparatus is not, as has been stated, of a sensational character, but follows the general lines of the existing wireless telephone instruments. It was desired in the first place to find a type of apparatus which was adapted to be used for signaling between war vessels or from the latter to coast stations, and M. Thomson, the Minister of Marine, is having the present work carried out by engineers at the tower plant who were appointed for the purpose. From the start of the tests, which occurred only recently, the success of the new apparatus was assured, as on the first trial at long distance it was found that they could reach the post at Dieppe, which contained a like set of instruments. The distance is nearly 100 miles, and conversation could be heard during the day and night. As the weather was stormy at the time there is no doubt that greater distances can be covered. At present the record of distance was made by M. Poulsen, the inventor of the system, who states that he was able to telephone from a point near Copenhagen as far as Berlin, at a distance of 234 miles.

While upon the present subject we should not neglect to mention the preparations which are being made at the Eiffel Tower station for receiving wireless telegraph messages from America. The first experiments will be carried out during the night, so as to avoid the disturbing effects which occur during the day. The apparatus at the tower plant is now in readiness to begin the experiments with New York, and these will be carried out very shortly. However, when the new high-power plant of the tower station is finished much greater distances can, no doubt, be covered. Work has now been commenced upon the underground station which is to replace the present plant. Its operations were much hampered owing to the small power of the apparatus, and the change will bring about quite a new state of affairs.

An enterprise of an interesting nature has been undertaken by the company which operates the Solingen mines in Westphalia. It is taking steps to utilize the peat bogs of this region, and will burn the peat in an electric plant which is to be erected on the spot. Current will be sent from the station in order to supply the towns and villages of the district. At the same time the peat will be used to furnish various chemical products by treating it in the proper way. It is found that sulphate of ammonia can be produced to advantage by this method, and the company has already been working a chemical plant with some success. It is proposed to utilize the vast peat bogs which lie in the Rhine region in the district of Westphalia and Hanover, and current will be produced much more cheaply than from coal.

The new Edison battery is used on an automobile car which has been recently put in service in Berlin. It is constructed by the Bergmann firm and uses a five-horse-power motor with a gear ratio of 5 to 1, working upon the rear axle of the car. There are sixty-four cells of the Edison battery used, and these furnish eighty volts for the motor, which works at a speed of 1,500 revolutions per minute. The battery is held in eight different wood cases. Each of the cells weighs sixteen pounds and gives 1.23 volts. The entire battery furnishes fourteen kilowatt-hours, and the charging current is sixty-five amperes at three and one-half hours' duration. The motor has two separate windings and the battery is divided in halves. By varying these different circuits at the controller the various speeds of the car are obtained, of which the highest is twenty miles an hour. The expenditure of energy is found to be seventy-five watt-hours per ton-kilometre. With battery and motor, the car weighs 16.5 tons.

A new process for making an insulator which is said to resemble ebonite has appeared on the Continent. Powdered tan bark is mixed with one-third of sulphur and the whole is heated until the sulphur melts, when the mixture is well stirred and then cooled. It has the form of small, black grains. These are put in a pressure mold and heated from the outside; this gives a block or a piece of insulating material of any form. The new insulator is said to possess many of the properties of ebonite.

Owing to the successful operation of the Ronchamps central station, which distributes current in the Belfort, Vosges and other regions in the eastern part of France, it has been decided to add a new steam turbine to the three existing units. This will be a turbine-alternator group of 5,000 horse-power, and it will use a transformer for giving 30,000 volts upon the power line.

Owing to the disastrous fire which occurred at the central telephone exchange of Paris, the principal subscribers in the business district will be obliged to do without the telephone for two months or more. There are nearly 20,000 subscribers affected by the loss of the exchange. The fire broke out about seven o'clock on the evening of September 20, when the odor of burned rubber appeared in the fifth or top floor of the building, where the new multiple switchboard on the central-battery system had been installed. An inspection of the apparatus showed that the ground cables placed in the basement were no longer in working order and that there must have been a short-circuit at that point. The cables which come from all over the centre of the city run into the basement and are thence brought through the building. The employés were ordered to leave the building as a fire was commencing to break out, no doubt in the basement, and owing to the inner conduits and shafts for the cables, the fire soon commenced to gain all the different stories of the building, which is a five-story one. The Gutenberg exchange fronts on the Rue du Louvre and extends back for a considerable distance to the Rue Jean Jacques Rousseau, being a long and narrow building, lying against the dwelling houses on one side and separated by the Rue Gutenberg, a narrow passage, from the Central Post-Office building.

Shortly after the employés had left the fire was seen in the top story, and it seemed to have reached this point directly from the basement by the shafts above mentioned. Soon afterward the fire spread to the floor underneath. The firemen, who soon arrived, could not enter the basement as the fire was in full progress there. At nine o'clock the whole building formed an immense brazier from which escaped flames and calcined stone. The metallic structure of the building, however, remained solid. Owing to the efforts of the firemen and the great number of hose which were made to play on the flames, the fire was gradually brought under control, and was finally put out several hours after. Two companies of infantry were brought out and they aided in keeping order around the building.

But little, if any, of the material which occupied the exchange can be saved, and most of the multiple telephone boards are a total wreck. In four stories of the exchange were installed the multiple switchboards, which served for 20,000 subscribers, or very nearly that number. There were also the boards for the suburban and interurban service. This latter suffered the least, but as regards the rest of the apparatus it is totally lost and the subscribers in the business part of Paris will be obliged to have recourse to the public cabins in order to use the telephone, and this state of affairs will last until a temporary exchange can be erected. A great disturbance among users of the telephone was thus occasioned. It was of the first importance to establish communication between Paris and London, Berlin and other cities, which had been cut off. This was done within twenty-four hours, and the ministerial offices, War, Navy and others, were also cared for, as it was most important that the government administrations should not be deprived of the telephone. The Bourse suffered greatly from the lack of communication, and it became difficult to carry on certain kinds of commercial affairs where the stocks fluctuate rapidly.

Usually there are 1,400 female telephone employés in the Gutenberg exchange, but as the fire occurred on Sunday, the number was much less, which was fortunate. No one was hurt on this occasion and the firemen, although they suffered much from the intense heat, were not injured. It is therefore a matter of congratulation that no lives were lost. The minister of Public Works and the Postal Telegraph and Telephone secretary are taking measures to restore order within the least possible time. The interurban service suffered the least, and it will be transferred to the other telephone exchanges of the city. A part of the apparatus will be installed in the office near the Bourse and the Chamber of Commerce will be asked to afford other localities in the central part of town. After establishing the London and Brussels telephone lines, the next in order will be the Bordeaux line, then the Lyons and other home telephone lines. Among the foreign lines, those to be opened first will be the Berlin and Frankfort lines.

Besides the damage to the telephone service, the telegraph also suffered from the fire. A certain number of telegraph cables pass in the basement of the Gutenberg exchange, especially the English and Belgian cables. About 800 feet of cable were destroyed in the basement. After the disaster there were four telegraph lines established with London and two with Brussels. By the time the present account appears the foreign and interurban lines will have all been established both for the telegraph and the telephone, as the work is being pushed forward with all haste.

The city subscribers will suffer most, however. It will take at least two months before a temporary exchange can be erected and there seems no other way of solving the problem. However, all the public cabins will be in working order, as they will be at once connected with the other exchanges of the city. At the same time there will be many temporary cabins opened up either in the post-offices or in other localities, and the subscribers will have the free use of these by showing their card. This, however, will be but a feeble remedy for the difficulty, and most of the business offices will suffer considerably. This applies to the 20,000 subscribers who were connected to the Gutenberg exchange. The rest of the subscribers in the city, to the number of 25,000, are using the telephone as usual, seeing that they are connected to the six outer telephone exchanges which are of smaller size. But they can not, of course, communicate with the central subscribers' lines and will thus be cut off from the central part of town. This will mean a great rush at the public telephone cabins in all parts of the city. No doubt the use of pneumatic cards and telephonic messages will increase. In the latter case one may telephone from a cabin to the employé in another office, who writes down the message and it is delivered to the desired address. Outside of the direct use of the telephone this is the quickest way to communicate from one part of town to another.

It is proposed to erect the provisory exchange, or rather two separate buildings, each with 10,000 subscribers, in the space which is embraced by the Louvre building, known as the Carrousel Place. This will be very objectionable, as it will spoil the appearance of this attractive site, but as it is necessary no doubt the measure will be approved. Two months at the very least will be needed to fit up this exchange, and the 20,000 subscribers will then be satisfied. Meanwhile there will be measures taken for the building of a new exchange, probably on the site of the present one, but this is not certain. At least, the use of a smaller unit for the exchanges is found necessary, as had such been the case the fire would not have caused the same damage. As to the monetary loss, this is difficult to judge at present, but the Paris journals mention sums varying from six to eight million dollars.

C. L. DURAND.

Paris, September 26.

The Old Time Telegraphers' and Historical Association.

The twenty-seventh annual reunion of the Old Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps was held at Niagara Falls, N. Y., September 16, 17 and 18. Headquarters were established at the Cataract International Hotel. There were in attendance a large number of delegates and guests, and the meeting was successful in every way.

The business meeting of the Society of the United States Military Telegraph Corps was held on the morning of Wednesday, September 16, Colonel William B. Wilson, the president, occupying the chair. The reports of the president, secretary and treasurer were presented, and the constitution and by-laws with all amendments made since 1882 were re-adopted.

J. H. Robinson, of Washington, D. C., addressed the meeting, referring particularly to the deeds of heroism performed by the military telegraphers during the Civil War.

It was resolved that all persons eligible to membership may be elected to life membership by the payment of $50, in which case the payment of annual dues will not be required.

A resolution was also adopted recording the appreciation of the society of the provision made by Andrew Carnegie for meeting the wants of the aged and needy members of the corps.

A resolution was passed expressing the appreciation of the society of the services to the organization of James E. Pettit, its secretary and treasurer for twenty-six years.

The following officers were elected: President, William B. Wilson, Philadelphia; secretary and treasurer, David Homer Bates, New York; vice-presidents, William L. Ives, New York, and Charles A. Tinker, Brooklyn.

General Thomas T. Eckert and Colonel Robert C. Clowry were elected honorary members of the society.

The business meeting of the Old Time Telegraphers' and Historical Association was held at 2 o'clock on Wednesday afternoon, September 16. The meeting was called to order by Harvey D. Reynolds, president, and Franklin D. McKenna, corporation counsel of the city of Niagara Falls, welcomed the delegates and members to the city in behalf of the mayor. The reply for the association was made by William J. Dealy, of New York.

In his presidential address Mr. Reynolds referred to the death of former President William Hamilton Young and of Secretary John Brant.

M. J. O'Leary, of New York, who was appointed to act as secretary *pro tem.*, read the report of the secretary and treasurer.

The following officers were elected: President, E. B. Saylor, Pittsburg, Pa.; first vice-president, C. E. Bagley, Pittsburg, Pa.; second vice-president, W. J. Camp, Montreal, Canada; secretary, Frank J. Scherrer, New York.

Northwest Electric Light and Power Association.

About seventy-five representatives of electric light and power companies in Washington, Oregon, Idaho and Alaska have organized the Northwest Electric Light and Power Association. A meeting was held in Seattle, Wash., on September 19, to bring together these interests, and the session closed with a banquet on the evening of that day.

The following officers were elected: President, Arthur Gunn, Wenatchee, Wash.; first vice-president, A. Welch, Portland, Ore.; second vice-president, Francis Rotch, Fairbanks, Ore.; third vice-president, Henry Adams, Lewiston, Ida.; temporary secretary, J. D. Crary, Aberdeen, Wash. Executive committee: H. L. Bleeker, Portland, Ore.; I. W. Anderson, Walla Walla, Wash.; E. E. Potter, Seattle, Wash.; L. B. Faulkner, Olympia, Wash.; C. G. Arrowsmith, North Yakima, Wash.; O. B. Caldwell, Portland, Ore., and N. J. Shields, Moscow, Ida.

Electrical Transmission of Time Signals Without Wires.

A system for the distribution of time signals by means of Hertzian waves, invented by Franz Morawetz, of Vienna, is described in *L'Industrie Electrique*. Paris, September 10, by Dr. A. Ferla. Attempts in this direction had already been made, but have failed on account of disturbances caused by extraneous, such as atmospheric, electric waves. The inventor conceived the idea of constructing an apparatus which remains in circuit only during one second. As soon as an electric wave strikes it, it is disconnected from the circuit by a suitable clockwork and remains in this condition for fifty-nine seconds. Thus the apparatus is capable of receiving a signal only during one second out of sixty and can be actuated only once in a minute, either by a wave intended for this purpose, or by some other wave. Mr. Morawetz, in conjunction with Professor Reithoffer, of the Vienna Technical High School, investigated the behavior of electric waves in a large city and the construction of apparatus for their utilization. A central station was installed in 1905 on the roof of the Technical Institute in Vienna, for which the municipal council granted a subsidy of 3,000 francs, and the best form of antennæ and the most favorable wave length were studied. The experiments showed that a wave length of 765 metres had the necessary inflection to overcome the inequalities of the territory. In 1906 the influence of atmospheric electricity on the apparatus was investigated and observations were made simultaneously at two receiving stations, one at Breitensee and the other at the Siemens-Schuckert works on the Praterquai. An increase in atmospheric electricity often manifested itself hours before the formation of clouds indicating a thunder storm. An extraordinarily violent thunder storm, which struck Vienna in July, 1907, did not disturb the system in the least and proved its complete insensibility to atmospheric electricity. Although the discharges succeeded one another almost without interruption, the clocks continued to keep exact time. The waves sent out from the central station could be distinguished very clearly from the atmospheric sparks at the coherer by their color. During the trials it was likewise demonstrated that large masses of metal are no obstacle to the propagation of electric waves. The metallic cupola of the St. Charles Church is between the central and one of the receiving stations, but with the wave-length employed the signals arrived without being disturbed or weakened in the slightest. During the experiments the sending and receiving instruments were perfected. At the central station the high-tension wave-transmitting apparatus is actuated by an electric clock invented by Mr. Morawetz. This clock is capable of closing the circuit of a transformer during a time-interval of either one, two, three or four seconds and from one to three times per minute. The secondary circuit of the transformer charges a battery of 100 Leyden jars, which is discharged across a spark-gap, producing radiating electrical oscillations in the antennæ. As the radiations can not be produced on one side of the circuit only, the other terminal is connected to the ground. At the receiving station in Breitensee a steel tube pole, twenty metres high, is installed in a wooden socket. The antennæ consist of copper wires suspended from an insulated cross-bar at an angle of forty-five degrees. The wires are joined at the bottom, enter the station through a glass tube and are likewise connected to the ground. When the waves reach the receiving antennæ, which must be in resonance with the oscillations, a system of induction coils and condensers transmits them to the coherer, and the latter closes a local circuit by means of a very sensitive relay. The chronometric apparatus of Mr. Morawetz, the principal part of the invention, consists essentially of a clock movement which, when actuated by the waves, interrupts communication with the receiving devices, so that signals can be received only during a predetermined number of seconds. If any extraneous wave arrives at another time it operates the apparatus at the receiving station, but the wave from the central station remains ineffective. In such a case there will be a slight discrepancy between the central and receiving stations, which will, however, be compensated during the following minute and can not exceed a few fractions of a second. The secondary clocks at the receiving stations may, of course, be of any construction. The advantages of this system are that the operation of the central station can be effected by a single master clock, that the installation of a great number of circuits is rendered unnecessary, and that the system may be extended without limit over a whole city, and eventually, by increasing the power at the transmitting station, over a whole country, without danger of disturbance. The cost of such an installation of clocks will be very nearly equal to that of a corresponding number of mechanical clocks, and it may be concluded that they will be the clocks of the future.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

SOUTH SIDE ELEVATED.

The income of the South Side Elevated Railway Company, Chicago, Ill., for the year ended June 30, 1908, as filed with the Warehouse Commission is as follows: Gross, $2,242,345; expenses, $1,569,231; net, $673,114; charges, rents, etc., $377,-684; surplus, $295,430; depreciation, $50,000; balance, $245,430; dividends, $281,317; deficit, $35,887, comparing with a surplus of $69,107 for the previous year.

METROPOLITAN WEST SIDE ELEVATED.

The Metropolitan West Side Elevated Railway Company, Chicago, Ill., reports as follows for the year ended June 30, 1908: Gross, $2,809,483; expenses, $1,457,152; net, $1,352,341; other income, $5,016; total income, $1,357,357; charges, $1,070,780; surplus, $286,577; dividends, $65,320; surplus, $221,257, which compares with $195,858 for the previous year. During the year the Metropolitan company paid off $376,387 equipment notes and purchased and paid for $200,000 new equipment. The total expenditure for equipment was $576,387. During the year the company increased its funded debt $400,000 by the sale of extension bonds. The difference between this sum and cost of equipment, or $176,387, was taken out of surplus. The company also reduced its collateral loan $50,000.

MINNEAPOLIS GENERAL ELECTRIC COMPANY.

The Minneapolis (Minn.) General Electric Company's gross earnings show an increase of $9,996 for July. This was offset to some extent by an increase of $1,662 in expenses. The July gain in net earnings was $4,374. For the twelve months the gross earnings showed a gain of $81,666, and the expenses were cut $3,027. The increase in net earnings amounted to $84,692 for twelve months. In detail the report for July is as follows: Gross earnings, $73,889, increase, $9,996; expenses, $32,025, increase, $1,662; net earnings, $41,864, increase, $4,374; charges and taxes, $32,400, increase, $5,576; July surplus, $9,464, decrease, $1,202. For twelve months: Gross earnings, $961,506, increase, $81,666; expenses, $435,638, decrease, $3,027; net earnings, $525,868, increase, $84,692; charges, $354,422, increase, $132,764; surplus, $171,446, decrease, $48,672.

DETROIT UNITED RAILWAY COMPANY.

The report of the Detroit United Railway Company for the month of August and eight months ended August 31, 1908, is as follows: August gross, $691,489; expenses, $443,939; August net, $247,550; other income, $4,957; total income, $252,-507; charges, $134,859; August surplus, $117,648, comparing with $171,168 for August, 1907. Eight months' gross, $4,656,365; expenses, $2,972,116; eight months' net, $1,684,249; other income, $40,028; total income, $1,724,277; charges, $1,083,811; eight months' surplus, $640,466. This compares with $773,763 for the corresponding months of 1907, a decrease of $133,297.

LEXINGTON & INTERURBAN RAILWAYS COMPANY.

The report of the Lexington & Interurban Railways Company for the month of August and eight months ended August 31 is as follows: August gross, $63,246; expenses, $35,844; August net, $27,402. Eight months' gross, $402,540; expenses, $260,593; eight months' net, $141,947. This is an increase of $15,547 over the corresponding figure for 1907.

MEMPHIS STREET RAILWAY.

The Memphis (Tenn.) Street Railway Company's report of earnings for the month of August and eight months ended August 31 is as follows: August gross, $141,191; expenses and taxes, $87,929; August net, $53,262; charges, $35,532; balance, $17,730; reserve funds, $2,500; August surplus, $15,230, comparing with $21,786 for August, 1907. Eight months' gross, $1,056, 720; expenses and taxes, $671,347; eight months' net, $385,373; charges, $279,437; balance, $105,935; reserve fund, $20,000; eight months' surplus, $85,935, comparing with $115,733 for the corresponding period of last year.

NASHVILLE RAILWAY AND LIGHT.

The Nashville (Tenn.) Railway and Light Company reports earnings for the month of August and eight months ended August 31 as follows: August gross, $127,795; expenses and taxes, $78,-166; August net, $49,629; interest charges $32,811; balance, $16,818; reserve funds, $3,829; August surplus, $12,988, as against $16,983 for August, 1907. Eight months' gross, $1,015,782; expenses and taxes, $620,565; eight months' net, $395,217; interest charges, $253,975; balance, $141,243; reserve funds, $30,357; eight months' surplus, $110,886, comparing with $140,615 for the previous year.

LITTLE ROCK RAILWAY AND ELECTRIC.

Little Rock (Ark.) Railway and Electric's earnings for the month of August and eight months ended August 31 are as follows: August gross, $56,868; expenses and taxes, $28,851; August net, $28,017; charges and sinking fund, $11,-315; balance, $16,701; reserve funds, $3,000; August surplus, $13,701, comparing with $18,968 for August, 1907. Eight months' gross, $441,161; expenses and taxes, $227,568; eight months' net, $213,593; charges and sinking fund, $80,190; balance, $133,402; reserve funds, $24,000; eight months' surplus, $109,402, as against $126,159 for 1907.

NORFOLK & PORTSMOUTH TRACTION.

The Norfolk & Portsmouth (Va.) Traction Company's earnings for the month of August and eight months ended August 31, are as follows: August gross, $174,872; expenses, $94,575; August net, $80,297. Eight months' gross, $1,232,-295; expenses, $740,436; eight months' net, $491,859, comparing with $642,039 for the corresponding months of 1907. The large net earnings for 1907 are due to the Jamestown Exposition.

Comparative Operating Costs of Small Arc Lamps and High Candle-Power Osram Lamps.

Hermann Remane makes a comparison in the *Elecktrotechnische Zeitschrift*, August 20, between high-candle-power osram lamps and small arc lamps. The osram lamps are made of 200, 300, 400 Hefner candle-power and 110 to 130 volts, and from 200 to 250 volts, consuming one to 1.1 watt per horizontal Hefner candle. Tests made with direct current and alternating current show a useful life of 800 hours, during which time the candle-power decreased from five to six per cent. The mean spherical candle-power is given as seventy-nine per cent of the mean horizontal, which is the same figure found by the Reichsanstalt for osram lamps up to fifty candle-power. It is stated that the osram lamp is of greater efficiency than the open direct-current arc lamp of less than five amperes and alternating arc lamps with pure carbons of less than fifteen amperes. Comparison is also made of the operating costs of arc lamps and osram, and it is found that the osram lamp is commercially much superior to the direct-current open arc of less than six amperes, and enclosed arcs up to 6.5 amperes, and to the alternating open arc of any size up to twenty amperes.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Electric Automobiles.

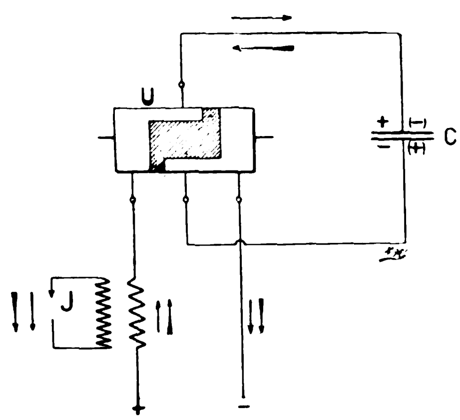
An electrically operated automobile, built by the Siemens-Schuckert Company, known as type "B," is made in three parts, the chassis, the storage battery and the body. The framework is of pressed Siemens-Martin steel. The front part carries an auxiliary frame of the same steel and serves as a base for the storage battery. The motor is suspended in a ring in the middle of the body, and drives the rear wheels through the medium of a differential gear. The normal capacity of the motor is 4.2 horse-power. The storage battery consists of forty-four cells, having a capacity of 145 ampere-hours at a five-hour discharge rate. For charging ninety-five to 120 volts are necessary. It is claimed that the advantage of an electrically operated automobile is safety in operation, doing away with noise and obnoxious odors common to gasolene and other explosion motors.—*Translated and abstracted from Centralblatt für Accumulatoren und Galvanotechnik, August 20.*

Series Repulsion Motor of Alexanderson.

Rudolf Richter starts out with a reference to a paper read before the American Institute of Electrical Engineers at Niagara Falls on the "Choice of Frequencies for Single-Phase Traction," fifteen or twenty-five cycles, which seemed to favor fifteen cycles, until Steinmetz pointed out the fact that Alexanderson succeeded in building a single-phase railway motor for twenty-five cycles having the same efficiency as the fifteen-cycle motor. It was pointed out that the weight of the twenty-five-cycle motor is about the same as that of the fifteen-cycle machine, and that the Alexanderson twenty-five-cycle motor is to be preferred. The author also discusses Alexanderson's paper on "Single-Phase Railway Motors." The article runs through two issues and contains many interesting charts and diagrams, giving comparisons between the Alexanderson and other commercial types of single-phase motors. The author also discusses the spark voltage of the different types at different loads.—*Translated and abstracted from Elektrotechnische Zeitschrift, August 20 and 27.*

The "Grissonator."

The name "Grissonator" has been given to a converter constructed by the firm of Grisson, in Berlin, for transforming direct current into interrupted current or into alternating current of any tension. The transformation is not effected by a circuit interrupter, but by the direct charge and discharge of a condenser. The direct current to be transformed flows from the positive pole of the source in the direction of the unfeathered arrow through the primary of an induction coil J, passes through the commutator U composed of small brushes and two collector rings, through the condenser C, and thence to the negative pole. The current charges



THE "GRISSONATOR."

the condenser to the tension of the direct-current source. At the end of the charge the current ceases of itself and, if the circuit is broken, this does not produce an interruption of the current, but a simple opening of the circuit without current. When the commutator U is rotated by a small motor the small brushes pass without current over the insulating part of the commutator, while the condenser maintains the tension of the current source. If the commutator continues to rotate a contact is made between the condenser and the opposite pole of the current source, and consequently a new charge flows in the same direction through the induction coil and charges the condenser in the direction of the feathered arrow. This apparatus is particularly useful with Roentgen-ray installations, for the secondary effect is not brought about by the extra current caused by the making and breaking of the circuit, but exclusively by a series of current impulses resulting from the closing of the circuit. The condenser used with this apparatus consists of aluminum sheets immersed in a special electrolyte, which become covered with a skin formed by disengaged oxygen when the apparatus is in operation. A condenser of this kind measuring twenty-five by twenty-five by thirty centimetres has a capacity of over 500 microfarads. The aluminum forms the anode and the electrolyte the cathode.—*Translated and abstracted from L'Electricien (Paris), September 5.*

Electrometallurgy at the Marseilles Exposition.

The employment of high temperatures was only made possible after the discovery of the electric furnace, and since its application to the production of aluminum great progress has been made in the manufacture of numerous siderurgical products, a great variety of which is to be seen at the Marseilles exposition, says M. de Kermond. The oldest firm engaged in the electrometallurgical industry in France is the Société Electrométallurgique de Froges, which originally started with a few hundred horse-power, about ten years ago, but now utilizes about 30,000 horse-power. The manufacture of aluminum by the Héroult process has been its principal occupation. It exhibits aluminum in ingots, sheets, bars, wires, cables, tubes, etc., and a magnificent collection of kitchen utensils. The use of this metal in the transmission of electrical energy, one of its important applications, is illustrated by exhibits of wires, cables, binding-posts, splices, etc. The firm of Morel exhibits aluminum rivets and tubes for special purposes, as oil and nitric acid channels, refrigerating apparatus, sign letters, medals, keys, etc. The cooking utensils exhibited are recommended not only for their beautiful appearance, but also for their indefinite wearing qualities. The Société Electrométallurgique has also installed an extensive plant for the electrical manufacture of steel and has put out products which are equal, if not superior, to the best brands of crucible steel. Among the samples exhibited there may be mentioned: Extra soft steel containing only traces of carbon; steel with very high carbon contents, up to 4.06 per cent; steel containing phosphor up to one per cent, sulphur up to 1.5 per cent, and silicium, manganese, chrome or tungsten in desirable quantities. By means of the Héroult electric furnace it is also easily possible to produce quick-cutting chrome, tungsten, vanadium and molybdenum steels. Photographs are exhibited of the oscillating Héroult electric furnace, in which these interesting products are manufactured. So far these fine steels made in the electric furnace have been used only for tools, but the time is coming when they will be cheap enough to be employed for all purposes. The same company manufactures also iron alloys, which are now so much appreciated in the siderurgical industries, and has exhibited samples of chrome iron containing from one to two per cent of carbon and from fifty to seventy per cent of chrome; silicium iron containing from twenty-five to fifty per cent of silicium; nickel iron containing about forty per cent of nickel, two per cent of carbon and less than two per cent of silicium. Samples of the raw material, bauxite, from which aluminum is made, complete this interesting exhibit. —*Translated and abstracted from L'Electricien (Paris), September 5.*

The Frequency of Telephone Currents.

This is a description of investigations made by Devaux-Charbonnel of the frequencies of telephone currents with the object of establishing a basis for the theoretical study of telephone problems. He established the fact that the vibrations representing the voice have a period of considerable regularity, and he investigated the fundamental notes and harmonics of which the voice is composed. "After decomposing the current into its various sinusoidal harmonics, it becomes easy," the author states, "to foretell the effects that will be produced during their propagation over lines and through apparatus. It will be possible to investigate how the different periods are altered according to their frequencies and to see if these can not be compensated by a judicious choice of lines and apparatus and thus arrive at an ideal telephony, the transmission of the voice without weakening and with the preservation of its tone and all its modulations." In the experiments a Blondel oscillograph was employed to produce tracings of curves representing the current vibrations in a telephone circuit. Very clear curves two to four millimetres in height and corresponding to a duration of about one-tenth of a second were thus obtained. The distinctly periodical character of the curves was evident at first sight. The curves were next decomposed into their harmonics, the tracings being enlarged by a projection lantern in order to facilitate the process. It was found that the prominent indentations of the curves were equidistant, the different peaks evidently corresponding to a harmonic, which could then be easily eliminated. By repeating this process of elimination a curve was finally obtained which no longer contained a harmonic and represented the fundamental sound. It was found that with the vowels the fundamental sound is less intense than the harmonics, the second and sixth harmonic predominating, but with the vowels *u* and *i* harmonics as high as the thirteenth were observed. In syllables the presence of consonants modifies the curve during four or five periods. The observations led to the conclusion that the human voice is a sound rather than a noise; that it is formed by a succession of vibratory phenomena, the largest number of which are regularly periodical, and the telephonic currents transmitting the voice naturally partake of this same property and their study enters into the general theory of alternating currents. In short, the telephone currents consist of alternating currents of very different frequencies, caused by the fundamental sound and its harmonics. As to determining in advance the effects that will be produced over a given line, experiments have shown that all the harmonics are not equally important as regards intelligibility, and that only a small number is indispensable, but that those in the neighborhood of 1,200 are necessary to make speech intelligible. It was further demonstrated that the frequencies between 800 and 1,200 are really indispensable. An average frequency of 1,000 is, therefore, proposed as a basis for the study of practical telephone problems, and the general conditions making telephony possible should be adapted to this frequency. It will be necessary, however, in the treatment of a problem, to ascertain if the lower and higher harmonics will not give results too greatly at variance with those of the standard frequency of 1,000, and it would seem that consideration of the frequencies of 200 and 2,600, corresponding, respectively, to the average fundamental sound and the thirteenth harmonic, will furnish useful information in this respect.—*Translated and abstracted from La Lumiere Electrique (Paris), September 12.*

The Electric Lighting of Drury Lane Theatre Royal.

It will be remembered that on March 25 of the present year the stage of the historic Drury Lane Theatre, London, was completely destroyed by fire. The electrical equipment was almost entirely consumed, and directly after the insurance losses were adjusted, plans were drawn up and work inaugurated to restore the electrical fittings. A great deal of the present equipment is practically the same as that which obtained before the fire, but provision has now been made for duplicate services, one from the mains of the local supply company, and the other from the regular theatre system. A system of ventilation has been secured by which the draft of cold air which heretofore annoyed those sitting directly in front of the stage has been eliminated. Warm air is forced on the stage at any point where the cold air can possibly come into the stage or stalls. The air is drawn through sheets of moistened canvas, the canvas being fixed on a large horizontal drum kept rotating so that it is continually moistened with water. The air is then forced through a grid of pipes which are steam-heated, somewhat similarly to an air-cooled condenser. The heated air is finally supplied to the required point through ducts in the usual way. The electrical and hydraulic plants for operating the lifts and the dimmer room are located beneath the stage. The dimmer room contains three rows of dimmers, corresponding with the three colored lights. Each large dimmer controls 125 thirty-five-watt lamps, and each of the smaller dimmers controls sixty-two thirty-five-watt colored lamps. Metallic-filament lamps have been substituted for the carbon lamps, and these work well on the resistances occasioned by the dimming. Arc-lamp projectors are not used, there being some twenty oxyhydrogen projectors in the flies. The gas supply is drawn from large drums at a pressure of three pounds per square inch. These drums are recharged from ordinary gas cylinders. The battens which are now in use are a little out of the ordinary. There are twelve of these, each forty-two feet long, weighing 700 pounds, and containing 250 lamps. The feature of particular interest lies in the fact that they are only ten and one-half inches wide. All of the battens are earthed by making contact with the runners which form the guides for the counterweights on each side of the stage. For connecting up each batten a fuse-board is provided, having eleven circuits. This board is fed by two pairs of nineteen No. 16 cables, and one pair of nineteen No. 14 cables.—*Abstracted from the Electrician (London), September 18.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Battery-Charging Rheostat.

The demand for a battery-charging rheostat which will not only meet all requirements of battery-charging service, but which shall possess automatic protective features as well, has led the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., to place on the market the panel here illustrated.

This battery-charging rheostat consists of a slate front mounted on an angle-iron frame containing the resistance, the whole being designed for attachment to a wall or switchboard.

The panel, which carries all of the operating mechanism, consists of three separate pieces of slate. On the face of the uppermost slate are mounted the terminals, or binding-posts, and a Weston voltammeter. The middle slate carries a double-pole knife-switch and fuses (National Electrical Code standard), and below these the contact segments and operating lever, by means of which the charging current is regulated. On the slate at the bottom of the panel are mounted the automatic protective devices, which are:

(1) A low-current cutout which automatically opens the circuit if the current drops to a predetermined minimum. This prevents the battery from discharging into the line should the line voltage drop below that of the battery.

(2) A maximum-voltage cutout. This automatically opens the circuit when the battery voltage reaches the point at which the cutout is set to operate.

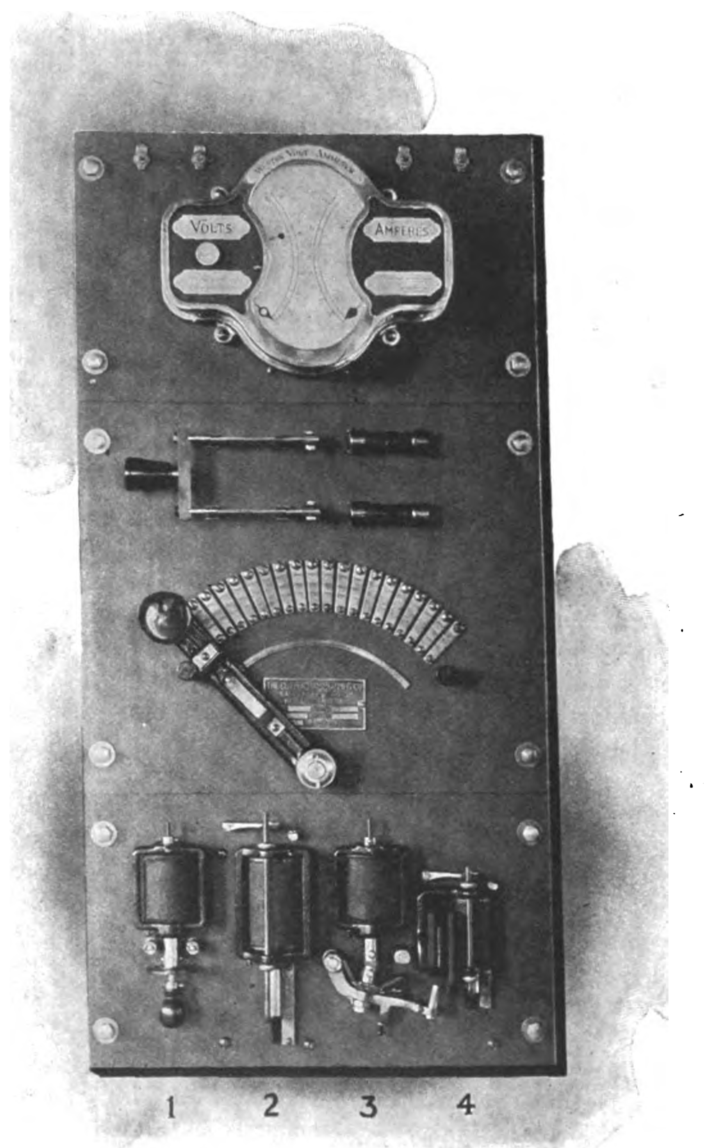
(3) A solenoid switch the opening or closing of which "breaks" or "makes" the main-line charging circuit.

(4) An overload circuit-breaker which automatically opens the circuit if the charging current rises to the point at which the breaker is set to operate. This insures the battery against being charged at an excessive rate.

The operation of this type of battery-charging rheostat is as follows: After the battery and line connections have been made the operator first closes the knife-switch and then moves the operating lever forward to the third-contact segment, at the same time raising the plunger on the low-current cutout (1), thus energizing the solenoid switch (3), which closes and permits the charging current to flow to the battery through the resistance.

If at the beginning of the charge the operating lever is not in the starting position (that is to say, resting against the rubber stop-post at the left) it must first be brought to the starting position and then moved to the third contact segment, as described above. It may then be moved further and further to the right, cutting out one step of resistance after another and increasing the amount of current until the desired amperage (as indicated by the ammeter) is obtained.

Should the current fail, or reverse, the low-current cutout (1) will release its plunger, thus de-energizing the solenoid switch (3), which will in turn open the main circuit. Should the charging current reach the point at which the overload circuit-breaker (4) is set to operate, this will open the main circuit. Finally, when the charge is continued until the battery reaches the voltage at which the maximum voltage cutout (2) is set to operate, this will automatically open the circuit, thus insuring the battery against an overcharge.



Battery-Charging Rheostat and Panel.

It will be evident from the above description that the use of this panel protects the battery under all charging conditions, as it not only guards against an excessive charging current, but also prevents the battery discharging back into the line should the line voltage fall below the voltage of the battery. It possesses, moreover, the advantage of requiring no attention after the charge is once begun, since the maximum-voltage cutout (2) will cut off the current of itself when the battery is fully charged.

As an additional protection the operating lever is provided with an electrical interlock, which prevents the operator from closing the circuit to the battery except when the lever is in the "off" position, that is to say, with all resistance in circuit.

These battery-charging rheostats are made at the New York works of the Cutler-Hammer Manufacturing Company, One Hundred and Thirtieth street and Park avenue, New York city.

Wagner Electric Manufacturing Company Central Station Transformers.

In an advertisement of the Wagner Electric Manufacturing Company that appeared in our columns last week, in referring to the efficiency of the central station transformers manufactured by that company, the phrase "Iron or copper losses are properly proportioned" should, of course, have read "Iron and copper losses are properly proportioned." In this connection it should be pointed out that the purchaser of a transformer can have, at his election, either extraordinarily low core losses, or extraordinarily low copper losses. Thus, the Wagner company has built, as an extreme of design, a 110-kilowatt transformer with a core loss of one-quarter of one per cent. Such a transformer, however, would obviously not do for any kind of ordinary service.

The Westinghouse Electric and Manufacturing Company Plan.

The modified plan of the Readjustment Committee of the Westinghouse Electric and Manufacturing Company has been made public. The detailed statement does not differ in any important points from the preliminary statement issued after the meeting of the Readjustment Committee last week. It is repeated that the adoption of the plan is contingent upon the raising of $6,000,000 cash by the stockholders by subscription to assenting stock, and that the consent of all the bank creditors must be obtained. Subscriptions to assenting stock now amount to $4,500,000.

Interests of the Westinghouse Company declare that now that the merchandise creditors' plan has been adopted in modified form by the Readjustment Committee, no difficulty will be encountered in obtaining the required subscriptions and assents from the bank creditors.

The Readjustment Committee of the Westinghouse Electric and Manufacturing Company submits the following statement of the company's present debt, exclusive of interest:

Unsecured debt:	
Convertible sinking fund five per cent gold bonds, due January 1, 1931	$18,500,000
Five per cent gold debenture ctfs., due July 1, 1913	1,969,000
Mdse. debt, including notes issued for mdse.	4,762,560
Bills payable for money borrowed	7,919,000
Total unsecured debt	$33,150,560
Debts secured by collateral:	
Three-year six per cent collateral notes, due August 1, 1910	$6,000,000
Ten-year five per cent collateral notes (French loan), due October 1, 1917	2,702,702
Total secured debt	$8,702,702

The modified or substitute plan for the readjustment of the debt of the Westinghouse Electric and Manufacturing Company contains the following features:

The funded debt is not to be disturbed.

The merchandise debt is to be satisfied by the merchandise creditors surrendering their claim in exchange for new assenting stock of the company at par.

Holders of the bank debt—notes payable for money borrowed—are to receive in exchange therefor one-half thereof in convertible sinking fund five per cent gold bonds of the present authorized issue at par, and for the other half either five per cent notes, in three equal amounts, maturing respectively in four, five and six years, to the extent of thirty per cent of the face value of the claim and for the balance of the claims assenting stock of the company at par, the creditor to have the privilege, however, of taking a larger amount of assenting stock and a lesser amount in obligations; or at the option of the creditor in respect to the one-half of the claim not covered by convertible bonds, five per cent notes of the company maturing in fifteen years.

In addition to the stock subscriptions payable by the surrender of debt, the company is to receive from stockholders and others subscriptions at par for $6,000,000 of assenting stock.

The committee has approved the following plan for the future management of the company:

1. The company to have a board of twelve directors, with power to add additional members to be distributed equally among the four classes hereinafter mentioned.

2. The board to be classified in respect of the tenure of office of its members so that there shall be four classes, the term of one class to expire each year.

3. The new board of directors to consist of persons approved by the Readjustment Committee with representation on the board of persons acceptable to the Merchandise Creditors' Committee.

4. The Readjustment Committee is to appoint a Proxy Committee, to remain in existence for five years, the members thereof to be chosen after a conference with the Merchandise Creditors' Committee and the principal stockholding interests.

The modified or substitute plan outlined above is not to become operative unless and until subscriptions to $6,000,000 of assenting stock and the necessary assents of the holders of the bank debt and merchandise creditors' claims are in hand, and the committee have fixed October 27, 1908, as the date by which such subscriptions and assents may be received.

The committee, however, may in its discretion impose such additional conditions or grant such additional extensions as may be necessary or proper to effect the readjustment of the debt of the company and to determine when assents of a sufficient number of creditors have been received to make it advisable to declare the plan operative.

The position of the company would be greatly strengthened if the plan could be completed immediately, and what should be striven for above all, by the stockholders particularly, is the elimination of the proposed four, five and six-year notes. A statement prepared by the auditor of the company, estimating the resources and requirements for five years beginning April 1, 1908, gives the minimum resources as $38,190,920, with probable resources of $54,090,920. The company's investments available for sale at sixty per cent of their book value total $2,415,800. The total requirements, under the merchandise creditors' plan, based on the bank creditors accepting twenty per cent of claims in assenting capital stock, are $33,811,700. This figure includes six per cent dividends on the assenting stock. The requirements under the same plan, based on the bank creditors accepting fifty per cent of claims in assenting capital stock, including six per cent dividends on assenting stock, are $31,579,785.

Delivery of securities may be made to the following depositaries: Bankers' Trust Company, New York; First Trust and Savings Bank, Chicago; the First National Bank of Pittsburg, and the National Shawmut Bank, Boston.

Some Products of the Massachusetts Chemical Company.

A product of the Massachusetts Chemical Company, Walpole, Mass., known as Walpole insulating board, is an interesting example of the evolution in quality of materials for the electrical trade.

This insulating board is, as its name implies, a solid insulating material manufactured in sheets of various thicknesses ready for use for all appropriate electrical insulating purposes, for which hitherto ordinary fibre board or other similar material has been employed. It "machines" well—that is, may be sawed, drilled and turned, and will hold a thread—and thus is adaptable to all the multifarious uses in electrical apparatus and machinery, and about central stations, calling for solid insulation in various shapes and sizes. The great feature of the material, however, is its inherent resistance to moisture, acids and alkalies, and oil.

That such a material fills a long-felt want is patent to every practical electrician. The wide adaptability of the product is attested by the extensive and growing use that is being made of it by the more progressive electrical manufacturers and engineers. The efficiency of the material in resisting the action of moisture and corrosive substances has been very strikingly shown by the performance of samples in the Chicago tunnels.

The value of this insulating material may be illustrated by the following examples of its use, taken from among many in which the maintenance of insulation, under continuous or temporary adverse conditions, is of the greatest importance:

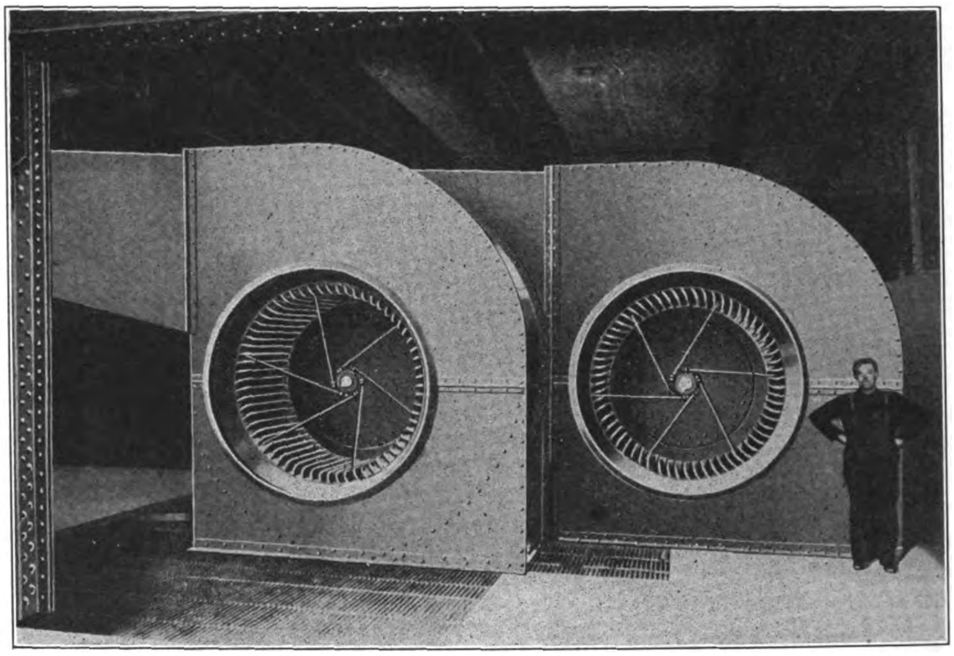
As a motor bed—in a slab extending underneath the entire base of the motor or as small plates under the four or more base-pads of the machine—this material gives assurance against grounds under any conditions. Dripping oil, dirty water, the muck that accumulates under a motor from sweepings, etc., which ordinarily endangers the insulation of the machine from ground, can not affect this material. Especially in damp locations, where the use of painted wood or ordinary slab "insulation" under the motor can not be counted on at all. As a base on which to mount field rheostats for generators and exciters, starting boxes for motors, potential regulators, and other similar devices.

Another product of this company is the Field-Coil Cushion. This device, which is designed to slip on over the field poles of railway motors, between the coil and the frame, prevents injury to the coil due to its movement on the core under the combined influence of the varying magnetization of the core and the vibration of the motor.

The field-coil cushion was developed by the Massachusetts Chemical Company about three years ago, at which time, in order to afford a practical test of the device, a single car of a well-known New England electric railway system was equipped. As a result of the performance of this test equipment, it was not long before these field-coil cushions were installed on the entire system.

Forced Draft Installation in Pennsylvania Terminal Power Station.

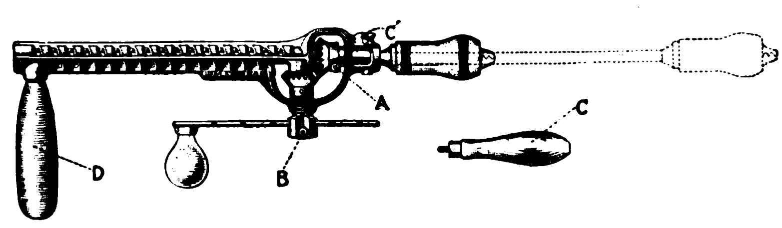
The installation made by Westinghouse, Church, Kerr & Company in the power station of the Pennsylvania Tunnel and Terminal Railroad Company, West Thirty-first street, New York city, is noteworthy for its space and power-saving features. Aside from the efficiency of the installation, saving in space was the most important element in this case, and led to the adoption of Sirocco turbine fans. Two special seventy-inch Sirocco fans are used in conjunction with Neomes grates. These fans deliver 82,000 cubic feet of air per minute against a pressure of two and one-half inches water gauge at 290 revolutions per minute. The fans, as will be noticed from the illustration, are of single-inlet type and are direct connected to horizontal engines.



SEVENTY-INCH SIROCCO FANS INSTALLED IN POWER STATION OF THE PENNSYLVANIA TUNNEL AND TERMINAL RAILROAD COMPANY.

A Telescopic Drill Brace.

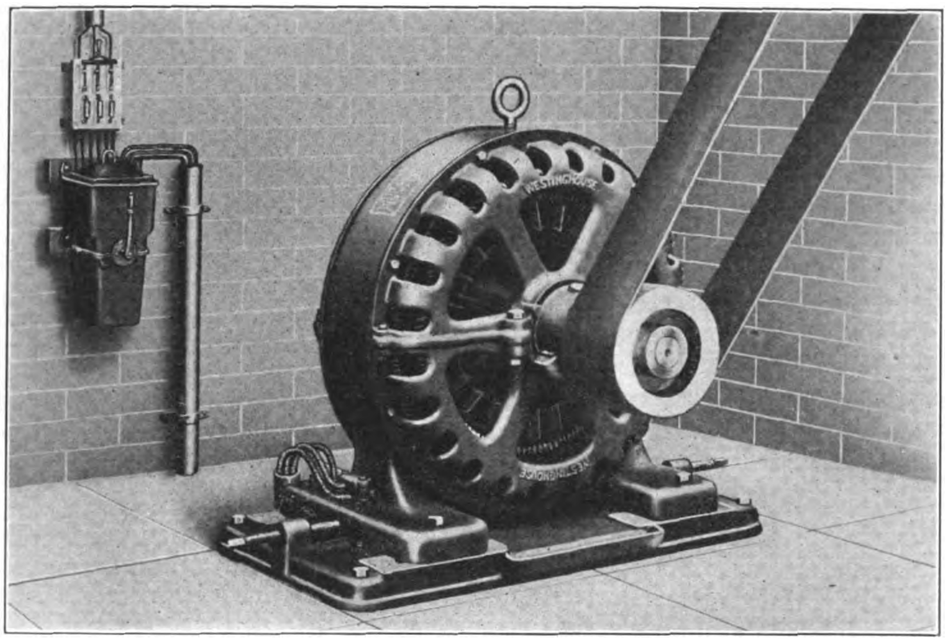
The accompanying illustration shows a telescopic drill brace which has been placed on the market by J. H. Rusby, 23 Boudinot street, Newark, N. J. This brace is instantly adjustable to three different lengths by pressing the latch on the shaft gear A and drawing out the shaft. The crank also is instantly adjustable by pressing the latch on the crank head B, to four, six, eight, ten or twelve-inch sweep. The length of brace over all, when closed, is sixteen inches, and, when open, twenty-five and three-quarters inches, with a stop midway between these extremes. The chuck is equipped with hardened alligator jaws, accommodating round-shank drills as well as square-shank drills and bits. The breast-drill handle C, when screwed into the frame, forms a breast drill. The rear handle D is removable by unscrewing.



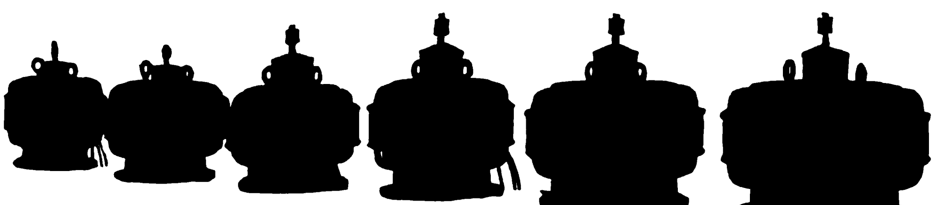
TELESCOPIC DRILL BRACE.

Westinghouse Type CCL Polyphase Induction Motors.

For many industrial installations polyphase induction motors of the squirrel-cage type offer distinct advantages. The absence of sliding contacts makes possible extremely simple construction, and the freedom from sparking assures this type of motor safe operation in places where inflammable gases exist or where inflammable material of any nature may be suspended in the atmosphere. The Westinghouse type CCL polyphase induction motors, manufactured by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., possess the advantages inherent with this type of machine, and are characterized by great strength of parts, large self-oiling bearings, high starting and pull-out torque, large overload capacity, low operating temperature, practically constant speed, and high efficiency and power-factor.



Westinghouse Type CCL Polyphase Induction Motor..



Type CCL Motors for Vertical Attachment.

Type CCL motors are built in standard sizes for slow and moderate speeds on two and three-phase circuits as follows: From one-half to 200 horse-power, inclusive, twenty-five and sixty cycles; from one to seventy-five horse-power, inclusive, forty cycles.

The frame consists of a cylindrical cast-iron ring having substantial supporting feet. Inside this ring are several lugs that support the stator core far enough from the frame to allow a good ventilating space between the frame and the core. The ends of the lugs and the frame are machined to receive the cast-iron bearing brackets, which are of the ventilated type, and which are bolted to the frame in such a way that they can be rotated through a ninety-degree angle. This permits mounting the motor on the floor, wall or ceiling.

The stator core or primary is built up of circular sheet-steel laminations punched from thin plates. These punchings are assembled, clamped and keyed between end rings inside the lugs on the frame. The stator windings generally consist of coils of insulated wire, form-wound; and before they are placed in the slots each slot is lined with insulating material..

The rotor core is built up of circular sheet-steel laminations, assembled, clamped and keyed between stiff end plates on the arms of the rotor spider. The rotor windings of all except the smallest frames consist of insulated copper bars, both ends of which are securely fastened to cast-metal end rings by copper-plated machine screws. The windings of the smallest sizes consist of insulated round copper rods riveted to the core end plates.

Ample ventilation is provided on every size, the end plates of the rotor cores on the larger sizes being provided with vanes or blades.

The bearings are liberally proportioned and lubrication is provided by supplying the split bearings with two oil rings, and the solid bearing with one oil ring.

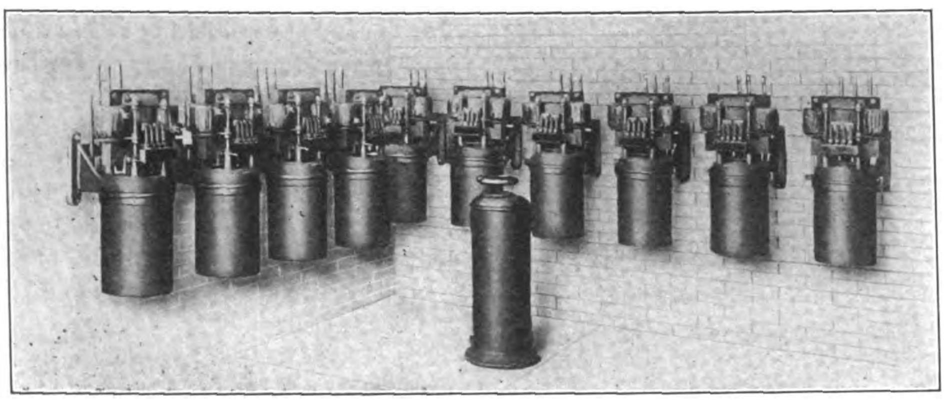
In order to supply a convenient method of driving certain types of machines such as vertical-shaft centrifugal pumps, a modified form of the type CCL motor is arranged for operation with the shaft vertical. The frame is a cylindrical casting without supporting feet. Each bearing bracket has ventilating openings near its outer edge. The upper bracket has a solid central section to prevent the entrance of foreign substances. This bracket carries a thrust bearing and a guide bearing. The lower bracket is cast with a flange or base for supporting the motor, and with ventilating openings in the central portion. This bracket also carries a guide bearing.

The ball thrust bearing carried by the upper bracket is capable of carrying something additional to the weight of the rotor, the exact amount of the excess weight depending on the size and speed of the motor. The weight is supported by balls rolling in a raceway between hardened steel discs, and spaced by a suitable brass cage. Attached to the upper end of the shaft is a thick steel washer, by means of which the weight of the rotor is transferred to the thrust bearing. The bearing is enclosed in a cup or bearing pot. The balls of the thrust bearing are immersed in oil. The cap over the top of the bearing pot carries a sight-feed oil cup, from which oil drops into a hole in the end of the shaft and is led to the upper guide bearing.

In many applications, especially where motors and lamps are supplied by the same circuit or transformer, large starting currents create undesirable fluctuations. For this reason it is not practical to apply full-line voltage to the motor primary in starting any but small squirrel-cage induction motors. Therefore each type CCL motor larger than five horse-power is provided with an auto-starter consisting of two auto-transformers and an oil-immersed switch for changing connections. All the parts are enclosed in a dust-proof cast-iron case.

The Westinghouse type E two-point auto-starters have been adopted as standard for use with all type CCL motors at standard voltages and frequencies up to 100 horse-power, and for sixty-cycle motors for 400, 550, 1,000 and 2,000 volts up to 200 horse-power. The auto-transformers are contained in the upper part of the cast-iron case, and the switch mechanism is attached to the same part. The lower part of the case forms the oil tank in which the switch contacts are immersed. The case is provided with lugs for mounting against a wall or column.

In special cases where CCL motors are required to start heavy inertia loads, more than two starting points may be advisable. For such installations the Westinghouse multi-point auto-starter, consisting of two auto-transformers in connection with a drum-type, oil-immersed contact-changing device, is supplied. The voltage is thus applied gradually to the motor in increasing steps. The contacts are made and broken under oil.



Single-Point Switch, Auto-Starters.

For type CCL motors up to fifty horse-power, driven by means of air-compressors, automatic multi-point auto-starters can be supplied. These differ from the multi-point auto-starters previously described chiefly in the method of operation. Each automatic auto-starter is equipped with an operating head which is actuated by the rise and fall of a liquid level or by the change of pressure in a closed-tank system.

New Business for Electrical Manufacturers.

In the following statement of orders placed by traction companies throughout the country for new equipment or improvements to existing apparatus, will be found an indication of more than ordinary significance when coupled with reports of returning activity in nearly all manufacturing lines. Electric railways are, normally, among the largest purchasers of machinery and other material, so that renewed buying on their part can not fail to be reflected in every department of industrial activity. To illustrate by specific instances:

The Omaha & Council Bluffs Street Railway Company recently placed an order for fourteen straight air-brake equipments. This is the second contract awarded the Allis-Chalmers Company by the Omaha City & Interurban line during the current year for straight air-brake equipments, and that the first to be installed are giving entire satisfaction is evidenced by the repeat order.

The Denison & Sherman Traction Company, Denison, Tex., recently changed the brake equipments on all of its cars, the new equipment being for straight air, with twenty-inch compressors of the same company's manufacture. The Northwestern Elevated Railway Company, of Chicago, has awarded a contract for air-compressors and governors for the twenty new cars now being built at the Pullman Car Company shops. The compressors will be of the Allis-Chalmers Type C-5 enclosed design, thirty-five feet capacity per minute, and the governors are the manufacturer's standard Type "OB" pneumatic. The Yonkers Street Railway Company, Yonkers, N. Y., recently placed an order with the Allis-Chalmers Company for twenty straight air-brake equipments. These include the new AA-6 sixteen-foot enclosed compressor and "OB" governor.

The Allis-Chalmers Company has also completed installation of automatic brake equipments on cars for the Niagara Gorge Scenic Railway, Niagara Falls, N. Y.; and, among others, additional orders for railway motors, controllers, compressors, governors or complete air-brake equipments have been received from the following railway and car-building companies: Winnebago Traction Company, Oshkosh, Wis.; Milwaukee Northern Railway Company, Cedarburg, Wis.; McGuir-Cummings Manufacturing Company, Paris, Ill.; New York, New Haven & Hartford Railway Company; New Orleans Railway and Light Company, New Orleans, La.; East Liverpool (Ohio) Railway and Light Company; Utica & Mohawk Valley Traction Company; Virginia Passenger and Power Company, Richmond, Va.; Roanoke Railway and Electric Company; Connecticut Company, New Haven, Ct.; Fremont City Railway Company, Fremont, Ohio; Eastern Pennsylvania Railway Company, of Philadelphia, Pa.; Springfield (Mass.) Street Railway Company; Interborough Rapid Transit Company, New York; Western Ohio Railway Company; Connecticut Valley Street Railway Company; Lehigh Valley Traction Company; Exeter, Hampton & Amesbury Street Railway Company; Lancaster (Ohio) Traction and Power Company; Indiana Union Traction Company; Interurban Railway and Terminal Company, Cincinnati, Ohio; Porto Rico Railways Company, San Juan, Porto Rico; Ohio Electric Railway Company; Angola Railway and Power Company, Angola, Ind.; Western Ohio Railway Company, Lima, Ohio; Worcester Consolidated Street Railway Company, Worcester, Mass.; Warren Street Railway Company, Warren, Pa., and Eastern Ohio Traction Company.

Among companies making large additions to their power equipment or taking advantage of the present excellent opportunity to bring their generating stations to a state of higher efficiency are the following:

Winona Interurban Railway, Warsaw, Ind.; New Jersey & Pennsylvania Traction Company, Trenton, N. J.; Wausau Street Railway Company, Wausau, Wis.; Chicago, Indiana & Southern Railway; Petaluma & Santa Rosa Railway Company, Petaluma, Cal.; Indianapolis, Columbus & Southern Traction Company, and others.

Another feature of the situation which is of interest, reported by the company as builder of the Gates gyratory breaker, is the fact that quite a number of traction companies having their own rock-crushing equipment, or allied interests in control of it, have been putting it in good repair as well as adding to it. Evidently it is with the intention of materially improving roadbeds during the remaining open months. There is also considerable activity noticeable among the creosoting plants where ties are treated, and, as the steam roads are doing very little at present, considerable of this must be due to orders from electric traction companies, particularly those of the Middle West, where the financial depression does not seem to have been so severely felt as elsewhere.

Current Electrical News

DOMESTIC AND EXPORT.

A TWELVE-MILLION-DOLLAR POWER COMPANY FORMED—With a capital of $12,000,000 the Nebraska Power Company has been incorporated in Delaware. The purposes are to construct and operate hydroelectric power plants, with everything pertaining thereto. The incorporators of the company are: B. E. Babcock, Columbus, Neb.; W. J. McEathron, Omaha, Neb., and Harry W. Davis, Wilmington, Del.

POWER PLANTS FOR UPPER SKAGIT RIVER—It is announced that surveys are under way on the upper Skagit River, Wash., for power plants which will develop from 75,000 to 100,000 horse-power. Colorado capitalists and an English syndicate are said to be behind the movement. Water rights have been taken out on the Skagit River and on its tributaries above Bacon Creek. A surveying crew under the direction of C. L. Mitton, a Colorado civil engineer, is running a line for a three-mile tunnel which will have its down-stream end near Rockport. By means of this tunnel a 250-foot head will be secured. The first step to be taken in the project will be the erecting of a 10,000-horse-power plant at the intersection of Bacon Creek with the Skagit River. The power developed here will be used in the work of developing the larger power plant further up-stream. The locators of the water rights are: A. Freeman, of Anacortes, and B. Thomas, of Seattle, Wash.

MEXICAN ELECTRIC MERGER—F. S. Pearson, president of the Mexico Tramways Company, and vice-president of the Mexican Light and Power Company, states that the proposed merger of the two companies will probably be effected on January 1. Meetings of the stockholders will be held within a few weeks to vote on the matter. The Necaxa power plant will be increased from 40,000 to 100,000 horse-power if the merger is carried through, according to a statement by Mr. Pearson. Heretofore the plans have called for an increase of only 20,000 horse-power, instead of 60,000. The increase will be obtained by using the same water over and over again. Work is now under way on a power plant above the present plant, which will use the water for the first time. A third plant will be built below the present one, the two new power-houses furnishing the 60,000 increase in horse-power. Mr. Pearson forecasted that the tramways company would spend over $5,000,000 in the Federal district alone in improving the tramways and electric light property, if the merger is agreed upon.

INTERSTATE RAILWAYS COMPANY TO EXTEND SYSTEM—Arrangements are being made by the Interstate Railways Company, of Philadelphia, Pa., which controls an electric railway system of about 450 miles in eastern Pennsylvania, for important improvements and extensions. The Reading Power Company is to issue $1,500,000 first mortgage bonds, guaranteed by the United Traction Company of that city. Proceeds of these bonds will be expended on a new power plant at Reading having a capacity of 20,000 kilowatts. This power will operate the lines from that city down to Chestnut Hill, as well as in the Lebanon Valley. Refinancing plans of the Interstate Railways Company which, it is understood, will be underwritten by E. B. Smith & Company, contemplate several extensions of the present system. One of these will be a new line twenty miles long, from Reading to Hamburg, at a cost of $400,000. The Wilkes-Barre & Wyoming Valley system will be extended from Pittston to Avoca, and from Miners Mills to Hudson. Rights of way have been secured for these three extensions.

NEW CALIFORNIA ELECTRIC ROAD—Articles of incorporation have been filed by the California Company, which proposes to build and operate a railroad, either steam or electric, between Marysville and Sacramento, Cal., the line to run through Marin, Sonoma, Napa, Solano, Yolo and Sacramento counties, its total length to be ninety-five miles. The incorporators of the California Company are: C. W. Conlisk, R. A. Morton, C. H. Lind, L. N. Pryor, George James, Frank E. Cornice and Russell B. Sage. Of the capital of $2,500,000, the sum of $150,000 has been subscribed. Richard Hotaling is the promoter of the enterprise. Conlisk is the manager of the Hotaling estate. After a trip to the East in the summer of 1907, Hotaling began active work on his system and it was announced that he had made arrangements for the expenditure of $9,000,000 on a network of electric lines in the bay counties. One of the branches will run from Gallinas Creek in Marin County to Petaluma, a distance of eighteen miles, and the other will extend from Napa to a station five miles distant from that place.

MERGER OF ELECTRIC COMPANIES—Negotiations have been completed whereby the Northern California Power Company will take over all the rights and physical properties of the Keswick Electric Power Company, Battle Creek Power Company, Redding Light and Power Company, and Willows Water and Light Company, which have been operated for years past by the Northern company, of which H. H. Noble, of San Francisco, Cal., is president. With a bond issue of $3,000,000 it is intended to retire the bonds at present outstanding in the companies named and also to proceed with the installation of work under construction and contemplated. It is expected that the full installation will be completed early in December of this year when 13,000 horse-power will be available. The present horse-power generated is 10,000. Twenty-six towns in the counties of Glenn, Butte, Tehama and Shasta, besides isolated pumping stations consuming from five to fifty horse-power, are served. There are also long-term contracts calling for 14,600 horse-power, deliverable to mines, smelters and factories. The water rights owned by the system have a capacity of 150,000 horse-power. A meeting of stockholders will be held on October 12 to vote on the proposed consolidation.

NEW INCORPORATIONS.

DOVER, DEL.—Center Valley Power and Light Company. $100,000.

COLUMBUS, OHIO—Scioto Valley Traction Company, Columbus. Increase of capital stock from $3,000,000 to $3,500,000.

GRAFTON, W. VA.—People's Mutual Telephone Company, of Romney, W. Va. $10,000. Incorporators: J. D. Byre, W. N. Guthrie, James C. Heath, C. H. Cookus, K. Taylor and J. M. Millison.

WILMINGTON, DEL.—Johns River Heat, Light and Power Company, Wilmington. $500,000. Incorporators: Elisha W. Meloney, Avondale, Pa.; Benjamin F. Groff, Lancaster, Pa.; Charles B. Evans, Newark, Del.

HARRISBURG, PA.—Wiconisco Electric Light, Heat and Power Company, of Wiconisco township. $5,000. Incorporators: John Pfeiffer, G. Schoffstal, A. W. Long, R. Sterling, P. Maher, H. T. Beistline and B. W. Fells, of Tower City.

OAKLAND, CAL.—Tuolumne Water Power Company. $1,000,000. Directors: Warren Gregory and H. H. Rolfe, of San Francisco; Winfield Dorn, of Oakland; George H. Whipple, of Alameda, and J. S. Lamson, of Berkeley. To develop electric power at the head waters of the Tuolumne River for use in the cities about the bay.

COLUMBUS, OHIO—Springfield Light, Heat and Power Company. To take over the People's Light, Heat and Power and the Home Electric Lighting companies, of Springfield. $1,000,000. Incorporators: J. D. Price, W. H. Sharp and L. M. Ferguson, of Columbus; and W. W. Keifer, C. S. Kay and F. M. Hagan, of Springfield.

LOGANSPORT, IND.—Logansport, Frankfort & Indianapolis Traction Company. $25,000. To build an electric line from Frankfort, Ind., north to Logansport, thirty-five miles. Directors: S. H. Blakeslee, Allen G. Barane, Eben Miller, Frank Sargent, all of Cleveland, Ohio; William W. Palmer, New York; Ephraim A. Thomas, Pittsburg, Pa., and W. P. Clark, Kent, Ohio.

ELECTRIC RAILWAYS.

STERLING, ILL.—Work has been begun on the grading for the new electric line from Tampico to Hooppole.

STOUGHTON, MICH.—At a special meeting of the council the Cincinnati Construction Company was granted an interurban franchise.

SACRAMENTO, CAL.—The Sacramento Terminal Company has been organized to build the freight tracks and bridge of the Northern Electric Company in this city.

FORT WAYNE, IND.—It is said that $50,000 additional stock has been subscribed for the extension of the Fort Wayne-Decatur trolley line southward from Decatur to Berne.

BOISE, IDA.—The Boisé & Interurban is engaged in purchasing additional land along the entire right of way to Pierce Park with a view to double-tracking the park line in the spring.

CHAMBERSBURG, PA.—The Chambersburg & Western Trolley Company has decided to build its line from Chambersburg to St. Thomas and Edenville, provided the right of way can be secured without too great expense.

COOS BAY, ORE.—L. J. Simpson, of North Bend, has secured a franchise from the county court for the use of the public highway between Pony Slough and Sunset Bay for an electric line. Mr. Simpson will probably begin construction next spring.

ALBANY, N. Y.—The Public Service Commission has granted the application of the New York & North Shore Traction Company for approval of construction and extension work on its street surface railroad from Hicksville to Mineola, in the county of Nassau.

ATLANTA, GA.—The Knickerbocker Trust Company, New York, has asked the United States Court to foreclose its mortgage on the property of the Gainesville (Ga.) Electric Company. The Knickerbocker company holds a mortgage to secure an issue of $400,000 in bonds.

CANTON, OHIO—John Monnot, the well-known electric railroad man of Canton, is authority for the statement that within a year there will be an electric railroad operated upon a private right of way paralleling the line of the Mahoning Valley from Youngstown to Warren.

FREDONIA, N. Y.—The Buffalo & Lake Erie Traction Company has let contracts for three power stations on its line from Silver Creek to Westfield, to the Bailey Contracting Company, of Brocton. One will be at Silver Creek, one midway between Dunkirk and Fredonia, and one at West Portland.

CHOUTEAU, MONT.—At a special meeting of the county commissioners a franchise for an electric line was granted to G. Calvin Bower, of Great Falls, or to any corporate body which may succeed him. The franchise permits the use of the public highways of Teton County and covers a period of forty years.

PHILADELPHIA, PA.—The Pennsylvania & Maryland Street Railway Company has started work on its line which will be built from Myersdale to Johnstown by way of Currott, Berlin, Somerset and Boswell. When this is completed, the line will be extended to connect with the Piedmont & Cumberland electric line.

WASHINGTON, D. C.—A new building is to be built for the Capital Traction Company at First and B streets, southwest. The contract, which calls for an expenditure of about $30,000, has been awarded to James L. Parsons. The building will be two stories high and will have a frontage of thirty feet and a depth of eighty feet.

SCRANTON, PA.—Work has been started on the power plant of the Scranton Railway Company, which it is planned will provide, when completed, not only all the power now needed but meet the increasing demands on the system that will come with the growth of the city. The plant when completed will cost not less than a half million dollars.

ALBANY, N. Y.—The Public Service Commission, Second District, has authorized the Rochester, Corning & Elmira Traction Company to sell $1,000,000 bonds. The commission required, as a condition to this consent, that $380,000 stock of the company should be subscribed by responsible parties before any bonds were issued. The company has complied with this requirement.

EL PASO, TEX.—Richard Caples was granted a franchise and the right of way for an interurban from the New Mexico line, near Anthony, to Fabens, and sets forth that work shall commence at El Paso within six months from the time such franchise was granted. and that the line shall be completed to within a mile of the Catholic Church at Ysleta within eighteen months.

BLOOMINGTON, ILL.—The Illinois Traction System is contemplating improvements for its lines entailing a cost of several thousand dollars. The improvements are either under way or about to the promulgated. The company has decided to complete the Decatur belt railway system and install new machinery in the power-house at that city. A new boiler house will also be erected.

MILWAUKEE, WIS.—The Milwaukee-Northern Railway Company has placed in operation its line from Milwaukee to Sheboygan. The company will double-track its road from Milwaukee to Brown Deer, a distance of ten miles, to accommodate the increasing business on that part of the line. Work of grading the road for the second track is under way, and the rails will be laid to begin the service early in 1909.

COLUMBIA, MISS.—The directors of the Mexico, Santa Fé & Perry Traction Company, at a recent meeting elected officers, and they also discussed the plan for extending the road to Columbia. This company holds a franchise in Audrain, Monroe and Ralls counties and some of the grading has been done. The officers are: President, Mathias Crum; secretary, G. W. Gaither; treasurer, Judge W. W. Botts; general manager, S. L. Robinson.

NEW YORK, N. Y.—A. V. Porter and J. R. Spelman, architects for Adrian Joline and Douglas Robinson, receivers of the Metropolitan Railway Company, have filed plans for a new car house to replace the old Ninth avenue structure, which stood for half a century on the corner at Fifty-fourth street. It will be of brick and ornamental stone, 135 feet 10 inches by 298 feet 10 inches, five stories high in the main part and three in the annex. It will cost $450,000. Two stories will be built at once at a cost of $300,000.

MINEOLA, L. I.—By request of counsel for the New York & North Shore Traction Company, the Nassau supervisors have granted the company an extension of six months on its franchise to build and put in operation a trolley line from Roslyn to Manhasset. The franchise is based on the contingency that the company shall obtain a franchise from the New York city authorities to extend the line beyond the city limits. The company has not been able to obtain the city franchise yet, but hopes to within the coming six months.

CAMBRIDGE SPRINGS, PA.—The Titusville Traction Company will build a line between Cambridge Springs and Titusville, touching Hydetown, Clappville, Little Cooley, Teepleville. The road is already completed to within one mile of Tryonville, where a branch will extend north to Union City. The company has made arrangements to co-operate with the Meadville Traction Company, the Erie Traction Company and the Erie Railroad at Cambridge Springs. Contracts are being made with the Wells Fargo Express Company to handle express matter.

PATERSON, N. J.—John R. Lee, of Paterson, has been awarded a contract to build a fifteen-mile traction line between Paterson and Suffern, and finish it in four months. The president of the company behind this line is William Barber, of Paterson, and the vice-president, Malcolm R. McAdoo, of Montclair. This is to be the nucleus of a high-speed third-rail electric line to be built later between Hoboken and Paterson by the New York & New Jersey Rapid Transit Company as soon as the needed capital can be obtained. The total cost of the Paterson-Suffern branch is estimated at $500,000.

BEAVER, PA.—A company has been formed to build a line from Pittsburg to East Liverpool over an airline route. The distance over the new route is thirty-four miles, ten miles less than by any railway or electric line now existing. The new company is known as the Pittsburg & East Liverpool Electric Railway and the officers are Professor J. M. Reed, Dravosburg, president; Rev. A. Moore Buchanan, Morgantown, W. Va., secretary, and Hon. J. H. McClaren, of Murdocksville, treasurer. A large amount of money has been raised by those living along the proposed line to make a complete survey, and rights of way have been given.

PERSONAL MENTION.

MR. EUGENE CREED has resigned from the new-business department of the Narragansett Electric Lighting Company, of Providence, R. I., and has accepted a position as sales agent with the Auburn Light and Power Company, of Auburn, N. Y.

MR. I. B. WHITE, of Alexandria, La., has been made manager of the Alexandria Electric Railway Company. He was formerly owner of a private telephone system in the town of Winnfield, La. The company has ordered rail for an extension two miles west of the city.

MR. J. D. EDMONDS has resigned his position with the Western Electric Company, Chicago, Ill., where he was associated with both the operating and sales departments for several years, and accepted the position of superintendent of works with the Sterling Electric Company, of Lafayette, Ind.

MR. WILLIAM M. DUANE has resigned his position as chief engineer of the Big Four Railroad, to take effect November 1. He will become vice-president and general manager of the Walsh Construction Company, of Davenport, Iowa, which will construct an extensive electric railway system.

MR. HARRY MUNN SLAUSON, of the inspection department of the New York Edison Company, has accepted a position with the Enos Company, manufacturer of lighting fixtures. Mr. Slauson represented the Enos Company at the New York Electrical Show, introducing the company's new fixtures and electroliers.

MR. J. P. PULLIAM, of Oshkosh, Wis., has been appointed general superintendent of the East Wisconsin Electric Railway and Light Company, of Fond du Lac. Mr. Pulliam is also general superintendent of the Wisconsin Electric Railway Company, of Oshkosh, formerly the Winnebago Traction Company. These two roads have a traffic arrangement, and Mr. Pulliam will have general charge of both systems.

MR. HORATIO A. FOSTER, who for the past year and a half has been in charge of the Baltimore office of L. B. Stillwell as resident engineer, has resigned and become connected with the valuation department of the Public Service Commission, First District, New York. This department is under the direction of Bion J. Arnold, of Chicago, and is evaluating the surface car lines of Manhattan and the Bronx.

MR. H. W. WORTHLEY, who has been district superintendent of the Salem district of the New England Telephone and Telegraph Company, comprising Salem, Beverly, Gloucester and Newburyport exchange districts, has been appointed district manager of the Manchester, Concord, Franklin, Laconia, Claremont, Newport, Rochester, Portsmouth, Dover, Exeter and Nashua exchange districts. R. Robins, Jr., formerly manager at Lynn and now district superintendent of the first suburban district of the Boston division, has been appointed district manager of the Salem district.

DATES AHEAD.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

Railway Signal Association. Annual meeting, Washington, D. C., October 13-15.

Order of the Rejuvenated Sons of Jove. Annual meeting, Buffalo, N. Y., October 15-16.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Association of Car-Lighting Engineers. First annual meeting, Chicago, Ill., November 18.

National Society for the Promotion of Industrial Education. Annual meeting, Atlanta, Ga., November 19-21.

American Roentgen Ray Society. Annual meeting, New York city, December 28-30.

ELECTRICAL SECURITIES.

Last week's stock market was marked by dull, narrow and irregular price movements, with values inclined to fall, if anything. Professional operations ruled almost entirely, and the public indifference was very manifest. Toward the end of the week conditions showed a little more animation, but the whole situation is so thoroughly and completely dominated by political possibilities that it is quite impossible to predict which way things will turn in the immediate future. It appears also that trade improvement has been somewhat halted by the election uncertainty, although there is no change of moment to record in the monetary situation or outlook. No radical change is expected in the crop reports, and the promise is that, while the harvest will not be record-breaking in proportions, as was indicated in the earlier part of the year, it will still be of such abundance that the agricultural interests will have good reason to be well satisfied.

Dividends have been declared upon the following electrical securities: Mexican Light and Power Company; directors have placed the common stock on a 4 per cent basis, declaring a quarterly dividend of 1 per cent. Standard Underground Cable Company; regular quarterly dividend of 3 per cent, payable October 10. Shawinigan Water and Power Company; quarterly dividend of 1 per cent. A quarterly dividend of 2½ per cent on the stock of the Brooklyn City Railroad Company, guaranteed under the terms of the lease by the Brooklyn Rapid Transit Company, payable October 15.

ELECTRICAL SECURITIES FOR THE WEEK ENDED OCTOBER 3.

New York:	*Closing.*
Allis-Chalmers common	10¾
Allis-Chalmers preferred	33½
Brooklyn Rapid Transit	49½
Consolidated Gas	147
General Electric	139
Interborough-Metropolitan common	10⅝
Interborough-Metropolitan preferred	31¼
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	68
Mackay Companies (Postal Telegraph and Cables) preferred	67½
Manhattan Elevated	134
Metropolitan Street Railway	24½
New York & New Jersey Telephone	114
Western Union	60½
Westinghouse Manufacturing Company	74

Boston:	*Closing.*
American Telephone and Telegraph	127¾
Edison Electric Illuminating	225
Massachusetts Electric	52
New England Telephone	119½
Western Telephone and Telegraph preferred	75

Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	35
Electric Storage Battery preferred	35
Philadelphia Electric	10⅛
Philadelphia Rapid Transit	20½
United Gas Improvement	86⅝

Chicago:	*Closing.*
Chicago Telephone	—
Commonwealth Edison	106½
Metropolitan Elevated preferred	40
National Carbon common	67
National Carbon preferred	108

NEW MANUFACTURING COMPANIES.

BOSTON, MASS.—The International Telephone Company has been incorporated with a capital of $200,000 to deal in electrical goods. H. I. Hahn, of Boston, is president, and A. H. Cobb, of Lynn, treasurer and clerk.

AUGUSTA, ME.—The American Annunciphone Company has been organized at Portland for the purpose of manufacturing and dealing in telegraph, telephone and electrical supplies of all descriptions, with $500,000 capital stock, of which nothing is paid in. The officers are: President, T. L. Croteau, of Portland; treasurer, F. H. Morrill, of Portland.

ELECTRIC LIGHTING.

WEATHERFORD, TEX.—The city council has awarded a contract to the electric light company for three arc and ten Nernst lamps.

CADDO, OKLA.—The light plant at this place, which was shut down several months ago, has been taken over by O. Q. Moon, of Caddo.

MORENCI, MICH.—The Morenci electric light plant was sold at the Adrian court house recently for $3,500 to G. F. Avis and Mills Lamb, of Hudson, who will improve the system.

WAKEFIELD, MASS.—A new switchboard will be installed at the municipal lighting plant at a cost of $3,500, and eighty-seven arc lamps will be replaced with 400 forty-candle-power units.

SMITHVILLE, TEX.—The Missouri, Kansas & Texas Railway Company is preparing to put in its own electric light plant for the shops at this place. The plant will furnish 100 lights of sixteen candle-power.

CUMBERLAND, WIS.—The contract for erecting a new building for the lighting plant and the installation of the necessary machinery has been let by the common council to J. R. Robertson, of St. Paul, Minn., for the sum of $17,000.

EUREKA, UTAH—The Telluride Power Company will begin work shortly on a new transmission line from its substation in Eureka to the Tintic smelter, which will give the latter two sources on which it can rely for electric power.

BUCYRUS, OHIO—It is expected that specifications for the proposed municipal lighting plant at Bucyrus, for which $90,000 in bonds was recently voted, will be issued about November 1, when it is thought the bonds will have been disposed of.

GOSHEN, IND.—Disregarding injunction proceedings brought against the city, Robert E. Ashe, of Richmond, Ind., who has the contract for rebuilding the municipal lighting plant here at a cost of $32,700, is preparing to go ahead despite the court proceedings.

MAGAZINE, ARK.—The Magazine Gin and Grist Company is preparing to install a system of electric lighting in Magazine. Power for running the lighting system will be obtained from the machinery already in use in furnishing power for the gin and grist mill.

FAIRMONT, W. VA.—The Fairmont & Clarksburg Traction Company has been awarded a contract by the city council for a minimum of ninety street arc lamps at $55 each. This provides for the addition of thirty lamps. The company now has a contract which has still two years to run.

MARYSVILLE, CAL.—The Great Western Power Company, whose line passes through Marysville, has begun stretching wires along its tower line from Big Bend to Oakland. The power company has also started work on the erection of a $2,000,000 auxiliary steam power plant on Session's basin, in Oakland.

TEMPLE, TEX.—Local capitalists, whose names are withheld for the present, are forming a company for the purpose of establishing a new electric light and power plant in this city, which may also supply Belton. As soon as plans are far enough along application will be made to the city council of Temple for a franchise.

LAUREL, MD.—Wallace Stebbins & Sons, of Baltimore, were the successful bidders for the construction of the new electric lighting plant to be in operation here about November 15. Their bid was $11,766. C. L. Reeder, of Baltimore, appointed several months ago by Mayor William E. Gilbert, is engineer in charge of the work on the new plant.

CHARLOTTE, N. C.—The Louise Mills have been equipped with motors of 750 horse-power and a substation is being built from which electricity will be supplied to the mills. These mills operate about 600 looms and 27,000 spindles. The Chadwick-Hoskins Company, the owner of this plant, will similarly equip several of its mills which, combined, operate about 100,000 spindles and 2,300 looms.

ALBANY, N. Y.—The Public Service Commission, Second District, has granted the application of the Plattsburgh Light, Heat and Power Company for authority to dispose of an issue of $250,000, recently authorized, at eighty-five instead of ninety, as required in the original order. It was shown that the company was unable to dispose of the bonds at ninety, but has found a market for them at eighty-five.

BALTIMORE, MD.—A move is on foot to extend the service of the Patapsco Electric and Manufacturing Company to cover Mount Washington, Arlington and West Arlington, and later take in other territory in that section of Baltimore County, which is now supplied with electric current by the Mount Washington Electric Power Company, a subsidiary of the Consolidated Gas, Electric Light and Power Company.

WILKES-BARRE, PA.—Arrangements have been completed by which the Scranton Electric Company secures control of the Lackawanna Valley Electric Light and Power Supply Company, of Carbondale. The company controls all the electric light plants between Pittston and Carbondale, with the exception of a couple of municipal plants in the small towns of the upper valley. C. D. Hubbard, of Scranton, is now general manager at Carbondale.

BUFFALO, N. Y.—The Appellate Division, in session at Rochester, has handed down a decision affirming the judgment of the Supreme Court entered on the decision of Justice Marcus last May in the action brought by the Economic Power and Construction Company against the city of Buffalo, Commissioner of Public Works Ward and Chief of Police Regan restraining the defendants from interfering with the Economic company in the construction of its plant in the city of Buffalo.

ST. LOUIS, MO.—Following the decision of City Counselor Bates that the electric light and power franchise of Browning, King & Company is valid, the West End Light and Power Company, which now owns the franchise, has filed a bond for $20,000 as a guarantee that it will comply with the provisions of the Keyes ordinance. The company now has an application pending before the board of public improvements for permits to string electric light and power wires in the district bounded by Lindell avenue and Sarah street and King's Highway.

PAWTUCKET, R. I.—Acting under authority of the city council, the joint standing committee on street lights has executed a ten-year contract with the Pawtucket Electric Company for the lighting of the streets by electricity. The old contract expired about five years ago, and since that time the city has been paying for its lights at the same rate. The new contract is in effect and under it the price per light for the lamps that burn all night is $105, the old price having been $112.50. For the lights on the one-o'clock circuit the new price is $70 per light, as compared with $72.50 under the old contract.

BUENA VISTA, VA.—At a meeting of the city council a franchise was granted to the Rockbridge Power Company to furnish power and lights to the citizens of this place. The Rockbridge Power Company is composed of W. G. Mathews and several citizens of Clifton Forge, and it is their intention to develop the water power on the North River, several miles below town, and to furnish power and lights to Buena Vista, Glasgow, Buchanan and possibly Lexington. They will install substations in each of the above-named towns. Owners of several small industries who contemplate locating in Buena Vista have applied for power. Work on the dam will begin at once.

ZANESVILLE, OHIO—It is announced that eastern capital has become interested in the Central Valley Light and Power Company and that the company has been financed. Actual construction work will commence early in the spring. The site of the plant will be opposite the railroad station at Philo. The building, completed, will cost $165,000. Over nine miles of pole-lines will be installed. The greater part of the current generated will be distributed in the vicinity. Enough bonds have been issued to erect the power plant without delay. The plant will also furnish power for the Central Valley Electric Railway, which it is proposed to construct from this city to down-the-river points.

KENNEWICK, WASH.—It is announced that the local electric light and water plants, owned by the Kennewick Electric Company, have been purchased by the Northwest Light and Power Company, which owns and operates electric plants throughout the Inland Empire. It is also asserted that the new organization will be known as the North Coast Electric Company. President Strahorn, of the North Coast, is president of the Northwest Light and Power Company. The plants in this city are being enlarged and will be made of sufficient capacity to furnish lights to Pasco, where the electric plant recently burned. Machinery is now being installed and it is announced that the work of enlargement will be carried on rapidly.

KILLINGLY, CT.—Massachusetts, Connecticut and Rhode Island capitalists are behind the Nashawaug Electric Power Company, which is to establish a power plant near Ballouville in the northeast part of Killingly. The company has acquired the Sabin L. Sayles water-power privilege, located between Dayville and Attawaugan, and will reserve it for future development. The Attawaugan company, which manufactures cotton goods and which operates plants at Ballouville and Attawaugan, has negotiated a contract to take electric power from the Nashawaug company for twenty-five years. Arrangements will be made later to distribute electricity for light and power purposes in Killingly, Plainfield, Canterbury and Griswold. The Nashawaug company has authorized an issue of $37,500 of six per cent cumulative preferred stock and $112,500 of common stock. It has also authorized an issue of $100,000 five per cent bonds. Grosvenor Ely, of Norwich, is president of the corporation; Frank B. Perry, of Boston, is secretary, and Frederick Taber, of New Bedford, is a member of the board of directors.

TELEPHONE AND TELEGRAPH.

ANDREAS, PA.—The Bell Telephone Company will extend its line to Andreas.

HILLSBORO, ILL.—The stockholders of the People's Mutual Telephone Company have selected C. E. Landers, of Coffeen; W. R. Gunn, of Raymond, and Victor A. Bost, of Fillmore, as directors.

MARSHALLTOWN, IOWA—The city council has granted a franchise to the Farmers and Merchants' Telephone Company to enter Marshalltown. A $200,000 plant will be installed if the franchise is accepted by the people on November 3.

BRENHAM, TEX.—The Brenham & Long Point Telephone Company has completed its line and is now connected with the Southwestern exchange of this city, giving it complete service from Brenham to Long Point, and from there to Burton and Gay Hill.

DOYLESTOWN, PA.—The Bell Telephone Company has rebuilt its trunk lines from Doylestown to Newtown, including way trunks to Wycombe and Buckingham. All the iron wires have been replaced by copper wires. The poles and wires of the old Standard company have been abandoned.

TROY, N. Y.—Announcement is made that an operating agreement has been made between the Hudson River Telephone Company and the Champlain Telephone Company. The Champlain company operates a system in Plattsburg, Malone, Montreal and important towns in northern New York. An agreement has also been entered into with local telephone companies at Chazy and other small places in the Adirondacks by which the facilities and service of the Hudson River-Champlain telephone combine are rendered available to their subscribers.

INDUSTRIAL ITEMS.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., is distributing two handsome bulletins, devoted, respectively, to electrical equipment for hotels and department stores.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., in bulletin No. 4,617, describes and illustrates direct-connected generating sets. Copies of this bulletin will be forwarded to those interested upon request.

THE HOYT ELECTRICAL INSTRUMENT WORKS, Penacook, N. H., has issued a new catalogue devoted to the Hoyt volt-ammeter for ignition testing. Copies of this bulletin will be furnished to those interested upon request.

I. P. FRINK, 551 Pearl street, New York city, has issued a catalogue, No. 56, devoted to Frink's special reflectors for tungsten lamps. These lighting units have some exceptional features and are meeting some very exacting requirements in illumination. Copies of this catalogue will be furnished on request.

THE TUNGSTOLIER COMPANY, Citizens' Building, Cleveland, Ohio, is distributing regularly a Tungstolier talk devoted to some important phase of illuminating engineering. This new lighting unit, equipped with tungsten lamps and Holophane shades, making a scientific lighting device, is winning support in every direction.

ELLIOTT BROTHERS, Lewisham, London, England, are distributing pamphlet D-20, devoted to a description of Elliott ammeters, voltmeters and wattmeters for alternating and continuous current, in both portable and switchboard patterns. The agents for the United States are John Bliss & Company, 128 Front street, New York city.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., in bulletin No. 59, describes the Northern type "S" motors. These are for constant and adjustable speed, and are built either open, semi-enclosed or enclosed, for mill and factory service. Copies of this bulletin will be furnished to those interested upon request.

THE PACIFIC ELECTRIC HEATING COMPANY, Ontario, Cal., in the September issue of "Hot Points," makes a number of very interesting suggestions concerning its flat-irons. It points out to central stations the advisability of inaugurating a flat-iron campaign, and directs attention to the successful work which has been done in other parts of the country.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing several publications on Columbia tungsten and Columbia tantalum-filament lamps, calling attention to the fact that Columbia lamps have been on the market for some nineteen years with unqualified success. Accompanying these publications is a considerable amount of information, showing the watt consumption of the various lamps.

THE AMERICAN BRAKE SHOE AND FOUNDRY COMPANY, Chicago, Ill., has issued a bulletin describing manganese steel castings. These castings enter into the manufacture of jaw crusher parts, gyratory crushers, crushing rolls, stamp mills, screens, clay-mixing machinery, wheels and, in fact, every form of mechanical appliance. The company is also prepared to furnish vanadium, chrome, nickel and chrome-nickel-steel castings.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., announces that the waterworks, electric light and power plant of the city of Austin, Tex., is installing an Allis-Chalmers steam-turbine generator unit. The turbine will increase the efficiency of the plant beyond its rated capacity, besides materially reducing its operating expenses. It is a 500-kilowatt, sixty-cycle, three-phase, 2,300-volt machine, designed to run condensing at a speed of 3,600 revolutions per minute.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., in bulletin No. 1,110, describes standard multiphase switchboard panels. The company has also issued bulletin No. 1,111, devoted to electric motor drives applied to machine tools. This is a very handsome catalogue, and is replete with interesting information on this phase of electrical application. In addition to the descriptive matter there are illustrations of a great many installations which indicate the wide range of utility of Fort Wayne motors.

THE MASSACHUSETTS CHEMICAL COMPANY is building a new addition to its factory at Walpole, Mass., comprising some 15,000 square feet of floor space, to accommodate the tape department, which has entirely outgrown its present quarters. The tapes manufactured by this company, as a result of close attention to the needs of the electrical trade, backed up by patient research work in the laboratory and the co-operation of a well-equipped plant, have been for many years well and favorably known for their high initial and permanent quality.

THE WARD LEONARD COMPANY, Bronxville, N. Y., reports increasing orders for its portable meter-testing rheostats. These rheostats are now in use by the New York Edison Company, Commonwealth Edison Company, of Chicago; Detroit Edison Company, Brooklyn Edison Company and lighting companies in Tucson, Ariz.; Bay City, Mich.; Tyrone, Pa.; Earlville, N. Y.; Vinita, Okla.; Roanoke, Va.; Utica, N. Y.; Ironwood, Mich.; Chattanooga, Tenn.; Kansas City, Mo.; Pensacola, Fla.; Denver, Col.; New Orleans, La., and Decatur, Ill. There are demands from every section of the country, and many have been sold in Canada. Over 600 of these load boxes are now in service.

Directory of Electrical and Allied Engineering and Scientific Societies.

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AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, Walker Electric Company, Twenty-third and Noble streets, Philadelphia, Pa. Next meeting, January, 1909.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Cosmos Club, Washington, D. C.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Dr. J. W. Richards, Bethlehem, Pa. Fall meeting, New York city, October 30-31.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, 352 Willis avenue, New York city.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Dr. Richard Moldenke, Watchung, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West Thirty-ninth street, New York city.

AMERICAN INSTITUTE OF MINING ENGINEERS. Secretary, Rossiter W. Raymond, 29 West Thirty-ninth street, New York city.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN RAY SOCIETY. Secretary, Dr. G. C. Johnson, 514 Bijou Building, Pittsburg, Pa. Annual meeting, New York city, December 28-30.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Professor Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Fifty-seventh street, New York city.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 29 West Thirty-ninth street, New York city.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, A. P. Folwell, 239 West Thirty-ninth street, New York city. Annual meeting, Atlantic City, N. J., October 20-23.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth street, New York city. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, Elmer M. White, treasurer Birmingham Railway, Light and Power Company, Birmingham, Ala. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION. Secretary, B. B. Davis, claim agent Columbus Railway and Light Company, Columbus, Ohio. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, J. W. Corning, electrical engineer Boston Elevated Railway Company, Boston, Mass. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION. Secretary, George B. Keegan, 2321 Park Row Building, New York city. Annual convention, Atlantic City, N. J., October 12-16.

ARKANSAS ASSOCIATION OF PUBLIC UTILITIES OPERATORS. Secretary, J. E. Cowles, superintendent of lighting, Hot Springs Light and Railway Company, Hot Springs, Ark.

ARKANSAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

ASSOCIATION OF CAR-LIGHTING ENGINEERS. Secretary, G. B. Colegrove, Illinois Central Railroad. First annual meeting, Chicago, Ill., November 18.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, D. L. Huntington, second vice-president and manager Washington Water Power Company, Spokane, Wash.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington street, Newton, Mass.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Wisconsin Central Railway, Milwaukee, Wis.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION. Secretary, L. E. W. Pioda, Oak and Broderick streets, San Francisco, Cal.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Canada.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Acton Burrows, 33 Melinda street, Toronto, Ontario.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, W. F. Milholland, secretary and treasurer Indianapolis Traction and Terminal Company, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. C. Lawler, Colorado Springs, Col.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, F. W. Poole, Bridgeport, Ct.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water street, Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine street, St. Louis, Mo.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA, LIMITED. Secretary, William R. Stanley, Royal Insurance Building, Montreal, Canada.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall street, New York city. Board of directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau street, New York city.

ENGINEERS' CLUB OF PHILADELPHIA. Secretary, H. G. Perring, 1317 Spruce street, Philadelphia, Pa.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt street, New York city.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. A. Camp, Henry, Ill.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Van Rensselaer Lansingh, Engineering Societies Building, 33 West Thirty-ninth street, New York city.

INDEPENDENT TELEPHONE ASSOCIATION OF TEXAS AND LOUISIANA. Secretary, C. A. Shock, Sherman, Tex.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. S. Norton, Indianapolis, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ward, Grand Rapids, Mich. Secretary's office, Monadnock Building, Chicago, Ill.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Iowa.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Iowa.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Annual meeting, Pittsburg, Kan., October 8-10.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. G. Turpine, Henderson, Ky.

MAINE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, M. E. Crow, Houlton, Me.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MICHIGAN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. A. Burch, Battle Creek, Mich.

MISSOURI ELECTRIC LIGHT, GAS AND STREET RAILWAY ASSOCIATION. Secretary, Claude L. Clary, Sikeston Electric Light and Power Company, Sikeston, Mo.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, George W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee street, Utica, N. Y.

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OLD TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, Frank J. Scherrer, New York city.

ORDER OF THE REJUVENATED SONS OF JOVE. C. B. Roulet, Mercury, Dallas, Tex. Annual meeting, Buffalo, N. Y., October 15-16.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. S. Smith, Towanda.

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PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa. Annual meeting, Washington, D. C., October 13-15.

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WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION. Secretary, Clement C. Smith, president Columbia Construction Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

Record of Electrical Patents.

Week of September 29.

899,499. STREET SIGNAL FOR CARS. Newell G. Augir, Brooklyn, N. Y. Filed June 28, 1907. A continuous designation curtain is mounted upon rollers which are actuated at certain points on the line.

899,514. SWITCHBOARD SIGNAL LAMP. Edward B. Craft, Wilmette, Ill., assignor to Western Electric Company, Chicago, Ill. Filed February 1, 1907. The lamp base is entirely separated from the bulb.

899,524. TELEPHONE CUTOFF. Henry S. Gilbert and William F. Drake, Pueblo, Col. Filed October 26, 1907. The transmitter or receiver may be cut out of circuit.

899,535. ELECTRICAL SYSTEM OF DISTRIBUTION. Albert S. Hubbard, Belleville, N. J., assignor to Gould Storage Battery Company, New York. Filed January 29, 1908. The storage battery is connected to one of two independent circuits.

899,564. SELECTIVE SIGNALING SYSTEM. Harry O. Rugh, Sandwich, Ill. Filed December 9, 1907. The time element of the circuit is controllable.

899,578. TROLLEY-POLE CATCHER. John H. Walker, Lexington, Ky. Filed December 26, 1907. The trolley pole is controlled by a ratchet and carrier.

899,588. TRANSPORTATION SYSTEM. William C. Carr, Buffalo, N. Y. Filed September 25, 1906. The position of the car is indicated upon a device at the central station.

899,593. AUTOMATIC THIRD-RAIL CONTACT-SHOE GUARD. William E. Hayes, Frankfort, N. Y. Filed January 22, 1908. The contact shoe is equipped with a traveler arranged in advance of the shoe, and adapted to engage with and be operated by the third rail.

899,598. SOLENOID MOTOR. Lemuel F. Howard, Edgewood Park, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed October 23, 1906. A semaphore arm is operated by the movement of a plunger in a solenoid.

899,613. CABLE DRUM. Alvin A. Pifer, Cleveland, Ohio, assignor to Cleveland Armature Works, Cleveland, Ohio. Filed March 6, 1908. Means are provided for effecting contact between a cable reeled upon a drum and an outside source of power.

899,618. STARTING DEVICE FOR GASOLENE ENGINES. Frank Reynolds, Syracuse, N. Y. Filed February 17, 1904. Contact is made through the medium of levers working on the shaft of the engine.

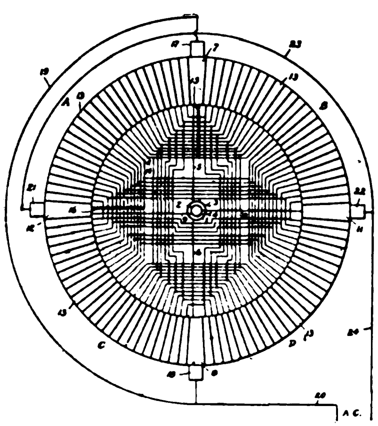
899,629. CONVERTER. Harry Shoemaker, Jersey City, N. J., assignor to International Telegraph Construction Company, New York. Filed December 20, 1906. Means are provided for supplying direct current to a plurality of commutator segments at symmetrical points.

899,634. HIGH-POTENTIAL SPARK-COIL. Chester H. Thordarson, Chicago, Ill. Filed December 23, 1907. The air-gap is formed transversely through the magnetic circuit of a high-potential spark-coil.

899,636. GROUNDING CLAMP FOR ELECTRIC WIRES. Wheeler H. Vibber, New London, Ct., assignor to the Gillette-Vibber Company, New London, Ct. Filed April 20, 1907. The clamp is provided with a yielding stop finger at one end.

899,637. ELECTRIC INSTALLATION MOLDING BOX. Wheeler H. Vibber, New London, Ct., assignor to the Gillette-Vibber Company, New London, Ct. Filed June 11, 1907. The molding box body contains one or more U-shaped parts.

899,638. COMBINED BUSHING AND COUPLING FOR ELECTRIC INSTALLATION. Wheeler H. Vibber, New London, Ct., assignor to the Gillette-Vibber Company, New London, Ct. Filed January 30, 1908. A combination of an elbow having a bushing end formed with an external shoulder and external threads provided with a locknut.



899,629.—CONVERTER.

899,639. BOX CONNECTOR FOR ELECTRIC INSTALLATION. Wheeler H. Vibber, New London, Ct., assignor of one-half to the Gillette-Vibber Company, New London, Ct. Filed June 4, 1908. A combination of a bushing formed with a transverse slot and a yielding binding strap entering said slot.

899,641. PLEASUREPHONE. Charles A. Wardner, Brushton, N. Y. Filed April 19, 1907. Telephonic receivers are connected in multiple to main-line conductors at outlying stations.

899,684. FAN. Otto Seig, New York, N. Y. Filed April 22, 1908. A fan provided with a coned deflector composed of a series of flaring rings set one behind the other, and increasing in diameter from front to rear.

899,708. CONNECTION FOR ELECTRIC CONDUCTORS. Frank H. Ball, North Plainfield, N. J. Filed August 6, 1906. Spring clamps engage the conductor with a spring-pressed contact.

899,717. CONTROLLER REGULATOR. Cyrus P. Ebersole, Keokuk, Iowa, assignor, by mesne assignments, to American Automotoneer Company, Philadelphia, Pa. Filed December 16, 1907. A hood is rotatably mounted in such combination that its movement in one direction is regulated.

899,749. FIRE ALARM. Bernard B. Mears, Baltimore, Md. Filed November 16, 1907. A battery and bell are connected in the fire-alarm circuit.

899,751. IGNITION-CONTROLLING APPARATUS. Charles Mitchell, Jr., Milwaukee, Wis. Filed October 21, 1907. Means are provided for switching the ignition current from one circuit to another.

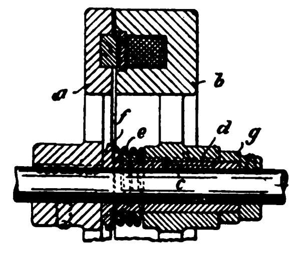
899,770. IGNITION SYSTEM FOR EXPLOSION ENGINES. Richard Varley, Englewood, N. J., assignor to Varley Duplex Magnet Company. Filed November 8, 1907. A continuously rotating shaft makes contact with metallic plungers in different angular planes.

899,773. TROLLEY SWITCH. Benjamin G. Watkins, Nehawka, Neb., assignor of one-third to Julian A. Pollard, Jr., and one-third to Julian A. Pollard, Nehawka, Neb. Filed January 1, 1907. The switch is operated by the passage of the car over an actuating mechanism.

899,787. TELEPHONE SYSTEM. Alfred H. Dyson, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Filed February 5, 1906. Means are provided for the transmission of directive currents to selective switches.

899,815. AUSCULTAPHONE. Louis A. Townsend, Fort Dodge, Iowa. Filed May 13, 1907. A combination receiver and transmitter.

899,822. CLUTCH. Heinrich Ast, Vienna, Austria-Hungary, assignor to the firm of Vulkan Maschinenfabriks-Actien-Gesellschaft, Vienna, Austria-Hungary. Filed June 15, 1906. The clutch member is slidably mounted on the running shaft.



899,822.—CLUTCH.

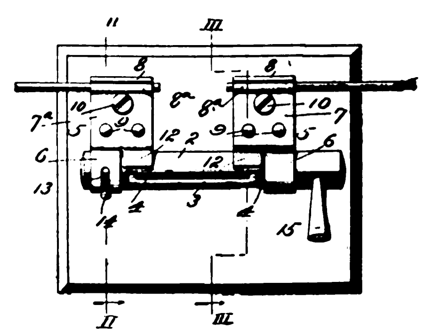
899,823. PRIMARY BATTERY. Wilhelm A. F. Bleeck, Brisbane, Queensland, Australia. Filed March 20, 1908. A primary battery of the double fluid type having a combination of sodium-hydroxide and chromic acid.

899,839. HEATING SYSTEM. Andrew G. Paul, Boston, Mass. Filed May 15, 1900. The thermostatic gauge is operated through the closing of an electric circuit.

899,850. TELEPHONE EXCHANGE APPARATUS. Emil Tanke, Berlin, Germany, assignor to Siemens & Halske A. G. Berlin, Germany. Filed June 17, 1905. Annunciators are controlled by means of single and double-coil relays.

899,858. TROLLEY WIRE HANGER. James Bryan, Pittsburg, and Harry Etheridge, McKeesport, Pa. Filed March 20, 1907. The wire hanger is equipped with a clamping member for engaging with the arch portion of the wire.

899,859. AERIAL TROLLEY SUPPORT. James Bryan, Pittsburg; Harry Etheridge, McKeesport, and Edgar M. Balsinger, Pittsburg, Pa. A combination of a pole, span arm, support and hanger.



900,005.—ELECTRIC SWITCH.

899,983. ADDING MACHINE. William S. Horry, Niagara Falls, N. Y., assignor, by mesne assignments, to Burroughs Adding Machine Company, Detroit, Mich. Filed September 26, 1903. The mechanism is motor driven.

900,005. ELECTRIC SWITCH. Charles W. Wachtel, Jamaica, N. Y. Filed November 23, 1907. The rotary oscillating switch-bar carries a contact strip to engage contact lips on the bearings.

900,006. PUSH BUTTON. Charles W. Wachtel, Jamaica, N. Y. Filed November 23, 1907. The contact lever is provided with an angular portion for making intimate contact with the terminals.

900,035. ELECTRIC MOTOR STARTER. William C. O'Brien, Baltimore, Md., assignor to Monitor Manufacturing Company of Baltimore City, Baltimore, Md. Application filed October 23, 1905. The switch is operated by the progressive movement of a plurality of electromagnets.

ELECTRICAL REVIEW

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CONTENTS

THE ELECTRIC LOCOMOTIVE.

The renaissance of invention was never more strongly indicated than to-day in its establishment of modern servants to human need.

The first effort to utilize steam for work in Hero's æolipile has been followed by other varied rotary engines alike in their uselessness, until the recent development of this type under the hardly accurate name of the steam turbine has furnished an engine whose economy of steam, limitations of space occupied, and uniform rotative velocity furnishes a marked change in the development of the steam engine which has otherwise advanced by hairbreadths for nearly two generations.

The automobile furnishes another example of the proverbial instance that progress advances by leaps, for the earliest attempts to apply power to locomotion was by steam carriages, and the pneumatic tire has made all possible.

It is over seventy years since Jacobi under the patronage of the Czar endeavored to make this application of electricity, and nearly twenty years later Dr. Charles G. Page in this country spent $160,000 of the money of the United States Government in making a one-half-horse-power motor.

The electric locomotive has been making history during the last year. Its promoters, in the full appreciation of the importance of the problem of making a machine which must maintain the continuity of the service, have devoted their highest skill, but proceeded conservatively, for there were both novelties to be introduced and precedents to be followed. They have produced machines which bear comparisons with the time-honored steam locomotive, and include many advantageous features which can not be ignored in railway operation.

Quicker changes of speed, either in starting or stopping, and the absence of smoke to obscure signals permits closer train leeway, and therefore enables a more dense train occupancy, which is of great importance, especially at terminals and during rush hours. The absence of reciprocating parts relieves the rails, bridges and roadway of pounding. The consumption of current only when the machine is in operation provides an economy of fuel through the adjustment of the averages at the central power station which coincidently supplies a number of these motors.

One of the early instances of the advantages of the absence of smoke occurred in the case of a tunnel in the Far West where the smoke of one locomotive has been sufficient to asphyxiate the engineers and firemen on a train following.

A powerful spring in this tunnel had been regarded as a nuisance until its waters were conducted down a penstock at one of the portals of the tunnel to a valley at whose base it operated a power station whose current moved the trains through the tunnel.

One of the changes in the electric locomotive in comparison with its steam predecessor is its lower centre of gravity. While this permits higher speed on tangents, it applies lateral components on curves in a different manner, and in place of relying to the same extent on the elevation of the outer rail, the direct radial stresses must be considered.

The one element at this time which retards the adoption of electric locomotives to an extent which would otherwise congest the works of every establishment equipped for their manufacture is the financial one. The expense of abandoning existing locomotive plant is indeed serious, and yet, in a mechanical sense, perhaps no more difficult at one time than another.

The average life of a locomotive is generally taken at twenty years, and yet many of them may be like Mrs. Partington's stockings, which lasted just that time, thanks to the old lady's thrift in knitting on new feet each year and new legs every other year. The dictum of Horace Greeley, relative to the resumption of specie payments, "the way to resume is to resume," may apply to the electric locomotive problem.

Responsible manufacturers can furnish data as to costs of installation and operation, which will challenge such comparison with existing expenditures as to answer any question upon the profitable use of such capital, and under such conditions it is believed that the forthcoming financial market will readily respond.

The change is not necessarily a sudden one, for both types of locomotives can be used on the same track, although during the operation of a few electric locomotives the fixed charges on line plant and on a generating station operating at partial capacity would not permit the economy which would exist with the full utilization of an electric plant.

As to the old locomotives, they would be gradually transferred to other lines and disappear in time as did the horses when electricity was in like manner used for street cars.

THE ELECTRIFICATION OF THE MELBOURNE SUBURBAN RAILWAYS.

Charles Merz, consulting engineer to the Victorian Railways Commission, which is responsible for the management of the state railways of Melbourne, Australia, has presented a report going into the question of the electrification of the Melbourne suburban railway system. The report gives a rather complete résumé of the present experience with electric railroading, and the æsthetic advantages, such as deal with bodily comfort, are conceded. It is with the question of the financial and commercial desirability of the change that the report is principally concerned. It is conceded also that a heavy capital expenditure is necessary, and it is not expected that the reduction in operating expenses will be sufficient to pay the interest charges upon this capital expenditure. The advantage which naturally accrues from the more frequent service possible with electric traction must be capitalized, as the possibility of increased schedule speed is one of the characteristic features of electrical operation, particularly in suburban service. The usual features of electrical operation are enumerated; for example, the utilization of the same termini with increased train movement, and the ability to operate under closer headway and provide denser traffic conditions without enlarging or extending the existing track facilities.

Mr. Merz eliminates the three-phase system for various reasons, and devotes his calculations mainly to an analysis of the advantages and disadvantages of single-phase, alternating-current operation with an overhead system, and a protected third rail operating on direct current at 800 volts.

The possibility of extension of the present system is not very large, and it is estimated that beyond the electrification which will be determined upon at once there will not be any great extension; consequently, the advantages which the single-phase, alternating-current system holds in the event of future extensions do not seem to apply in this case. For the Melbourne system Mr. Merz concludes that the additional cost of train equipment with the single-phase system would balance the extra expenditure on the substations required in direct-current practice. This does not conform exactly to the opinions which have been reached in this country for undertakings which have a good many of the same characteristics. Mr. Merz considers also that as a mechanical structure a protected conductor rail is superior to overhead wires, both as regards simplicity and reliability; that it needs fewer repairs, and the repairs themselves are of a much simpler character. He also contends that the alternating-current equipment which would be required for the Melbourne system would be some fifty per cent heavier than that required with the direct-current system, and the latter would at the same time eliminate a good deal of wear and tear to which the heavier equipments would subject the roadbed and track.

As far as the generation of power is concerned, the report is not so definite. It may be that a portion of the power will be obtained from a water power and irrigation scheme which is now being considered. Then again, a portion of the power may be obtained from a power station to be erected some seventy miles distant, on the Brown Coal Fields. Mr. Merz considers that the initial service would have to be provided for by a steam-driven power station erected in the city of Melbourne. The initial requirements will call for a maximum load of from 32,000 to 35,000 horse-power, and an annual expenditure of some \$500,000. The station would be designed to deliver electrical energy as twenty-five-cycle, three-phase current at 12,000 volts, this being generated by high-speed turbines and delivered through underground cables in the city and overhead lines in the suburban districts.

Mr. Merz presents a summary of the expenses of working with steam and electric traction which shows a saving in operating cost of \$136,335 in favor of electricity. These figures, however, do not allow for interest charges upon the new capital outlay, but it is expected that with so considerable a margin this will not be essentially a point upon which a decision will hinge. It has been pointed out so often that it seems needless reiteration to refer to it again at this time, that, whereas in the earlier investigations looking to the application of electric operation to heavy traction the advantages to be gained by the abolition of nuisances in various forms were given prime consideration, the financial consideration was kept in the background. In the investigations which are being made at the present time the æsthetic advantages are conceded and are made an incident, and not a condition. In actual practice it appears that electrification, although involving a terrific capital expenditure, is bringing about such economy of operation that upon a financial basis alone it will be selected as the means toward the end of better traveling facilities at lower costs and with a higher return upon the investment of capital.

INTRINSIC BRILLIANCY.

Electric lights from their earliest use have been considered essentially a brilliant source of illumination, and this feature has been the one which the general public has accepted as affording their chief claim to superiority. This is far from being the true condition, for unless lamps of high instrinsic brilliancy are shaded so that they do not come within the line of vision unsatisfactory results will follow.

In commercial installations lamps are often left unshaded, the excuse being the increase in luminous efficiency. As an example of unnecessary brilliancy, however, there is the case of a new building given over exclusively to creature comforts—a place of recreation and rest. Included among the various rooms is a sun parlor, sumptuously furnished, and among the luxuries are numerous reclining steamer chairs. But the tired and overworked business man seeking rest after his labors, in this haven, must look directly into clusters of six forty-candle-power clear tungsten lamps! The proprietor takes great pride in these fixtures and explains that he designed them especially so that his guests would be able to enjoy the manufactured sunlight!

That some engineers have understood the importance of the subject is undoubtedly true, but just what was the maximum which could be allowed has undergone a great change, and one for the better.

In Dr. Bell's treatise, "The Art of Illumination," he lays stress upon the importance of the subject, and as a guide to the amount which should be permissible he states: "It is a safe working rule to keep the intrinsic brilliancy of all radiants within the field of vision below five candle-power per square inch; preferably down to half that value."

The above-mentioned work was published in 1902, and since that time practically all of the improvements in the lamps and burners, both gas and electric, have been accompanied by a considerable increase in intrinsic brilliancy; whereas the standards set by illuminating engineers have been continually reduced; so that when the authors of two papers at the recent convention of the Illuminating Engineering Society set a maximum which was only a small fraction of one candle-power, there was general acquiescence.

THE GROWTH OF THE INSULATED-WIRE INDUSTRY.

Under the somewhat misleading heading given above, Mr. Ira W. Henry, in the current issue of the *India Rubber World*, discusses the use of rubber as an insulating covering for electrical conductors. He credits Samuel F. Morse, the inventor of the telegraph, with establishing the first authentic record of the use of rubber as an insulator in covering a cable made in 1842. The telegraph, being the first commercial use to which electricity was applied, called for insulated wire, and continual experiments were made by the Magnetic Telegraph Company looking to a satisfactory insulation for a submarine cable; and in 1843 a cable manufactured by Day was laid across the Hudson River from New York to Fort Lee, N. J. This cable was followed, in 1845, by another rubber-covered cable made by Charles Goodyear for Ezra Cornell.

The manufacturers of insulated wires and cables are now using enormous quantities of the best Para rubber, and the constant increase in the demand for their products has led the more far-sighted to investigate closely the supply from its fountainhead. It is stated that one large corporation found it expedient to send experts to South America to arrange for a constant supply direct from the forests, and it is also stated that large quantities were purchased on the ground at a price that paid the expenses of the trip; but financial complications arose to prevent a continuation of this enterprise.

Various processes have been perfected for the utilization of substitutes for rubber, and for certain installations these substitutes render perfectly satisfactory service. But, like every other industry, there are good substitutes and others which do not serve as substitutes at all.

Navy specifications call for a content of between thirty-nine and forty-four per cent of pure Para rubber in rubber-compound insulation, and the United States Signal Corps, which operates over 2,500 miles of rubber-insulated deep-sea cable in Alaskan territory, and over 1,600 miles of rubber cables in various circuits throughout the Philippine group, specifies a pure Para content of forty per cent. Pure Para rubber in its native state absorbs considerable moisture, and upon being dried by evaporation is oxidized and becomes hard and brittle, being rendered useless as a dielectric; so that, while Para rubber often is very essential as a base, it must have produced within it such chemical change as will render available the whole usefulness of the article. This is done by vulcanizing, which practically is the adding to the rubber of about three per cent of sulphur and heating at a certain temperature for a certain length of time. Over-vulcanizing renders the product hard and brittle, while under-vulcanizing renders it inert and flabby. Therefore, even with a fine Para as a base, the utility of a rubber insulation depends upon its process of manufacturing to make it stand the test of time.

Illuminating Engineering Society—I.

Second Annual Convention Held at Hotel Walton, Philadelphia, Pa., October 5 and 6. Report of First Day's Sessions.

THE second annual convention of the Illuminating Engineering Society was held at the Hotel Walton, Philadelphia, Pa., on Monday and Tuesday, October 5 and 6. This convention was very well attended, and the greatest interest was manifested throughout the entire proceedings. Several hundred illuminating engineers and others interested in the subject listened to the addresses and enjoyed the entertainment features which were coincident with the celebration of the 225th anniversary of the founding of the city of Philadelphia.

The first session was called to order on Monday morning at 10.40 o'clock by George Ross Green, of Philadelphia, chairman of the Committee on Arrangements. Mr. Green introduced William F. Gleason, secretary to the mayor, who, in the absence of Mayor Reyburn, welcomed the convention to the city.

Dr. Louis Bell, president of the association, delivered his annual address. He said that he desired to bring before the convention as a feature the topic of street lighting. It was 200-odd years ago that the first attempts at systematic street lighting were made. The activities of men are so far transferred from day to night at the present time that it becomes absolutely necessary to make provision for those who are traveling about after nightfall, and for the general business that is carried on at night. For this purpose plenty of light is necessary, but this light we have to a rather limited extent in most cities. The fundamental criticism against most attempts at street lighting lies not in the illuminants used, nor in their application, so much as it lies in the improper adjustment of the illumination to the needs of the city. Street lighting has been a growth and an evolution, but, like all growths, it has proceeded to a certain extent along the lines of least resistance. The result is that, looking over a city, particularly an American city, however good the intention of the city government, and however excellent the technical skill of those who furnished the light, much is still left to be desired. The difficulty lies in the fact that we spread out our illumination too thinly, so to speak.

Streets which are largely used during the evening should receive illumination commensurate with their importance. Where the night traffic is light and where passersby are few, such a street needs only light enough to enable the people to go about comfortably. A third class of street, which needs individual treatment, is the merely suburban road. The important thing with such streets is to so distribute the light that the illuminants serve to mark the way and clear the passage for the passersby.

The chief streets in this country as a rule are rather poorly lighted; the secondary streets are not particularly well lighted, and the tertiary streets frequently have only one illuminant in every long block. Dr. Bell thought that the chief streets of a city should be so well lighted that it would be possible to consult a handbook or to read the address on an envelope without having to walk half a block to get under the nearest light. In connection with this matter he stated that the foreign practice, in England and on the Continent, is to provide in the different streets light enough to read a paper by. That is the ordinary standard of illumination which is lived up to in the large foreign centres. In actual amount the lighting in London averages something like a quarter of a foot-candle, as against one-tenth, one-eighth or one-quarter that amount in the ordinary American city. One of the great points of difference between the practice here and in Europe is that diffusing globes are practically in universal use except in the United States, and therefore there is less uniformity here than almost anywhere else.

In the matter of distribution one can not sacrifice too much for the sake of uniformity. It does not take an expert in illumination to see whether a street is badly lighted or not, and it does not consequently take an illuminometer with a measurement in the thousandths foot-candle to find a half-way distance between lamps to show that improvements are necessary. The thing is strictly a practical matter, and should be treated as such.

This brings up the question of the direction of measurement. The customary measurement here is a tacit apology for bad lighting. The customary method is a measurement practically half way between the lamps, with a disc or other measuring instrument held normal to the latter. If one gauges his illumination solely by such readings as this he can be guaranteed a mighty badly lighted street in every case, because the tendency of competition, from whatever source it come, is to secure that minimum at as low a maximum as possible. Some types of illuminants have been specialized for the purpose of giving 0.02 or 0.03 of a candle-foot at some point down the street, where, if the same illuminant was designed not to give a special form of illumination, but to give the best efficiency it was capable of, it would be possible to make it light not only the distant parts of the street, but the whole of the street. Every effort toward economy should be an effort directed to increasing the total flux of light, because, with our modern instruments, there is this to be taken into consideration for street lighting: the intrinsic brilliancy is so high that some diffusion is necessary, and they are all of a character which permits of securing diffusion to get redistribution if it is desired.

Dr. Bell considered lighting of municipalities on a moonlight schedule to be entirely inadequate, and discussed the origin of this scale. He showed that there was no real relation between the diffused illumination from the full moon and that which is secured even when a street is brightly illuminated by artificial illuminants. As far as economy in lighting was concerned it would be better to put out every other light than it is to utilize the light on a regularly reduced moonlight schedule.

In concluding, Dr. Bell said that the next three or four years will work a considerable change. Illuminating engineers should insist on having more light better diffused and more evenly distributed.

There was no discussion on President Bell's address, and the report of the Committee on Nomenclature and Standards, of which Dr. A. C. Humphreys, president of Stevens Institute of Technology, is chairman, was called for. In the absence of Dr. Humphreys the report was presented by Dr. E. P. Hyde.

This report consisted, in the main, of a recapitulation of the work which the committee had done in the direction of establishing a common national and international unit of candle-power. This special work was assigned to a subcommittee, and a report from Dr. E. P. Hyde, secretary of the subcommittee, appears in the Nomenclature Committee report. A joint committee composed of subcommittees of the American Institute of Electrical Engineers, the American Gas Institute and the Illuminating Engineering Society on February 14 adopted a resolution recommending the adoption of a common national candle unit, to be maintained at the United States Bureau of Standards, to be lower than the unit at present maintained at Washington by an amount not less than one per cent nor more than three per cent, the exact value to be agreed upon as the result of an international conference. This resolution has been endorsed by the directors of the American Institute of Electrical Engineers and approved by the council of the Illuminating Engineering Society. It will be presented to the convention of the American Gas Institute, which meets this month. The subcommittee also reported that the Bureau of Standards has entered into negotiations with the foreign laboratories in regard to possible agreement upon an international unit of luminous intensity, and the hope was expressed that final agreement may be reached very shortly.

After the presentation of the report Dr. Hyde said that it would be well if when we were speaking of photometric measurements of gas and electric lamps, or if we were speaking of photometric measurements made in this country or abroad, we could always use the same terms. It is a far cry, however, from a purely academic conception of such a condition to the practical realization of it. Many of the industries in this country have endorsed this movement and are backing it at no little inconvenience and expense to themselves: much credit is due to the Illuminating Engineering Society for taking the initiative in this matter, and credit is also due to the American Institute of Electrical Engineers and the American Gas Institute for the cordial reception which they accorded to the overtures of the Illuminating Engineering Society.

Dr. Bell said that he thought that the outlook was bright for an international standard. He had come in touch with representatives of the various interests abroad and found that they were very sympathetic in both Germany and France.

MONDAY EVENING SESSION.

The session on Monday evening was called to order by Dr. Bell at 8.30 o'clock, and the paper by T. J. Little, Jr., entitled "Modern Gas-Lighting Conveniences," was read.

This paper was devoted principally to descriptions of some of the conveniences which have obtained with modern forms of gas fixtures. The electric-spark ignition system and the pilot gas-flame system of ignition were described, and some of the adaptations of incandescent mantle burners to domestic and industrial uses were enumerated.

Dr. Bell remarked that in his experience it appeared as though ordinary electric systems of ignition for gas lighting got out of order very frequently.

Referring to this, Dr. Clayton H. Sharp asked Mr. Little whether there had been any modern developments or improvements in pneumatic lighters which would prevent this trouble from taking place. As he saw it, the chief reason for the failure of electric gas-lighting systems is due to the lack of insulation somewhere in the circuit, so that it appeared that the problem resolved itself largely into a question of proper insulation against the high electrical tensions which are involved either in the jump-spark ignition or in the make-and-break system. With regard to the pilot lighting system, Dr. Sharp asked whether there was any possibility of danger due to the extinguishing of the pilot light by drafts or air or perhaps by clogging of the pipe. In this manner a stream of gas would issue, and this brings up the question whether where water gas is used there would not be considerable danger.

F. N. Morton asked Mr. Little whether there were any developments in the self-lighting gas mantles. There was another type of igniter which was not mentioned in Mr. Little's paper, namely, the Welsbach pyrophoric alloy, about which he would be pleased to get some information.

Walton Forstall stated that it had been his experience to have the gas escape from the pilot light for about forty-eight hours before he realized it, and there was just a faint odor of gas present.

Fritz Beck described the pneumatic gas lighter, and stated that with the kind of tube now generally used it can be operated successfully on about twenty yards for one light. The number of lights to be supplied by one tube is about six, and the distance diminishes with the number of lights enclosed in one circuit. The tube is about one-sixteenth of an inch in diameter and has the advantage over electric wiring in that it does not need any insulation. There is no danger of fire or of getting out of order through lack of insulation, as is the case with the electric gas igniter. The simplicity of the parts of the pneumatic lighting system will probably induce many people to use it. It really consists of a valve, a tube and a pump, the mechanics of which are pretty generally known and understood. Another advantage of the pneumatic ignition system is that any number of lights may be turned on or off. On a chandelier of six lights it is possible to turn on one after the other or all at once, simply by pulling the line on the push-button or pressing a ball. For the ignition of a great number of lights, however, the electrical ignition is probably the best, because the distance over which the pneumatic ignition can be successfully operated is limited.

It seemed to be the consensus of opinion that the chief cause of failure with electric gas ignition systems was that the system was installed without due regard to the insulation. It is not remarkable that where single cotton insulation is used that the system should fail.

In closing the discussion Mr. Little said that the wiring necessary for an electric ignition system did not require the same restrictions as wiring for electric lights. While the potential may be high, the current carried by the wires is extremely low. Furthermore, in the make-and-break system the same insulation is not required as with the jump-spark system, where a potential of several thousand volts is necessary, depending on the number of burners in circuit. Insulating the wire by a covering is not resorted to, and in some installations the insulation would be of no avail. In these cases the wires are bare and run on insulators. The usual practice is to use a copper wire of about No. 18 Brown & Sharpe gauge. This is covered with double cotton windings, which in turn are covered with a heavy braided jacket. The entire conductor is impregnated with paraffin or some similar insulator. A good deal of the trouble which existed in the early ignition systems was due to the method of construction of the burners. Where a wipe contact was made, sometimes the wire, in wiping over, would stick and not pass back. When this happened the battery would be short-circuited and the system would be expensive to maintain. This trouble has been eliminated by the construction of the modern burners.

Mr. Little said that there was no danger from the escape of gas from an extinguished pilot burner in an ordinary room. The natural ventilation of the room would take care of the escape of gas even if it were closed pretty tightly.

Concerning the self-lighting mantle, it did not appear that one had been developed to such a point as would make it possible to state that it was commercially practical. The action of the heat destroys the pyrophoric element, and up to the present time a satisfactory self-lighting mantle has not been produced. Concerning the pyrophoric alloy invented by Dr. von Welsbach, this is in the experimental stage. It is an interesting alloy, the product of the electrical furnace. It is an alloy of iron and cerium, and has the property of emitting a brilliant stream of sparks on being scratched with a sharp, hard surface.

Dr. A. H. Elliott presented his paper, entitled "The Illuminating Value of Petroleum Oils."

This paper gave the results of a number of tests which had been made upon various forms of burners and several qualities of kerosene oil and kerosene-oil mixtures. The author remarked particularly upon the steadiness and reliability of flat-flame lamps, even when burned with common reservoirs where the level of the oil varies as the lamp burns. It was noted that the rate of consumption and the candle-power are extremely constant. The lamps were calibrated against standard sperm candles, and it was noticed that many lamps used gave nearly twice the candle-power of sperm candles for the same weight of oil, while the round-wick lamps gave fully three times as much.

C. O. Bond stated that in his work, using the oil lamp as a standard and employing the student feed and flat-wick type of burner, up to ten hours' use a very satisfactory light was secured. He hoped that a lamp could be produced so that the conditions during a run of twenty-four hours could be checked. After twenty-four hours he found that there was, in most cases, a rather heavy incrustation of the wick where it had been exposed to the flame. Any oil lamp will be open to two objections: First, that it is a wick feed, and second, that it is surrounded by a glass chimney.

Dr. Hyde asked the author whether the absolute value of the lamp could be depended upon, and also asked whether the Methven screen arrangement could be used without having to recalibrate the outfit. In the photometry of electric lamps it is not uncommon to check up the comparison lamps several times in order to see that they have not changed, and it appeared to him that the wick might be retrimmed and the lamp restandardized at intervals. If it ran perfectly constant for eight or ten hours it seemed worth further consideration as a secondary or working standard in gas photometry.

Dr. Elliott, in closing the discussion, stated that he has used kerosene oil of a gravity as low as forty-five degrees Beaumé, and had obtained within two or three per cent of the same light as he did if he used an oil at fifty degrees Beaumé. He did not intend that the discussion should turn upon a photometric standard; he simply desired to record the reliability and photometric value of the different types of flames, and did not wish to establish any claim for the lamps as a standard. He objected to the use of the Hefner light because, in the first place, it was too small a unit, and unless a very keen photometrist was employed it was difficult to read to one-tenth of a candle. Another objection was its color. With a white light such as a Welsbach candle to test, considerable trouble was caused in matching the two shadows on the disc. The Pentane light, he thought, was too clumsy an instrument, and the expense of maintaining it was entirely too high. With kerosene oil the upkeep could be reduced very materially. He described a five-candle-power lamp which had operated for six and one-half days, being turned off each night, and varying only 0.06 of a candle during the week. The lamp was not even trimmed, but was lighted every day and allowed to burn for seven or eight hours and then blown out at night. The next morning it was turned up and lighted, care being taken not to disturb the crust. As stated before, at the end of a week it had gained 0.06 of a candle. He used a cotton wick in preference to either asbestos or felt.

The paper entitled "Street-Lighting Fixtures—Gas and Electric" was presented by H. Thurston Owens.

This paper discussed very briefly the several forms of gas and electric illuminants which are familiar to-day, and indicated the general engineering trend with regard to the installation of these sources of illumination in retail business districts, wholesale business districts, residence streets, prominent thoroughfares in residence districts, and in outlying districts.

V. R. Lansingh described a scheme of lighting which was employed on the London Bridge, at London, England. This consisted of equipping the ordinary square lamp-post with three transparent panes of glass and one pane of opal glass. This threw a considerable percentage of the light back onto the roadway, illuminating the bridge and keeping the glare out of the boatmen's eyes. The scheme could be adopted in our cities to prevent a waste of light which goes toward vacant lots and toward houses, and makes this form of illumination uncomfortable for persons sitting in front of the buildings.

Dr. Elliott stated that in Toronto reflectors were used which redistributed the light so that up and down the street the illumination was about 300 candles, with practically no illumination going to the houses at the side.

J. E. Woodwell stated that it was important to cut down the intrinsic brilliancy of the light source, and that rather than project the light up and down the street it would be better to place a larger number of units on the street, directing the light more in a downward direction. He called attention to the lighting of the Connecticut Avenue Bridge in Washington, D. C., as a successful example of street lighting. The roadway is fairly uniformly lighted, and the sources are of low intrinsic brilliancy. A strong downward distribution of light is given, and the globes are a dense opal glass, which cuts down the intrinsic brilliancy to a very low value.

The paper entitled "Structural Difficulties in Installation Work" was presented by James R. Strong.

The author considers that the best electrical installation from the point of view of the first-class contractor is that installation which requires the least amount of changing and alteration after completion. Modern electric lighting installations in the better class of buildings are of some form of concealed conduit work, with iron or steel outlet boxes at the fixture locations. Therefore, the electrical equipment is as much a part of the structure of the building as is the plumbing or heating equipment, and any additions or alterations in the conduit work after the completion of the building must, to some degree, cause weakness in walls, floors or plaster. It would seem that in designing the lighting for an office building, the proper method of procedure would be to consider each floor as a whole, bearing in mind the class of tenants likely to occupy an office building in a given locality. If the outlets for general illumination are placed on the centre line of windows and if other outlets are placed around the ceiling a short distance inside the lines of partitions, it would seem as though every possible requirement could be met by simple fixtures, and the outlets need not be capped up. This plan would probably involve a greater number of outlets in the original layout than would be absolutely necessary, but when it is considered that no changes will probably be required, it will be appreciated that the additional first cost would be more than made up in the saving of maintenance in the first few years. The paper also discussed the arrangement of the installation for residence lighting.

Dr. Bell said that he felt that a great fault in most installations was an insufficient number of outlets. These should be allowed not only at various points in a room, but also at the central points.

G. H. Jones stated that the introduction of the modern high-efficiency unit has done more than anything else to make improvements and changes necessary in large office buildings. Heretofore the standard practice was to provide a small amount of light for general illumination and require that each desk should have a portable lamp or drop cord. Where it became necessary to shift the desks and office arrangements it resulted in either tearing up the floor or having drop cords carried all around the room. It is now becoming standard practice to have the general illumination intense enough to make all these extra lamps unnecessary. In laying out office-building lighting he recommended that no wall brackets or wall switches be installed in the interior of the walls; that is, in the walls leading from one office to another. The need for this can be done away with largely by having the wall switches put on the outside walls of the building, and if extra outlets are required they can be put on the baseboard of the outside walls and also the baseboard of the columns.

F. G. McGuire described a system of lighting which was under consideration in a building which has been erected for about ten years. The ceiling has no space back of it through which wires could be fished, and everything must run along the surface of the ceiling. All over this building a large number of drop lights have been used for illuminating purposes, and the general scheme has been to employ a network of molding, from which any number of local drops could be secured. Instead of forming receptacles at the base line, a tube was run around the entire room, which could be tapped into at any point, allowing great flexibility in the securing of side lights.

In closing the discussion, Mr. Strong said that the suggestion that the outlets in office buildings be kept off the outside walls was an excellent one. Briefly, his plan is to place a centre outlet and in addition a row of outlets, say, five feet apart, two feet from the wall, forming a square—if the room is square—around the centre outlet. With such a distance between outlets it would be possible by means of a fixture to reach a piece of furniture or desk placed in any part of the room, and while the first cost might be increased a little, the owner would be better satisfied in the long run if a simple change in fixtures could be made to take the place of tearing down the plaster or cutting holes in a brick partition. Mr. Strong stated that he was opposed to the use of moldings. They are unsightly and are dangerous, and the electrical contractor was getting beyond them.

The paper by F. E. Cady, on "The Relation Between Candle-Power and the Voltage of Different Types of Incandescent Lamps," was presented.

In this paper Dr. Cady holds that one of the more important relations governing incandescent lamps is that between voltage and candle-power. In the early days of poor voltage regulation this was evident even to the unskilled eye. At the present time, while a good system may have voltage changes large enough to have an appreciable effect on the life of lamps, they are generally too small to affect the candle-power to a noticeable extent. The author concludes that his experiments establish the following facts: The exponent for change of candle-power with change of voltage is not a constant, but a function of the watts per mean spherical candle; that this exponent is different for different types of filament, but probably very closely the same for lamps of the same type of filament when operated at the same watts per mean spherical candle; that the value of the exponent decreases as the watts per mean spherical candle decrease.

During the discussion of the paper Dr. Hyde asked whether any curves had been derived for the variation in current as compared with variation in candle-power.

Mr. Cady replied that such tests as he had been able to make indicate that these coefficients change in a very similar manner, although the change was not as marked as in the case of the change of candle-power with change of voltage. The coefficient for the change of candle-power with change of watts is smaller, and in some cases only half as great as the change of candle-power with change of voltage.

Dr. Sharp asked Mr. Cady what the change in efficiency of the filament amounted to practically in the photometry of incandescent lamps; what it amounted to in candle-power.

Mr. Cady replied that so far as he knew there were no data published either by lamp factories or the testing laboratories as to exactly what coefficient was used. He had pointed out in the paper the extreme limits over which the coefficients range.

Dr. Bell stated that in fourteen years he had measured something like 25,000 lamps, and that he could probably throw a little light on the matter by saying that there is no means known under the heavens whereby the errors due to bad sorting can be entirely eliminated.

The meeting was then adjourned until Tuesday morning.

New York Edison Entertainment.

The New York Edison Company tendered an entertainment and smoker to the electrical contractors of New York city, in connection with the New York Electrical Show, in the concert hall of Madison Square Garden on Tuesday evening, October 13. The occasion was enjoyed by about 700 or 800 contractors, and the programme, which was arranged by the United Booking Offices of America, included singing and dancing and instrumental performances of a very high order. From 9 to 11 o'clock the vaudeville arrangements held forth, and during this time cigars and other smokables were distributed with a lavish hand. After the entertainment the company's guests were invited to partake of a buffet supper, which was excellently served and greatly enjoyed. The Edison company is to be congratulated upon the handsome way in which it arranged for the entertainment and comfort of its guests.

Among those seen in the Edison box were: T. E. Murray, John W. Lieb, Jr., Arthur Williams, S. D. Sprong, F. C. Bates, Theodore Beran, Dr. George F. Sever, W. D'A. Ryan, E. B. Latham, Louis J. Auerbacher, W. H. Atkins and George H. Guy. William Marconi was an interested visitor to the Edison box during a portion of the evening.

Chicago Electrical Show.

The fourth annual Electrical Show, Chicago, Ill., to be held in the Coliseum, January 16 to 30, 1909, will surpass anything attempted heretofore, judging from preparations now being made. The beautiful decorations of the 1908 show are being enlarged upon and exhibits of many large companies are being prepared on a plan more comprehensive and attractive than ever, many working power exhibits being an added feature. Weber's band, which rendered the music at the last show, has been re-engaged. All indications point to boost for the electrical industry in general through the medium of this great exhibition.

The 213th Meeting of the American Institute of Electrical Engineers.

The 213th meeting of the American Institute of Electrical Engineers was held in the Engineering Societies Building, New York city, on Friday evening, October 9. President Louis A. Ferguson, of Chicago, Ill., called the meeting to order at 8 o'clock. The secretary announced that at the meeting of the board of directors held that afternoon 112 associate members had been elected. The following associates, upon the recommendation of the board of examiners, were transferred to the grade of membership: Robert Albert Hadfield, Mayfair, W., England; Edward Belden Merrill, Winnipeg, Canada; William Noble Dickinson, Jr., New York city.

The paper of the evening, entitled "High-Potential Underground Transmission," by Peter Junkersfeld and E. O. Schweitzer, of the Commonwealth Edison Company, Chicago, Ill., was presented by Mr. Junkersfeld. This paper, in abridged form, appears elsewhere in this issue.

In opening the discussion President Ferguson said that the subject was interesting not only from a scientific standpoint, but it was of considerable importance commercially because of the possible influence on investment and methods of operation in large power and lighting systems. The increase in value of property in the centre of cities has caused an expansion of the congested areas until, in the interest of public safety, overhead construction is necessarily limited, and we find ourselves facing the problem of placing high-tension transmission lines under ground. The possibilities of the future are so great, and the trend of the times so marked, that it would seem that the subject for discussion was a very fertile one, and it would appear very important that the large operating companies which produce electricity and sell it in bulk should make the matter of underground transmission a subject of further investigation and more serious thought.

Following President Ferguson, a discussion communicated by Charles H. Merz, chief engineer and manager of the Bulk Supply Company, Newcastle-on-Tyne, England, was read by Professor H. E. Clifford. Mr. Merz said that visiting engineers had always been impressed by the development and distribution of electrical energy in large cities of the United States. The fact that a large proportion of the work hitherto installed had been in crowded and congested districts probably explains why a conduit system had been generally adopted in this country. The solid system was preferred and largely in vogue in England, and armored cables are used largely there, and almost exclusively on the Continent of Europe. The extension of underground transmission to outlying and less congested districts will probably result in the merits of these systems of laying transmission cables being considered. For congested districts such as are met with in the centre of all of the large cities, the duct system is often the only practicable system because it is impossible to frequently take up the streets to lay further cables or carry out repairs. Accessibility to the cables is, however, some would say, the only advantage of this system, for when laid in this way the lead of the cables is probably more exposed to deterioration by electrolysis and chemical action than in either of the other two systems referred to above. In the so-called solid system the cable is laid in an earthenware or wooden trough sufficiently large to allow a three-quarters-inch clearance all around the cable, which space is filled with bitumen, pitch or similar substance. The trough is covered with three-inch brick or tile. According to the writer's experience, the solid system, in either earthenware or wooden troughs, is the cheapest of the three systems mentioned. An efficient armored cable costs, laid in the ground, in England, from five per cent to ten per cent more than a lead-covered cable laid on the solid system, but it would seem fair to say that an armored cable which is made and finished in the factory, where proper supervision is possible, should have a longer life than cables laid either on the solid system or drawn into ducts. Experience in the north of England shows that a 20,000-volt underground cable system may be installed with assurance that it will work well. In the counties of Northumberland and Durham there are now nearly 100 miles of such cables in use. The cables are three-core paper cables, lead-covered, and laid on the solid system in earthenware troughs.

H. W. Fisher, chief engineer of the Standard Underground Cable Company, said that the results of such tests as are given by the authors will add to the sum total of existing knowledge as to what voltages cables may be subjected to under working conditions. He thought, however, that under other working conditions it must be admitted that similar tests might have shown quite different results. It is therefore highly desirable that other operating companies make similar tests covering a long period of time. He said that the authors had not specified clearly what they meant by "double working voltage." With grounded neutral the voltage to ground on the 20,000-volt lines would be 11,550 volts. He would ask, therefore, if the voltage applied between conductors and ground is two times 11,500, or 23,100 volts, and that between conductors 40,000 volts. If these are the voltages applied, the test to ground is not sufficient, because in some cases the spark-gap method gave over 25,000 volts. He would suggest two and one-half times the working voltage as a figure that is more in keeping with tests made on other large installations. He took exception to the statement that asphaltum troughs certainly guard against electrolysis. If it were possible to perfectly protect a cable from moisture by asphaltum, electrolysis would not occur, but this is scarcely possible, and at the moist spots the electrolysis is greatly accentuated, causing pit-holes in the lead. He knew of cases where thousands of feet of cable laid in asphalt troughs were destroyed by electrolysis.

Henry Gorden Stott, chief engineer of the Interborough Rapid Transit Company, said that on the Manhattan elevated railway and in the subway system in New York city during the last three years there have been over 350 miles of 11,000-volt cable in service. Tables showing the classification of the troubles on this system indicated a total of seven burnouts, due to various causes, one of which was due to a surge, and one only was felt on the cable of 122 miles. The year that the subway was put into operation the cable troubles had fallen to six, due to the elimination of bad joints and various mechanical troubles. When the subway cables were put into operation the number of faults increased again. Lately, however, there have been very few faults, and in the last two years the number of burnouts amounted to 0.28 per 100 miles of cable. This is a record which is rather reassuring, and is better than is being accomplished with overhead transmission lines. So far as the discussion contributed by Mr. Merz was concerned, Mr. Stott would suggest some precaution in considering this. In the English system power was scattered between comparatively small stations. The American plants operate under entirely different conditions, and in the case of the Interborough Rapid Transit Company it was possible to have 300,000 kilowatts on short-circuit between stations.

Mr. Stott said that the mechanical feature which was going to help out materially in the development of power plants is the induction generator. We could not go on adding indefinitely to the capacity in synchronous machines in one plant, as a point would be reached where the short-circuit current would make it impossible to take care of the automatic apparatus. In the case of a bad short-circuit the time-element relays and reverse-current relays all fall back together, and everything goes out in a large system. With the induction generator, however, the present plant can be added to indefinitely without increasing the short-circuit current.

E. J. Berg stated that he had recently had occasion to carry out some experiments on the system of the Brooklyn Edison Company. It was found that abnormal voltages occurred relatively seldom, perhaps only once a week or once in two weeks.

Wallace S. Clark said that the putting of high-voltage primary on cables for the purposes of tests did not do the cable any good, as it did not show anything and there was no assurance that the cable under test would not burn out the next day or the next hour. Insulation tests are perhaps a little better made periodically, and furthermore, with the present tendency to make paper cables with very light insulation, it is rather difficult to get good results from such tests. He believed, however, that if the same amount of attention was paid to watching for electrolysis, as many burnouts or perhaps more would be saved as in any other way.

Alex Dow stated that thirty miles of rubber-covered cables which he had put down in Detroit in 1892 were, to all intents and purposes, as good six months ago as they were the day they were put in. In Detroit the Edison company has two cables operating regularly at 23,000 volts. Each is substantially seven and one-half miles long. The cable conductor is nineteen-strand, equal to No. 2 Brown & Sharpe gauge. The cable is insulated with two-thirty-seconds-inch rubber and six-thirty-seconds-inch varnished cambric on each conductor, and three-thirty-seconds-inch varnished cambric over all, with a three-thirty-seconds-inch lead sheathing. The lead sheath is sectionalized at every second manhole between 700 and 800 feet, and a strip of the lead is removed and insulating rubber substituted in order to prevent the continual travel along the lead sheath of street railway return current. At each of these 700 or 800-foot spaces the lead is solidly connected to earth by copper ground wire. One of these cables has been in continuous service for thirteen months. It is not the older of the two cables, but it has the most continuous and useful history. It went into service on September 4, 1907, and since that time has broken down six times. One of these breakdowns was due to high temperature from a steam-heating pipe in the vicinity, and the other five are not attributable to any known cause. Four breaks were in the cable itself and two were in the joints. There were four breaks to earth and one between phases. Adding this experience to the experience with the second cable, which was actually the first cable in service, the total breakdowns are twelve, seven of which were in the joints and five in the cable. The most notable observation is that the faults that are attributable to nothing but extraordinarily high pressure seem to occur in the middle third of the cable, and are not accompanied by any particularly notable disturbances at the terminals. This seems to confirm the observation made by the authors of the paper of the finding that these disturbances do not travel the entire length of the cable, but may spend their energy in one part thereof.

Warren Partridge said that the experience of the Public Service Corporation of New Jersey with high-potential underground transmission, when reduced to burnouts per mile of cable per year, had been considerably better than the 20,000-volt experience in Chicago, as reported in the paper. When compared with the 9,000-volt system in Chicago, however, the results have been very much worse. In spite of the difficulties experienced on their system, however, it could be agreed with the authors that cable systems are fully as reliable as other elements in an electric power system.

E. E. F. Creighton said that the work presented by the authors was most valuable. If one may look into the future, it seems safe to predict that engineers of power transmission systems will some day study the conditions of service as carefully and conscientiously as the insulation is studied on a marine telegraph cable.

L. T. Robinson stated that the reference to the limitations of the oscillograph which was used was not entirely justified. As far as concerns the free periodicity of the vibrators, it is quite possible to produce moving systems in which the current passes through the strips having a frequency nearly double that which was used, or, roughly, 10,000. This is accomplished, however, at such a sacrifice of strength and size of the moving parts that it is not desirable for industrial use. In reference to the statement that the vibrators can not be made absolutely dead-beat, he thought that this must be due to a misunderstanding of what can be accomplished.

Henry Floy stated that, as far as the alternating-current, high-tension cables were concerned, the manufacturing companies were ahead of the operating conditions—that is to say, the manufacturing companies have for years been ready to furnish high-tension cables. He had recently secured figures as to the commercial financial practicability of using high-tension cables. Where conductors are intended to be used on 50,000-volt service it would appear that the thickness of insulation would become so great that three-conductor cable would be impossible, as the leading machines at present available would not be capable of producing a lead sheathing for the cable. The average price for three single-conductor cables is about $4.40 per running foot.

John W. Lieb, Jr., stated that about 1882 a fairly extensive underground system was laid in Milan, Italy, with Edison tubes. It took only about six months in that particular locality to destroy an iron tube under ground. Some time in 1887 or 1888 a line some three or four miles in length, operating on 2,000 volts alternating current, was laid under ground. This was laid with iron-banded armored lead-covered cable, and with this cable was had probably the first experience in operating alternators direct-driven and coupled in parallel. The cable has been in operation ever since, and except for the early troubles, which were due to mechanical defects in the switches and generators, this type of construction has given great satisfaction.

Mr. Lieb read a communication from Philip Torchio, of the New York Edison Company, which described some of the experiences with the New York Edison service. Since June 10, a year ago, there were twelve disturbances on the system, and of these twelve disturbances at least four were indicated by a selective ground detector located on the feeder where the lowering of resistance was going on before the ground indicator gave an indication.

Dr. C. P. Steinmetz said it was extremely satisfactory to discover that underground cable systems can be operated even when on enormous magnitude and with enormous power back of them, with high safety and a small proportion of breakdowns. It would be interesting to investigate and calculate how much stored energy there is available in the system the authors describe.

In closing the discussion, Mr. Schweitzer said that, with regard to the question of the meaning of 100 per cent above normal voltage, this had reference to 100 per cent above normal pressure of any phase to ground, and where the paper referred to 200 per cent rise in current, that meant 100 per cent above the normal full-load current.

The meeting was then adjourned.

Electric Cooking for Restaurants.

An article in *Electrical Engineering* (London), September 17, describes the results of some experiments conducted in a London restaurant with electrical cooking apparatus. The apparatus consists of an oven, a large grill measuring fifteen inches by ten inches and consuming 1,800 watts when hot; an egg poacher six and one-half inches in diameter, consuming 600 watts; a toaster, and a six-and-one-quarter-inch hot plate. The most interesting piece of apparatus is the large grill. This is constructed as follows: Under the nickel-plated cover is a pad of asbestos wool some two inches thick, beneath which is a metal reflector. A grid of spirally wound resistance wire is supported from the latter on small porcelain buttons, and the heat is reflected down onto the chop or steak placed on the grid below. A five-gallon copper boiler is used to keep water at the boiling point. This consumes 1,000 watts. A test made for eight days, during which time the plant was in use almost continuously from twelve noon to 9 P. M. daily, showed that the average consumption of the oven, which had been in use only for keeping the plates hot, was eight and three-quarter units per day; that of the egg poacher, five and one-eighth units; of the grill for chops and steaks, thirteen and one-half units, and of the small grill for toasting bread, eleven and three-quarter units. The total consumption was 313 units, making an average daily consumption of thirty-nine and one-eighth units, which, at 1.8 pence per unit makes a daily cost of three shillings eight pence for current, or about eighteen cents per day, or two cents per hour for each grill, boiling plate and oven in use. The large grill, which is capable of cooking twelve chops or steaks at one time, cooked 678 pieces of meat, at a cost for current of three-eighths of a cent per chop or steak.

STREET RAILWAY CONVENTIONS.

MEETINGS OF THE AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION AND ITS AFFILIATED ORGANIZATIONS AT ATLANTIC CITY, N. J., OCTOBER 12 TO 16.

The annual series of conventions of the American Street and Interurban Railway Association and its affiliated organizations was opened at Atlantic City, N. J., Monday afternoon, October 12, with a meeting of the Transportation and Traffic Association. President C. Loomis Allen, of Utica, N. Y., called the meeting to order at 3 o'clock and delivered his annual address. He said that it was a cause for regret that the congratulatory remarks from the Hon. W. Caryl Ely would have to be deferred until the next day.

The work of the American Street and Interurban Railway Association will, in the future, undoubtedly be confined very largely to questions of policy and public relations, including national, state and municipal governments, and to such other matters as only the chief executive officers would be interested in.

Mr. Allen discussed the work of the Accountants', the Engineering and the Claim Agents' associations. The Transportation and Traffic Association, he said, has a much larger field of work, and it will require in the future the expenditure of more energy, more time and more money if the greatest results from this fertile field are to be produced. The Claim Agents, Accountants and Engineers, to a large extent, are consumers of gross earnings. The Transportation and Traffic men are primarily the producers of gross earnings. Since the organization meeting it has been a pleasure to devote considerable time to the work of this association.

Mr. Allen is convinced that the best results will be produced by committee work. It is not intended that committee work shall be confined to a meeting of the committee once or twice during the year, but by committee work is meant the study and knowledge of conditions existing in the various properties of the member companies, the reduction of these conditions to a fair statement in writing, the remedy which should be applied to reconcile abnormal conditions, in so far as is practicable, and the recommendation by the committee of a practical application that will meet transportation and traffic conditions, and perfect street railway service for its patrons, with all that that perfection may mean.

President Allen's address was greeted with enthusiasm, and the secretary read the report of the organization meeting.

The president called for a vote on this report, and stated that if there were no recommendations or exceptions, it would be received and printed in the official proceedings.

John I. Beggs, of Milwaukee, Wis., took some exceptions to several points in the constitution, particularly as regards the matter of eligibility for voting. The paragraph to which Mr. Beggs took objection read: "Each active member shall be entitled to one vote on all questions coming before this association, which shall be cast by a properly accredited representative of its transportation or traffic department." The point was raised that it might not be convenient at all times to have in attendance a representative of the traffic department. In this case there would be no opportunity for a duly accredited officer of the company not a representative of the traffic department to cast the vote for his company.

Mr. Allen said that the points which had been raised by Mr. Beggs should receive careful and serious consideration, and it was finally decided to refer the portions of the constitution and by-laws under discussion back to the committee, with a request that they be given consideration and a further report made.

The report of the executive committee was presented by the secretary. This was accepted, and will be published in the proceedings.

The report of Secretary Swenson covering the period to September 30, 1908, was presented. This report was accepted.

The paper entitled "How Can a Small Road Best Promote Traffic and Increase Its Revenue?" by Ernest Gonzenbach, general manager of the Sheboygan Light, Power and Railway Company, Sheboygan, Wis., was read by J. H. Pardee. This paper was discussed by Messrs. Sylvester, Hegarty, Passailaigue, Gossler, Davis, Pardee, Allen, Dozier, Beggs and Parker.

The meeting was then adjourned to reconvene the next morning.

The Transportation and Traffic Association held further meetings on Tuesday, Wednesday and Thursday. The meetings of the American Association were held on Tuesday afternoon and Wednesday and Thursday afternoons. The meetings of the Engineering Association were held on Tuesday, Wednesday and Friday afternoons and Wednesday morning. The meetings of the Claim Agents' Association were held on Monday and Tuesday afternoons and on Tuesday and Wednesday mornings. The Manufacturers' exhibit was particularly comprehensive and covered the entire expanse of Young's million-dollar pier.

CHILE HYDROELECTRIC PLANT ON THE RIO LOA.

BY FRANK KOESTER.

For the extraction of saltpetre a hydroelectric plant has been installed some eleven miles north of Rica Aventura, utilizing the water of the Rio Loa in the northwestern part of Chile, South America. In this vicinity the saltpetre is found under a layer of gypsum about ten feet thick. The saltpetre is extracted by dynamiting, then transported to the "Oficinas" where it is treated for commercial use.

Prior to the present hydroelectric installation there was a steam-operated plant in connection with which is a 2,000-volt transmission line. Owing to the high cost of the transportation of coal, it proved a poor financial proposition. The steam plant is now used as a reserve.

For utilizing the water of the Rio Loa a comparatively small dam only had to be built across the river. The power plant is located a short distance down stream, as seen in Fig. 1, and has a head varying from eighty-two to 102 feet. It has been designed to accommodate four units, three of which are at present installed, each having a capacity of 455 horse-power at 5,000 volts.

It will be noticed in the accompanying illustration that the complete machinery and also the switchboard were installed before the erection of the superstructure. This was done under the certainty that there would be no rain during that season of the year.

The substructure is made up of rough-faced stone while the superstructure is of a wooden-frame skeleton and brick, the interior being cement plastered, while the floor is tiled. The switchboard itself is located on a raised platform, while the switch gear is housed in a two-story wing. The generating room is served by a hand-operated traveling crane.

The turbines are the inward-flow Francis type and are connected by means of an isolated flexible coupling to a three-phase generator. Between the coupling and turbine is a heavy flywheel to take up fluctuations caused by the cutting of

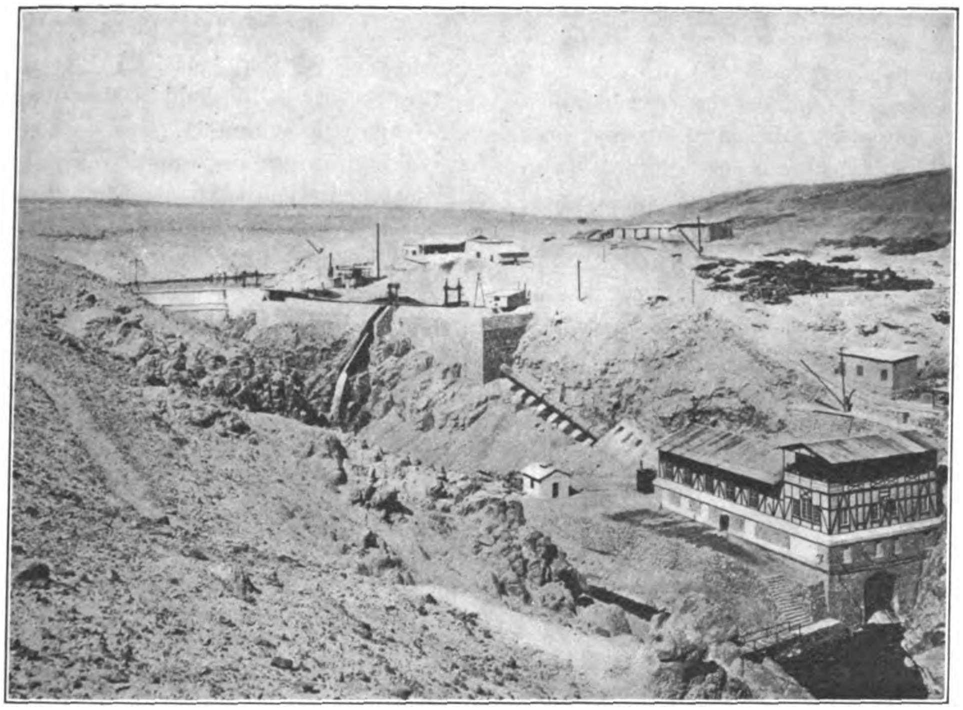


FIG. 1.—PLANT ON THE RIO LOA, NEAR AVENTURA, CHILE.

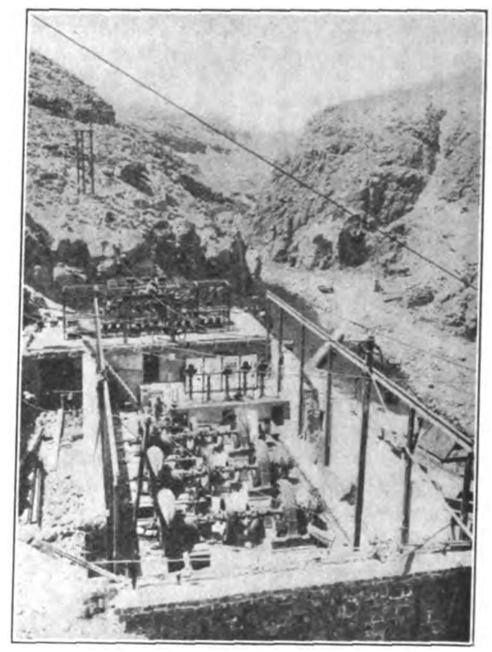


FIG. 2.—HYDROELECTRIC PLANT NEAR AVENTURA, ON RIO LOA, SHOWING METHOD OF CONSTRUCTION.

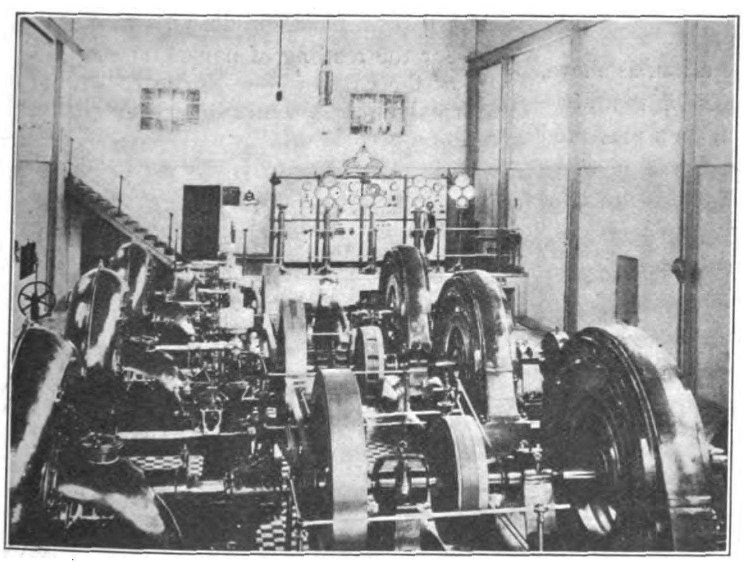


FIG. 3.—INTERIOR OF POWER PLANT NEAR AVENTURA, ON RIO LOA, CHILE.

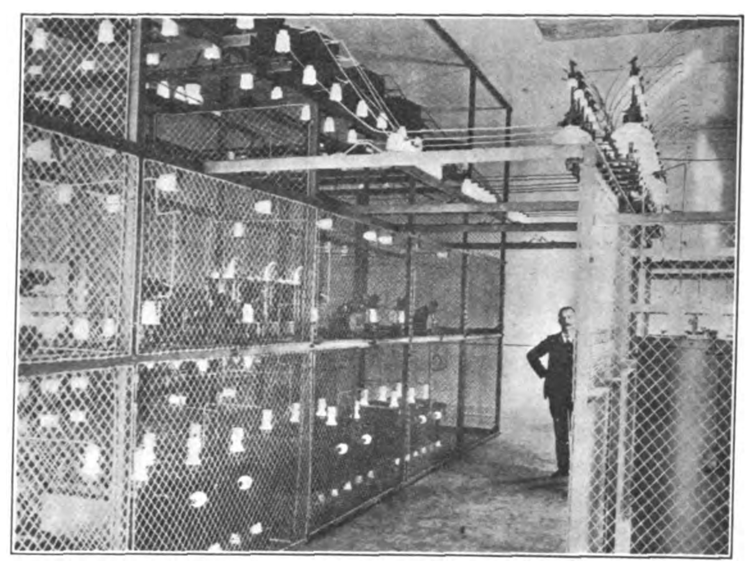


FIG. 4.—HIGH-TENSION SWITCHING COMPARTMENT, HYDROELECTRIC PLANT ON RIVER LOA, NEAR AVENTURA, CHILE.

motors in and out in the various "Oficinas."

Each generator unit has its own exciter mounted on the overhang of the shaft. The generator leads run through trenches to the switchboard. The latter is of ornamental-iron design faced with white marble slabs, there being four panels. In front of the switchboard are five instrument columns, one for each generator unit, and one master control.

The power is distributed by a 20,000-volt transmission line a distance of thirteen miles to the substations at Rica Aventura, Grutas and Empresa, while a fourth substation at Prosperidad is now under construction.

The first section of the conductor is twenty-five square millimetres, the remaining section is sixteen square millimetres. They are carried on wooden poles of a rectangular cross-section.

The line is well protected by lightning arresters and automatic circuit-breakers, the latter being electrically controlled. The lightning arresters consist of a series of horn-gaps, Fig. 4, choke-coils, fluid rheostats and water flow grounds.

The plant was designed and constructed by the Siemens-Schukert Werke, Berlin, who also furnished the above-mentioned steam-power plant.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

INTERNATIONAL RAILWAY OF BUFFALO.

The International Railway Company, of Buffalo, N. Y., reports to the Public Service Commission at Albany, for the year ended June 30, 1908, as follows: Gross operating revenue, $4,702,850; operating expenses, $2,751,335; net operating revenue, $1,951,515; taxes, $244,682; operating income, $1,706,833; non-operating income, $26,065; total income, $1,732,898; fixed charges, $894,397; net corporate income, $838,501.

KANSAS CITY RAILWAY AND LIGHT.

The Kansas City (Mo.) Railway and Light Company's report for August and three months, June 1 to August 31, is as follows: August gross, $537,499; expenses, $306,609; August net, $230,890; taxes and interest, $155,540; August surplus, $75,350, comparing with $104,505 for the same month last year. Three months' gross, $1,576,542; expenses, $922,-907; three months' net, $653,735; taxes and interest, $465,349; three months' surplus, $188,386, as against $279,151 for the corresponding quarter of 1907.

PORTO RICO RAILWAYS COMPANY.

The report of the Porto Rico Railways Company for the month of August is as follows: August gross, $35,427; expenses, $21,385; August net, $14,042, as compared with $12,760 for August of last year.

Allis-Chalmers Company Issues Favorable Report.

In the annual report of the Allis-Chalmers Company, which was made public last week, President W. H. Whiteside shows that the operating profits for the year ended June 30, 1908, amounted to $2,573,961, or more than double those of 1907. At the same time there was a surplus after all charges of $385,997, comparing with a deficit last year of $229,817. In his remarks to stockholders President Whiteside says:

"Noteworthy success has been obtained in the sale and operation of our new lines of production, namely, gas engines, steam turbines, hydraulic turbines and electrical apparatus, which are now among the standard products of our company. The extended use of these lines of production, often in connection with our older products, not only by purchasers who have long been our regular customers, but by numerous new customers in almost all classes of industry, forms the basis for an increasing and profitable business."

The detailed income account for the year, with comparisons, follows:

	1908.	1907.
Profit on operation....	$2,573,961	$1,226,242
Maintenance, depreciation, interest, etc...	1,958,147	1,613,540
Net profit for year...	$615,814	*$387,298
Previous profit and loss deficit.........	229,817	†157,481
Surplus.....	$385,997	*$229,817

* Deficit. † Surplus.

The item, profits on operation, as above, is after deducting expenses of manufacturing and selling; dividends on preferred stock of the Bullock Manufacturing Company and ordinary provision for doubtful accounts.

The surplus profits for the year, $615,-814, as above, are equal to 3.81 per cent earned on the $16,150,000 preferred stock.

The report adds: "Inasmuch as owing to present financial conditions there may possibly be a shrinkage in the collection of certain bills receivable, it has been deemed advisable to set aside out of profits a special reserve of $60,000 shown above. Beginning with the second quarter and continuing for half the company's fiscal year, owing to the severe contraction in general business throughout the country the volume of the company's sales averaged about one-half of normal. During the last quarter there was a gradual and steady increase in orders booked."

The balance sheet shows reductions in the inventories amounting to $2,518,841; increase in notes and accounts receivable of $272,137; increase in cash of $1,059,-300, and decrease in accounts and notes payable amounting to the substantial sum of $2,304,413. These changes, together with the net profit on the operations of the year not used for additions to plant and equipment, considerably strengthen the position of the company and increase its working capital.

American Electrochemical Society.

A meeting of the American Electrochemical Society will be held in New York city, October 29, 30 and 31. Headquarters for registration and information will be established on Thursday evening, October 29, at the Hotel Cumberland, Fifty-fourth street and Broadway. On Friday morning and afternoon headquarters will be established in the Chemistry Building of the College of the City of New York. On Saturday, October 31, the meetings will be held at the Chemists' Club. The following programme has been announced:

Thursday, October 29, at 8 P. M., meeting of the board of directors at the Chemists' Club.

Friday, October 30, at 9 A. M., meeting at the Doremus Lecture Theatre, Chemistry Building, College of the City of New York, for reading and discussion of papers; 12.30 P. M., luncheon, by invitation of the staff of the department of chemistry, College of the City of New York, Alumni Hall, main building; 2 P. M., session for the reading of papers, at the College of the City of New York; 7.30 P. M., informal subscription dinner—details to be announced later.

Saturday, October 31, at 9 A. M., session for reading of papers and discussion, at the Chemists' Club; 1 P. M., luncheon at the Hotel Cumberland; 2 P. M., inspection trip—to be announced later; 8.30 P. M., smoker at the Chemists' Club.

Electrical Engineer, Technologic Branch, United States Geological Survey.

The United States Civil Service Commission, Washington, D. C., announces an examination on November 9 to secure list of eligibles from which to make certification to fill a vacancy in the position of electrical engineer in the technologic branch of the United States Geological Survey, at a salary ranging from $1,620 to $3,000 per annum, according to the rating received; and vacancies requiring similar qualifications as they may occur. Applicants should at once apply to the United States Civil Service Commission, Washington, D. C., for application form 304 and special form.

HIGH-POTENTIAL UNDERGROUND TRANSMISSION.[1]

BY P. JUNKERSFELD AND E. O. SCHWEITZER.

From present indications systems operating at potentials of 100,000 volts and over will not be uncommon in a few years, and none dare prophesy what further increase the future has in store.

Within the confines of the largest cities the conditions are sometimes such that it is not advisable to carry these high potentials overhead. In such cases it may be necessary to place the conductors underground. The limitations of insulation and size have kept the transmission voltage for underground cables at about one-third that of overhead transmission, and while there has been a considerable advance in the art the approximate ratio of 1 to 3 seems still to be maintained. However, in large systems of underground transmission, insulation and size are not the only cable limitations. The line-constants may become such that the cable is frequently subjected to dangerously high potentials.

This paper will not deal with experience at pressures lower than 5,000 volts. A typical system using high-potential underground transmission extensively is that of the Commonwealth Edison Company, of Chicago, and its experience will be cited principally. Suffice it to say that at present (September, 1908) the system consists of two generating stations (a third is in process of erection) with a maximum capacity of about 18,000 kilowatts and 100,000 kilowatts, respectively, sixty-six 9,000-volt, three-phase transmission lines aggregating 272 miles, supplying forty-four substations containing synchronous converting equipment almost exclusively. Three additional substations and sixty-eight miles of additional 9,000-volt cable are now under construction.

There is also a 20,000-volt line eleven miles long connected to the 9,000-volt system through step-up transformers and feeding railway and frequency-changer substations located in an outer or suburban zone. Forty-four miles of additional 20,000-volt underground lines are under construction, which will bring the total up to fifty-five miles. The entire cable system is shown in Fig. 1. This 20,000-volt system will be permanently supplied from 5,000-kilowatt, three-phase, step-up transformers connected delta to star with the neutral grounded. The standard size of 20,000-volt cable is 00, and of 9,000-volt cable 0000 and 250,000 circular mils.

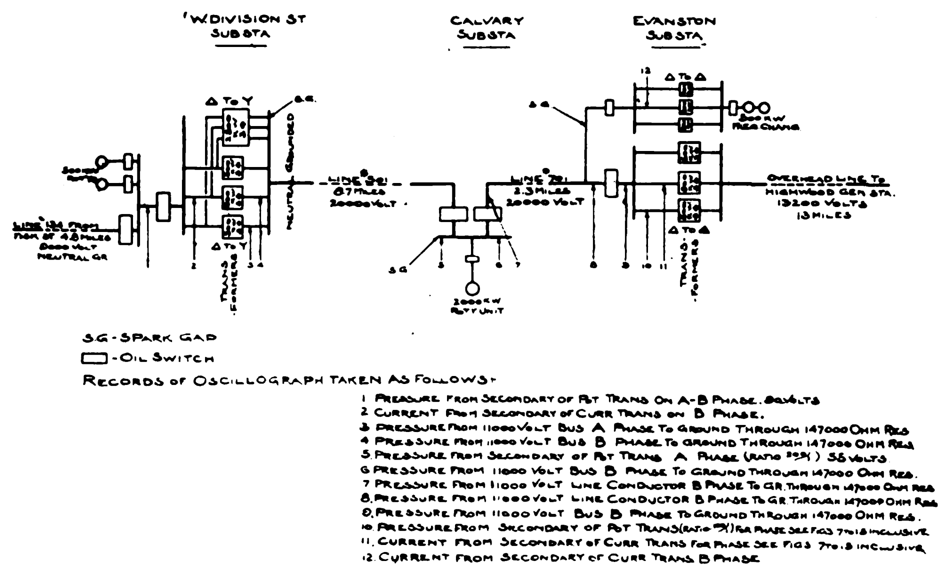


FIG. 1.—SUBSTATION CONNECTIONS OF 20,000-VOLT LINE, SHOWING POINTS AT WHICH OSCILLOGRAMS WERE OBTAINED.

In February, 1902, the twenty-five-cycle, three-phase system of about seventeen miles of three-conductor cable and seven synchronous converter substations was raised from 4,500 to 9,000 volts, the equipment and cable having been installed with this change in view. This transmission system was first put into service in August, 1897. The greater part of the cable at the time of the change to 9,000 volts was 00, some 0 and about one-fifth of 0000 size. The insulation on the original 4,500-volt cables consisted of five-thirty-seconds-inch inner wall of paper around each conductor and an outer wall of three-thirty-seconds inch thick surrounding all three. The thickness of the lead sheath was one-eighth inch. In the 9,000-volt cable the thickness of the paper insulation was finally standardized at six-thirty-seconds inch and four-thirty-seconds inch, respectively.

The early experience in Chicago and elsewhere showed the necessity for avoiding sharp bends and for using extreme care in making the splices. A small number of burn-outs occurred during the first year's operation at 9,000 volts, and nearly all were due to sharp bends or to moisture at the joints. In order to determine how quickly moisture in a cable causes a breakdown, after it has entered through an opening in the sheath, in 1903 Mr. Burch,[1] of Minneapolis, made some interesting experiments. He found that it usually requires from a day to a week for the moisture to work down sufficiently to cause a burn-out. Paraffin had, up to this time, been used at the joints and in the terminal bells, but being hygroscopic in effect, due to voids left after cooling, it was not satisfactory at the higher voltage. About this time some of the engineers of the company, after considerable study and experimentation, developed a high-grade insulating compound which since then has been used exclusively on all high-potential work.

The splices are made up with great care and the compound is poured into the sleeve at a temperature of 150 degrees centigrade in a manner to exclude all moisture. The success of this work is evidenced by the fact that there have been but two failures in splices during the last five and one-half years and there are now some 3,400 splices in the high-tension system. The compound-filled terminal bells were formerly made of brass cylinders with a cast-brass base, a substantial ground connection being made at the base. On some recent work a few bells made of a special impregnated concrete have been used with very satisfactory results. The proper protection of cables against damage due to burn-outs of adjacent cable has received considerable attention, and all cables in manholes are covered with split vitrified-clay tile cemented in. Entirely separate duct lines, either on different streets or on opposite sides of the same street, are provided so as to divide the energy along different routes when possible, so that all important substations have at least two lines, each of which follows a different conduit route.

Semi-annual potential tests were made at the beginning but were discontinued

[1] A paper presented at the 230th meeting of the American Institute of Electrical Engineers, New York, October 9. Abridged.

[1] Burch, A. I. E. E. Trans. 1903, page 433.

when the system became more extensive. The danger and liability of accident from these frequent high-potential tests were thought to more than offset the doubtful advantages derived. Since then testing has been limited to new, altered or repaired cable which, before being put into service, is subjected to a test of double working voltage for one minute.

The record of cable trouble for the last five and one-half years' operation shows that failure of cables thus far has really not been a very serious matter. The line-protecting devices are now so perfected that a cable burn-out causes little disturbance. Of the total of forty-four cases recorded only four seriously disturbed the system, and each one of these was aggravated by faults in the protective relays.

On the 20,000-volt line in Chicago, which has now been in service about fifteen months and which was an initial installation at this higher pressure, there have thus far been a total of four burnouts, one of which was due to a mechanical injury, one to moisture in a poorly made joint, and two were in the cable itself.

It will be seen, therefore, that the experience with high-potential cable has not been such as to cause alarm. The most frequent sources of trouble are from without, and of these electrolysis is apparently the most persistent. However, with rapidly growing systems the destructive effect and danger of breakdowns tend constantly to increase, and it becomes advisable to forego complacency for a while and to look into the system with inquisitive eyes to see just what is going on.

It was this desire to know more about possible dangerous potential rises so that proper safeguards against them could be provided, if found necessary, that led the Commonwealth Edison Company to undertake a series of spark-gap and oscillograph investigations, the principal results of which thus far obtained are described in this paper. A further purpose of the tests was to obtain information regarding these high-voltage systems for use in their further development. The investment required for such 20,000-volt and higher transmission-cable system is very large; it, therefore, becomes all the more imperative to know that such investment is a safe one commercially.

About a year ago a series of oscillograph tests was started on the 9,000-volt system to determine whether or not resonance existed in any part of it, or if dangerous potential rises occurred from any other cause. The oscillograms obtained were taken at the Fisk street station and included current and pressure waves for all principal switching operations, as well as several for a special cable connection in which resonance was sought. None of the records showed any appreciable excess voltage.

These investigations were later continued and expanded but no dangerous rises were found. Spark-gaps were installed at four different points of the system and their record carefully kept. The gaps consisted of needle points in series with which are resistance and fuse. They were connected between each phase and ground. These spark-gaps showed that there are frequent rises of about seventy per cent and occasionally ones of about 100 per cent which apparently have no connection whatever with any switching. These occurred at the station and also in remote substations. At times of cable breakdown, one or more of the spark-gaps invariably discharged at double potential.[1] With grounded systems cables break down first between a phase conductor and ground. When the protective devices fail to act properly, as they did occasionally before recent improvements were made,[2] the arc continues until it is communicated to one or both of the other phases. The effect on the system is then far more severe. Such occurrences were, however, the exception rather than the rule. When, during a breakdown, one or two of the spark-gaps discharge it is on the phase or phases other than the one on which the burn-out occurs. Sometimes all three of the gaps discharge during cable trouble, but not simultaneously. It is quite probable that the potential rises evidenced by these discharges are due to magnetic effect in the generators as much as to surges in the cables. There was only one case of cable breakdown which seemed clearly the result of a surge. During some arrangements which were being made at the Fisk street station to put a potential test on a bus-bar, one of the test leads accidentally came in contact with a live switch stud, the door over which had been opened. This grounded one phase of the system through fifty feet of heavily insulated No. 12 wire in series with the high-tension coil of a dead 150-kilowatt testing transformer. The heavy insulation was punctured in a number of places and the entire fifty feet of test conductor was vaporized. No other damage was done in the station. A few seconds later one of the cables burned out at a point about one mile from the station.

The net result of this investigation indicates that at the present time the 9,000-volt system is reasonably free from dangerous conditions as far as destructive potential rises are concerned. It also indicates the advisability of continuing to make tests on newly installed or repaired cable at double potential for one minute.

Attention was then turned to the new 20,000-volt line in the attempt to learn what difficulties are to be met with there. On the diagram of this line in Fig. 1 are shown the locations at which current and pressure connections were made for the oscillograph. The numerals on the oscillograph refer to the corresponding ones of Fig. 1. Spark-gaps were connected to ground at points marked s.g. These spark-gaps were first installed in the Evanston substation at the end of the line and originally set at 1.1 inch, corresponding to 21,700 volts. During fifteen days A phase discharged eight times, B phase five times, and C phase six times. Five times during this period two gaps discharged at the same time (four on B and C and one on A and B). All other discharges were on one phase at a time. On only one day were there more than one discharge per phase, and on that day B and C phase gaps discharged together twice, the interval between the discharges being eighteen minutes. With the exception of a single discharge on A phase, none of the discharges could be connected with any switching or other apparent source of disturbance. In this single case a heavy lightning storm passed over the overhead transmission line which is fed through transformers from the 20,000-volt line. It seems probable that a static charge passed from the line into the transformer and caused the rise which discharged on the A phase gap. Fourteen days' experience with a gap of 1.15 inch (22,500 volts) showed seven discharges on A phase, six on B, and five on C. The only coincident disturbances were as follows: one discharge on A phase when a steam-driven generator at the Highwood station was "synchronized"; B and C phases discharged together when a steam-driven unit in parallel with generator or frequency changer in Evanston governed poorly causing heavy cross-currents; one discharge on A phase when a steam-driven unit was disconnected at Highwood, and one discharge on B phase when steam-driven unit was shut down in Evanston. With the setting increased to 1.2 inches

[1] Double potential when units with no neutral resistance were grounded and about 130 per cent over potential when neutral was grounded through resistance (R = 2.6 ohms).

[2] June paper A. I. E. E., Chicago, R. F. Schuchardt.

(23,300 volts) there were only five discharges recorded in four months, one on A phase, two on B phase alone, and one on B and C phases together. The simultaneous discharge on B and C phases occurred during a burn-out of the line, probably a breakdown of A phase to ground. One of the B phase discharges took place when a connection between the 9,000-volt coils of the C phase transformer at Division street burned out. A further increase in gap setting was made to 1.25 inches and left for six weeks, during which time A phase discharged when the line broke down. B phase also discharged, but the connection with a disturbance could not be learned. A final increase to 1.3 inches was made. This corresponds to 25,000 volts. During three months there was one discharge on A phase and two on C phase, but here again no cause for the potential rises could be ascertained. Spark-gaps were also installed at the step-up end of the 20,000-volt line in the West Division street substation during a test at that point. They were set at 1.1 inches and during the few hours that they were connected each of the phases discharged heavily at different times. Recently spark-gaps were installed at the Calvary substation. They are set at 1.1 inches and each phase has discharged heavily at times.

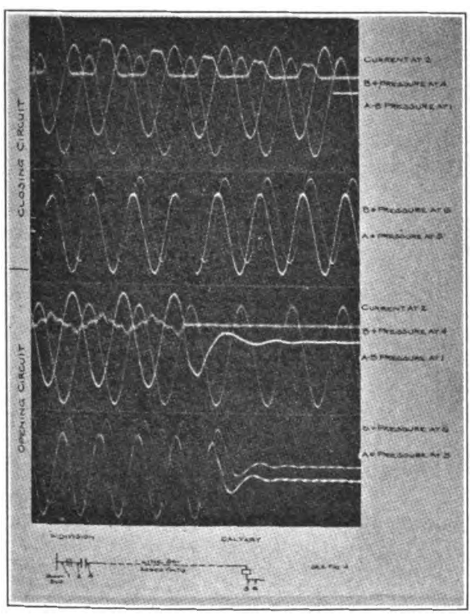


Fig. 2.—Closing and Opening Line No. 501.

An attempt was made with the oscillograph to determine the relation between the potential rises and operating conditions. The oscillograph was connected at various times at the three switching points of the line and some records were obtained for switching operations. Unfortunately the time during which the line could be kept out of service for these investigations was so limited that only a few records could be obtained for each operation. It is recognized that in such a limited number (and especially where, as in most cases, only one phase pressure could be recorded) many disturbances may have escaped detection. However, many of the curves are of considerable interest and may serve to bring out more discussion. A number of them are, therefore, included in this paper. It will be noted that none of the oscillograms shows potential rises as high as those recorded by the spark-gaps. Had more oscillograms been taken, or had all phase pressures been recorded simultaneously, higher rises might possibly have been observed. However, the function of the spark-gap is clearly to detect high potentials, while that of the oscillograph is to show the character of the disturbance and its duration. The spark-gap watches the line continuously while the oscillograph records occurrences for but very brief intervals.

In these figures the source of energy is always from the left, the opening or closing operation being performed on switch marked S. There being but one oscillograph and no pressure wires available, the records at the different substations were not taken simultaneously. The apparatus was set up at one place and curves were obtained for the various operations. The apparatus was then moved to the next substation and the operations were repeated.

Fig. 2 is for closing and opening line No. 501. The current wave in the upper curve is the characteristic exciting current wave of a transformer when first energized. The logarithmic curve due to hysteresis is clearly shown. The dying of the pressures in comparatively slow oscillations when the line and transformers are disconnected is shown in the lower curves.

The curves in Fig. 3 are for closing and opening the entire eleven miles of 20,000-volt line from Division street to Evanston.

Fig. 4 shows curves for closing dead transformers on to a live bus-bar. The first rush of current in this case was nearly six times full-load current. An interesting curve is the one for West Division street showing the duration and amount of the current rush. The curve obtained on opening the switch to the transformers is also given.

The motor of the frequency-changer set at Evanston is wound for 9,000 volts, the line pressure being stepped down in three 200-kilowatt transformers. In Fig. 5 are shown curves obtained when closing these transformers to a live bus-bar. In the upper curve the transformers had previously been demagnetized by keeping them connected to the motor while being shut down until it had come to rest, the fields being kept excited. In the lower curve they had been disconnected at full pressure. The difference in current rush emphasizes the advisability of keeping the transformers connected to a dying machine when shutting down. This applies

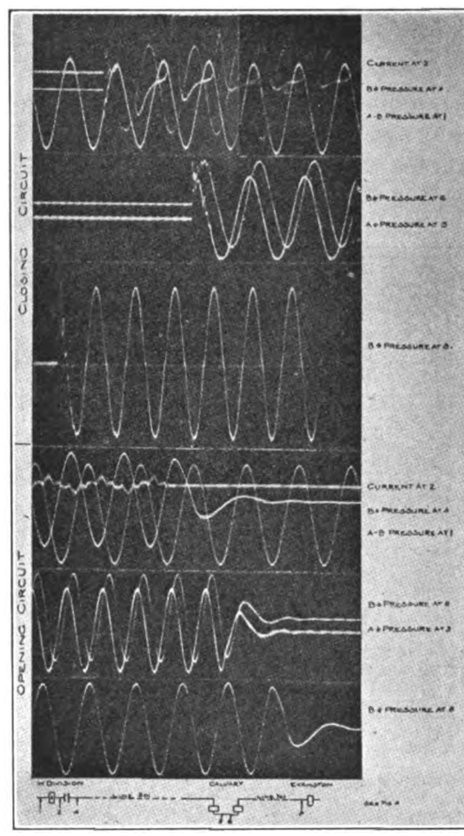


Fig. 3.—Closing and Opening the Entire Eleven Miles of 20,000-Volt Line.

also to transformers of synchronous converter sets.

The curves for starting the frequency-changer set from these transformers show no potential disturbance.

At the Evanston substation there are three 200-watt potential transformers connected in star with their neutral grounded on both primary and secondary. It will be remembered that the 20,000-volt line is grounded solid at the Division street transformers but at no other point. The oscillograph was placed in the neutral connection to ground of the Evanston potential transformers' primary and a current of seventy-six milliamperes was obtained, this amount remaining unchanged even when a resistance of 10,000 ohms was placed in series with the ground connection. The impedances of the three transformers have not been measured but their load is not balanced. In Fig. 6 this current wave is shown taken simultaneously with pressure. The wave for phase-to-phase pressure shows an unstable condition.

From the spark-gaps on the 20,000-volt line we learn then that pressure-rises in excess of 100 per cent occur occasionally. The oscillograms thus far obtained give no clear evidence of the cause, but the cable broke down three times in fifteen months—two of these times in the cable itself, either as a result of these rises or of weakness developed by mechanical stresses imposed upon the cable at the time of installation. This record is reasonably satisfactory, as during the first year's operation we must expect to eliminate the weakest points. The second 20,000-volt line which will complete this

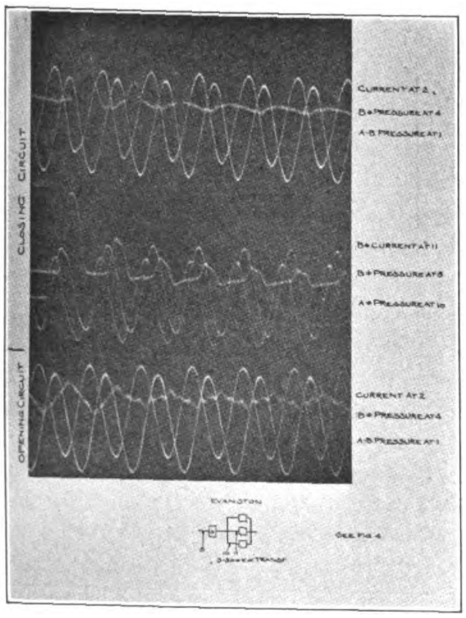


FIG. 4.—CLOSING DEAD TRANSFORMERS ON TO A LIVE BUS BAR.

northern ring is being installed at the present time. After it is put in service the investigation will be repeated. The spark-gaps are kept in service continuously. If dangerous potential rises still exist the remedy will be applied which, in the form of the aluminum arrester, is fortunately at hand. It is, therefore, quite prudent to state that 20,000 volts is a safe pressure for an underground system. Whether a higher voltage will be possible is a matter which has received and is receiving considerable attention.

SUMMARY.

From the viewpoint of the investor or operator the state of the art regarding high-tension underground transmission might be summarized as follows:

1. Underground cable systems of 11,000 volts and under, if properly made, installed and operated, will give at least equally and probably more reliable service than most of the other elements in the electric power system of which the cable system is a part.

2. Where local and commercial conditions justify, pressures as high as 25,000 volts can be satisfactorily used even for systems aggregating as much as a hundred miles of cable. No single line of such a system would be much longer than twenty miles. If higher voltages are needed to meet operating requirements, and can be justified commercially, special construction will be necessary to overcome limitations in paper, rubber or varnished cambric insulation, and also in the standard forms of underground conduit or subways used in this country.

3. On comparatively short lengths, underground or under water, as a part of a long overhead transmission line, cables operating at 40,000 volts can be used.

4. Potential rises of fifty per cent and 100 per cent are not uncommon in large underground cable systems, although this fact may not always be manifest, due to high factor of safety.

5. Definite knowledge of what actually occurs in large high-potential underground systems is still meager, especially regarding intensity and frequency of surges, heating effects and critical temperature for various kinds and thicknesses of insulation, corona effects and similar matters.

In conclusion we would urge all companies having high-potential cable systems to keep a complete and systematic record of all troubles. To quote Dr. Steinmetz:

"To determine the origin and cause of high-voltage disturbances, so as to be able to guard against their recurrence, the most important thing seems to be to very carefully observe and record all the details of the phenomena, even those which appear unessential. The existence of static on switchboards, lines, etc., and the existence of voltages and currents different from those which may be expected, require special attention. Either of these is sufficient to raise the suspicion of some dangerous fault in the system or some dangerous arrangement of apparatus, which requires consideration. . . . The severity of the phenomena depends almost entirely upon the power momentarily available in the system and

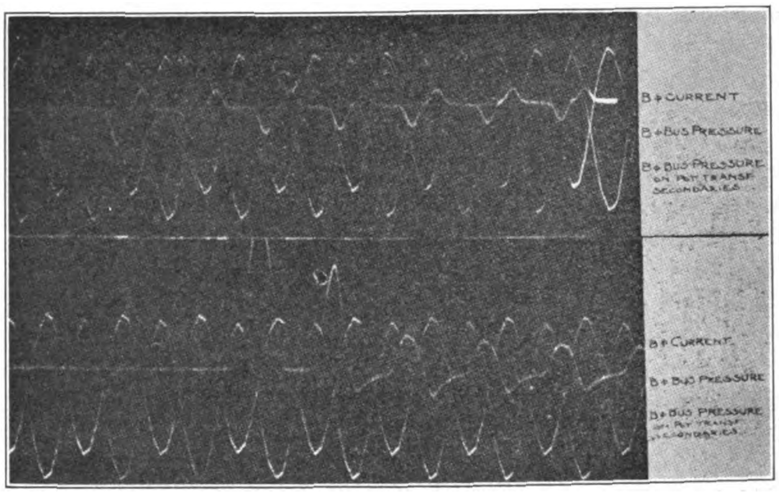


FIG. 5.—CURVES OBTAINED WHEN CLOSING 200-KILOWATT TRANSFORMERS ON TO LIVE BUS-BAR.

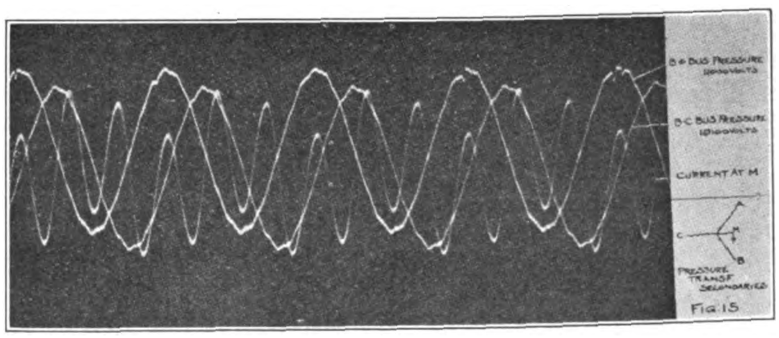


FIG. 6.—CURRENT WAVE TAKEN SIMULTANEOUSLY WITH PRESSURE.

very rapidly increases with the size of the generating stations. With the increasing power and extension of electric systems we must expect to see these disturbances increase in destructiveness. The prospect which this holds out for the future is not very agreeable; it shows, however, the increasing importance for the operating engineer to study and become familiar with the subject so as to be able to cope with the problems which are before him, which perhaps are the most serious in the field of electrical engineering. . . . It would, therefore, be a great help if a far closer interchange of experience existed between different operating engineers."

May we not urge on all engineers to remember these words and to appreciate how, by following Dr. Steinmetz's bidding, we all can help to advance the art?

ADDENDUM.

Spark-Gaps—In using spark-gaps as a means for measuring potentials, certain precautions must be taken to insure reliable results. This fact is, of course, well known. The spark-gaps mentioned in the paper were made up on the usual insulated standard and provided with ordinary No. 5 sewing needles. The series resistance consisted of carbon rods of an amount to limit the current to about one-half ampere at normal pressure. In order to get the correct interpretation for the various settings, the conditions of humidity and temperature of the places where the spark-gaps were installed were duplicated in the laboratory and the gaps were repeatedly calibrated from 0.4 to 1.3-inch gap. Within this range they were found to agree to within about two per cent of the Institute standardization rules. It is safe to assume then that the indications recorded in the paper are correct within five per cent, which is well within the accuracy required for this work.

Where the spark-gaps are in continuous service, to detect occasional high rises it is necessary either to renew the needles daily or to brush the points frequently to avoid an accumulation of dust which would alter the effective gap distances. Any tight enclosure around the gap to prevent this accumulation would introduce errors due to the ionization of the enclosed air. During a discharge the needle points burn to a bead, the size of this bead being an index of the severity of the discharge, and thus roughly of the intensity of the disturbance at that point. A recording meter is placed in series with the gaps to record the time of the discharge.

Oscillograph—The development of a successful portable oscillograph marked an important step in the development of cable systems. It afforded a means for studying the system analytically, so that causes for possible unstable conditions could be determined and guarded against. In the particular application of detecting voltage rises of short duration its usefulness, while still very great, is more limited. The time-interval, already mentioned in the paper, introduces an external limitation. The limitations of the apparatus itself are principally as follows:

1. The free periodicity of the vibrators is less than that of some occasional waves of very short length. In the oscillograph used in the test the vibrators were adjusted for their highest free periodicity, about 6,000 cycles per second. Any peak having a periodicity higher than this would not be correctly recorded. However, a peak of such extremely short duration would have too little energy to cause a harmful disturbance and would thus be of little interest.

2. The vibrator can not be made absolutely dead-beat, but fair results are obtained with five parts of castor oil and one part of turpentine as the damping medium.

3. The self-induction of the vibrator circuit is not entirely *nil*, but is sufficiently low to be practically negligible.

4. The sensitiveness of apparatus can not be made perfect, and its degree of perfection in this regard determines the degree of accuracy of its indications. The amperes per millimetre of deflection of the three vibrators used is from 0.00518 to 0.00578.

While in these four important qualities the oscillograph does not attain the ideal, yet for all practical purposes the apparatus is quite satisfactory. The limited time-interval of application is the most serious shortcoming, and probably the cause for the absence of double-potential peaks on the curves. A great number of oscillograms could be taken, and yet none of them happens to coincide in time with a high peak. This was actually the case in the tests made, during which there was never a spark-gap discharge simultaneous with the taking of an oscillogram.

Reports to the recent meeting in Chicago of the Western division of the American Association of Railway Telegraph Superintendents indicate that within the last two years over 6,000 miles of railroad have been placed under telephone operation.

THE ELECTRICAL FEATURES OF THE GARY (IND.) PLANT OF THE INDIANA STEEL COMPANY.

BY C. A. TUPPER.

The Indiana Steel Company has secured a site of 9,000 acres, with a lake frontage of one and three-quarter miles, on which to erect its steel mills and a residence city for its employés, twenty-three miles east of Chicago, at a point in northern Indiana where the Grand Calumet flows into Lake Michigan. This is the town of Gary, Ind., the like of which exists nowhere else in the world.

The unique and, to engineers, the inspiring feature of this great steel works is the utilization of the entire production of gas from the blast furnaces for useful service in operating blowing engines and in furnishing the source of power for gas engines driving alternating and direct-current dynamos, generating current for light and power.

Eight blast furnaces have thus far been erected, and there are two blowing-engine houses of similar construction to the power-house which contains the electrical machinery. One of the blowing-engine houses is 600 feet long and 104 feet wide. The other is of the same width, but only 530 feet long. The first-named house includes a central pumping and hydraulic power plant equipped mainly by the Snow Steam Pump Works, of Buffalo, N. Y. Besides gas engines, each house contains two steam-driven Tod blowers, but when the plant is in full operation these will not be used. The initial equipment of the plant calls for sixteen blast furnaces. These will produce about 44,900,000 cubic feet of gas per twenty-four hours, equivalent, when used in gas engines, to 500,000 brake-horse-power. Of this quantity approximately thirty per cent is taken for heating the stoves, seven and one-half per cent is diverted to steam-boiler furnaces, five per cent is consumed by various auxiliaries or lost in the process of cleansing, twelve and one-half per cent operates the gas-engine-driven blowers and forty-five per cent supplies the electrical power station.

Each of the sixteen blowing engines consists of a horizontal twin-tandem gas engine of 2,500 horse-power. Eight of the engines were built by the Westinghouse Machine Company and eight by the Allis-Chalmers Company. The power station is 966 feet long and 105 feet wide, with forty-two twenty-three-foot bays. It is located adjacent to the blowing-engine houses and between the blast and open-hearth furnaces. In this station there are installed seventeen horizontal twin-tandem double-acting gas engines running at eighty-three and one-third revolutions per minute. Fifteen of these engines are designed for coupling to alternating-current generators, and two will be connected to direct-current generators. The alternating-current machines are for twenty-five cycles, three-phase, 6,600 volts. The direct-current machines operate at 250 volts. The seventeen generators were built by the Allis-Chalmers Company.

The alternating-current generators are of a type developed by the Allis-Chalmers Company for use with these engines. The laminated stator core is held in a heavy box yoke designed to allow full circulation of air around all parts. The core punchings are held in place by means of dovetails and the armature windings are placed in open slots in the inner periphery of the stator core. The coils are held firmly in place by wedges and, on account of the open-slot construction, can be readily replaced in case of damage. The field poles are mounted on a cast-iron spider and so arranged that they can be removed; the exciting coils are of copper strip wound on edge.

The revolving fields are special in construction, with field poles of solid cast steel bolted to a heavy cast-iron spider; they can, therefore, be readily removed in case it is necessary to get at a field coil. The field-windings are held in place partly by the projecting pole tips and partly by brass rings running completely around the rotor on each side and fastened to the top of the poles by long brass screws. The construction, combined with the solid poles, gives a large damping effect, prevents hunting and aids in securing parallel operation.

The direct-current generators have also been designed with particular regard to this service, but in general are similar to the Allis-Chalmers Company's standard engine-type machines.

In connection with the generators the Allis-Chalmers Company has furnished Cutler-Hammer remote-control field rheostats and field switches. The controlling apparatus is located in the basement as near as possible to the generators and is operated from the bench board located in the power-house gallery. These rheostats are of a unique design, being what the manufacturers call the "cross-head" type. They are driven by means of vertical motors and are provided with automatic devices which insure the stopping of the motor at either limit of the "cross-head" travel, that is to say, either when all resistance has been cut in or out of circuit. Means are provided, also, for operating these field rheostats by hand in case of damage to the motor.

The power generated will be distributed throughout the works and used to operate the heavy induction-motor-driven rolls, the tilting and feed tables for the various passes, the hot saws, hot and cold pull-ups, hot rolls, transfer tables, straightening and drilling machines, cold saws, elevators, conveyers, pumps and a multitude of machines and mechanical devices auxiliary to the operation of such an enormous plant. Several of the motors built by the General Electric Company for these works are of 6,000 horse-power each, being designed for driving the rolls, and from this they range in size down to machines of the smallest capacity used to operate switches in the power-house.

The problems of control presented by the multitude of motors installed at this plant involve many interesting features, the solution of which was largely intrusted to the engineers of the Cutler-Hammer Manufacturing Company, of Milwaukee, and the automatic devices now installed at Gary represent the most recent developments in electric control as applied to steel-mill machinery.

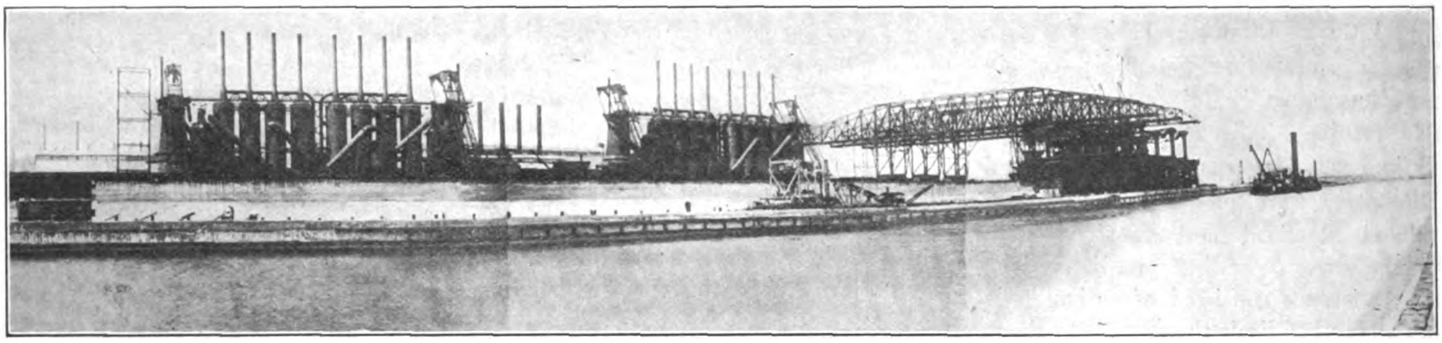
The electrical system as a whole is subject to central control at a switchboard operated from a gallery sixteen feet high. This switchboard, which was designed by the Western Electric Company, has the usual complement of instruments of standard types, and a detailed description would involve more space than can be given to the subject here.

To aid in securing maximum economy under heavy fluctuations of load, by utilizing the full value of the generating power of the gas, without regard to the amount of current required at any given time for the operation of the mills, a storage-battery installation furnished by the Electric Storage Battery Company has been housed in a two-story building, eighty-seven feet long by forty-seven feet wide, located near the power station. The batteries will be kept charged as nearly as possible to their full capacity in order to assist in meeting, for a considerable period of time if need be, any demands for excessive power made upon the gas-engine-driven generators. These can, in themselves, be heavily overloaded, but the best power-factor is, of course, to be secured at about their rated capacity. The battery also aids in maintaining, at light loads, a constant pull on the generating equipment.

The subfoundation of the power station, as well as of each blower-house, is a solid mass of concrete underlying the entire structure on the level of Lake Michigan, and having a depth of five feet. Above this are separate foundations for each of the generating and blowing units.

The arches forming the roof of the power station have a clear span of eighty-five feet, providing headroom, at the dome, of seventy-three feet above floor level. The station is served by two fifty-ton cranes. Roofing is heavy galvanized corrugated steel. The interior walls for a distance of ten feet are of white enamel brick, but above that point the surfacing is in red pressed brick. The exterior consists of red building brick.

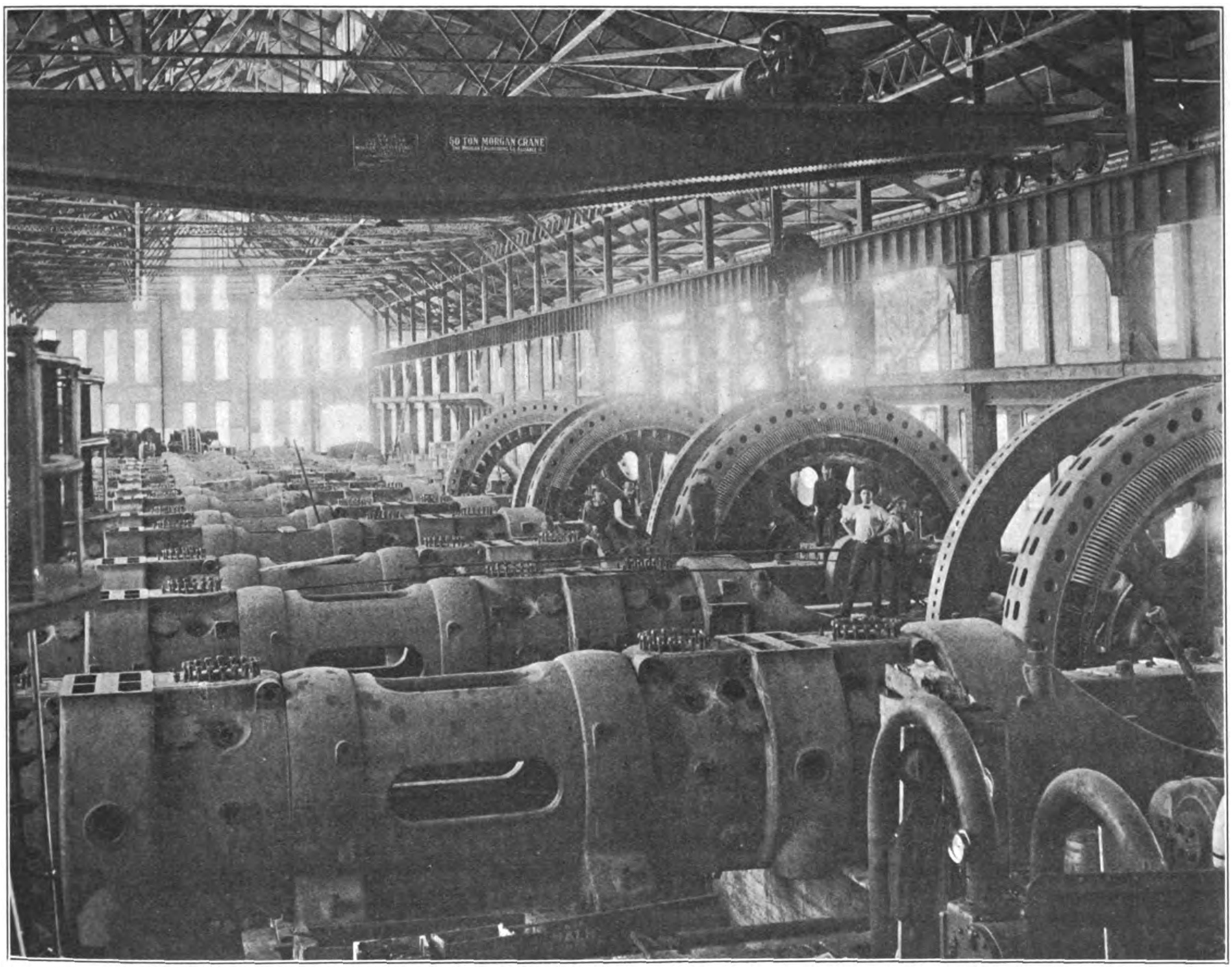
The plans of the plant provide for six batteries of basic open-hearth furnaces,



VIEW OF BLAST FURNACES FROM WATER-FRONT, INDIANA STEEL COMPANY'S PLANT, GARY, IND.

fourteen to the building, of which two batteries, or twenty-eight furnaces, are at present constructed.

With the four open-hearth buildings, now completed or under construction, in operation the Gary plant will have a capacity of over 12,000 tons of steel per day, or 2,000,000 tons per year. With all six buildings in use, the total capacity of the plant, as planned by the United States Steel Corporation, will be upward of 4,000,000 tons per year.



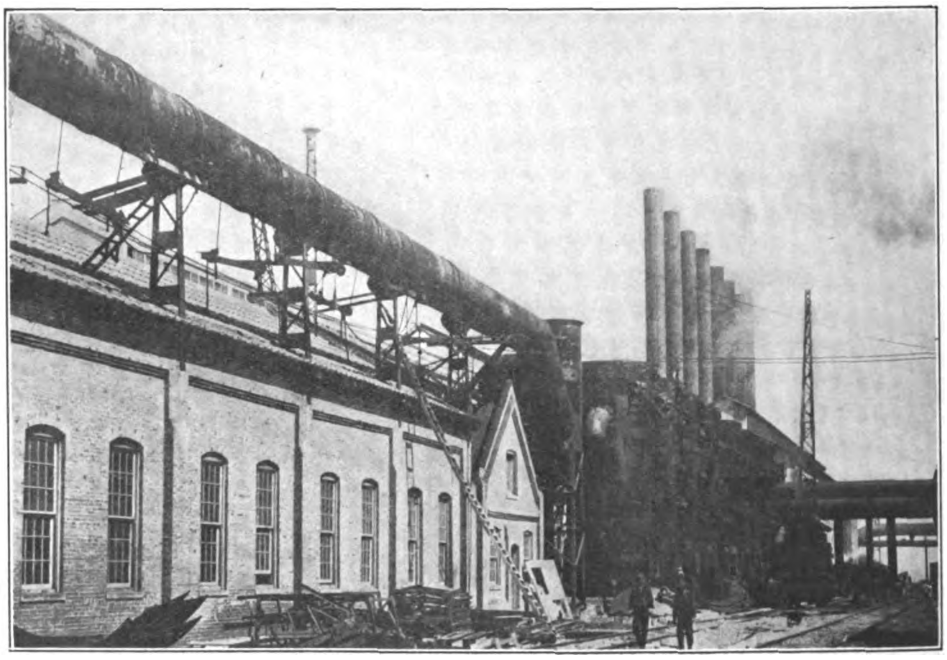
View in Central Station, Indiana Steel Company's Plant, Gary, Ind., Showing Gas Engines and Generators in Course of Erection.

With everything running at top notch 4,000 tons of steel rails can be produced daily; and in normal operation the mill is expected to turn out 100,000 tons per month.

The group of rail-mill buildings, located about 300 yards from the lines of the open-hearth furnaces, constitutes in itself an enormous plant. The main structure is 1,800 feet long, and at right angles to it is another building of one-third the length, with a width in a single span of eighty-five feet. This contains twelve soaking pits or furnaces, each of which is supplied with gas from an independent Hughes mechanical gas producer. The arrangement here is such that ingots enter from the open-hearth furnace buildings along the entire length of one side of the pit building, the other side being reserved for the electrically operated ingot buggies which transfer the heated ingots through the first stand of rolls. Each of the twelve pits has four holes, six feet by six feet, and is provided with the usual equipment of hydraulic cylinder covers and reversing air and gas valves of the well-known Dyblie type. The ingots used are twenty inches by twenty-four inches and six feet long, weighing 8,500 pounds each. For the operation of the two ingot buggies used, Cutler-Hammer Manufacturing Company, of Milwaukee, has developed an ingenious system of control. On account of the length of the building in which the soaking pits are located, it is impossible for the operator stationed at the mill to see when an ingot buggy is opposite a particular pit. It was, moreover, deemed necessary to guard against the possibility of the operator becoming confused and bringing both ingot buggies to the mill at the same time, which would result in a collision. The special controlling system provides guards against this contingency, at the same time enabling the operator to automatically stop the ingot buggy at any of the pits. There are two master levers for the control of the two buggies. Each of these levers can be set in any of eight positions, one corresponding to the rail mill itself, six to the six soaking pits which each buggy serves, and one "off" position. If, when one of the ingot buggies is at the mill, the operator desires it to go to pit No. 5, let us say, and there stop, he merely moves the controlling lever to the position corresponding to pit No. 5, and the buggy proceeds to that point and is there automatically stopped. A suitable interlock between the two controlling levers is provided which renders it impossible for the operator to throw both levers to the mill position at the same time, thus insuring a clear track for each buggy.

The rail mill is equipped with twelve sets or stands of roll trains, all operated at varying speeds by General Electric alternating-current motors, some of which are of the largest sizes ever constructed for industrial service. These are housed in a separate bay or "leanto" running parallel with the rolls. The rotors are twenty feet in diameter and have a speed of eighty-three revolutions per minute. All of the motors are connected directly to the roll trains by regular mill couplings. The aggregate driving capacity is 24,000 horse-power. Although the motors are provided with flywheels and operate in one direction, provision is made for reversing in case of necessity. The control system has been worked out with the greatest nicety, all operations being under the instant control of the operator by means of a master controller.

The first group of rolls consists of four stands of continuous forty-inch mills, each two of which are driven by a 2,000-horse-power motor. They are arranged in tandem, requiring no manipulation from stand to stand. Here, as elsewhere through the plant, sufficient distance is left between successive sets of rolls to enable a quarter turn of the ingot or bloom to be made, so that it is worked equally on all sides. The first two mills are at present equipped with forty-two-inch rolls, enabling twenty-inch by twenty-four-inch ingots to be used. After passing these four mills the ingot is sent to a forty-inch three-high blooming mill equipped with lifting tables and arranged with a combined hydraulic and pneumatic balancing device. This mill, which is operated by a 6,000-horse-power motor, gives the ingot five passes. After being bloomed the ingot is sheared in a ten-by-ten-inch horizontal blooming shear, and the crop ends or butts are taken outside of the mill by a butt conveyer of unusual construction, which was designed and built by the engineers of the Indiana Steel Company. Each bloom then goes through a twenty-eight-inch roughing mill, which is three-high and equipped with tilting tables. This mill has actually three stands of rolls. The roughing stand, however, is the only one that is three-high, the other two stands being two-high. The mill is driven by a 6,000-horse-power motor and gives the bloom three passes. After leaving the roughing mill the bloom goes through a two-high twenty-eight-inch forming mill driven by a 2,000-horse-power motor, receiving but one pass. Then it is sent to finishing mills, which consist of five stands of twenty-eight-inch mills driven by two 6,000-horse-power motors. After the dummy pass the bloom is transferred to the first edging, which is in this same mill but the second stand, and turns back on an elevated table to the second edging, which is in line with the twenty-eight-inch roughing mill. It then travels by chain transfer to the lower tables, and on the leading pass goes through a stand which is also in line with the roughing mill and driven by the same motor and continues on to the third stand of the twenty-eight-inch finishing mill, this being the eighteenth and last pass. After the finishing pass the rail travels through to the saws, of which there are five provided, thus cutting four rails to length. These four rail lengths consist of half the ingot. As the capacity of this dinarily large air space to facilitate the rapid cooling of the rails. The finishing building is 1,383 feet long, central with the hot beds, and provided with live rolls extending the entire length. The roller tables are equipped with stops and kick-offs to transfer the rails to the straightening presses, of which there are sixteen, built by the Hilles & Jones Company, of Wilmington, Del., these being of the usual type and motor-driven. From the straighteners the rails are transferred by the usual skids to three-spindle vertical drill presses furnished by William Sellers & Company, of Philadelphia, which are also motor-driven. These complete the rails for use. From the drill presses the rails are transferred to a roller table, which extends the full length of the building, and from which the rails may be skidded to the loading beds immediately outside of the building.



SECONDARY WASHERS OF GAS-CLEANSING SYSTEM, SHOWING BOILER HOUSE AT EXTREME RIGHT, INDIANA STEEL COMPANY'S PLANT, GARY, IND.

mill is 4,000 gross tons per twenty-four hours it will be seen that there must be a four-rail length sawed about every half minute. The saws are forty-two-inch blades, arranged to be raised and lowered in unison by one controller from the hot-saw operator. After leaving the hot-saw run the rolls pass over the usual cambering machine and are run onto hot beds, 100 feet long, of which four are at present installed, with provision made for an additional two, if necessary. These hot beds extend to the south of the mill proper. In the finishing-mill section they are of unusual design, being made of structural material and placed eight feet above the floor, allowing for an extraor-

The principal machinery was built and installed by the United Engineering and Foundry Company, with the exception of the finishing department, which was erected by the Morgan Engineering Company. For the lifting tables and transfers Westinghouse motors are used.

In the rail mill a number of Cutler-Hammer automatic remote-control devices are installed, the most interesting of which are those designed for the control of the elevating and tilting tables, the bloom shear and the transfer. The elevating table on the forty-eight-inch blooming mill, weighing about 250,000 pounds, is supported on huge bell-cranks which are connected to a rotating crank driven by a 250-horse-power motor operating at 150 revolutions per minute. By means of automatic controlling devices the throwing of a master lever starts the table from the low-level position and raises it to the highest level, where it is automatically stopped. In lifting the table from the low to the high level, the rotating crank moves through an arc of 180 degrees and, on throwing the master lever to the reverse position, the crank revolves another 180 degrees in the same direction, bringing the table to the low level once more. The operation of raising or lowering the table can be accomplished in a period of two seconds, which is quite remarkable when the masses to be accelerated, slowed down and stopped are considered. Its arrangement is similar to that of the elevating table, one end being pivoted and the other end supported on a bell crank. The tilting table is driven by a 150-horse-power motor controlled by a controller similar to that designed for the elevating table. The bloom shear is operated by means of a seventy-five-horse-power induction motor and the pin on the clutch by a direct-current auxiliary motor of five horse-power. The circuit of this motor is interlocked with the controlling device for the seventy-five-horse-power alternating-current motor so that the former can not be put in motion except when the latter is running at full speed. The latch is operated by a crank to which the five-horse-power motor is geared. Pressure on a push-button under control of the operator causes the motor to run long enough to revolve the crank 360 degrees, thereby releasing the clutch and returning the pin to the initial or "off" position.

Automatic controllers installed in connection with motors on the transfers make it possible for the operator to transfer the rail from one table to another by a simple throw of the lever, the motor being automatically stopped after the transfer has been completed.

For the operation of cranes, tables and other apparatus, in and about the rail mill requiring direct current, two 500-kilowatt synchronous motors driving direct-current generators have been furnished by the General Electric Company. This equipment, with the necessary switchboards, is located in one of the motor houses at the rail mill and designated "Substation No. 1." Other substations suitably equipped are being located in other sections of the plant.

The billet mill consists of four continuous stands of forty-inch blooming mills, each two of which are driven by a 2,000-horse-power motor. After leaving these the ingot is turned end for end on a turntable and passes through a five-stand thirty-two-inch continuous mill, the entire mechanism of which is driven by one 6,000-horse-power motor. At the end of this mill is placed a twelve-inch by twelve-inch horizontal blooming shear and also a ten-inch by ten-inch vertical blooming shear, from either of which shears either sale blooms or blooms for the twenty-four-inch mill immediately following may be sheared. The sale blooms are run out on hot beds on the other side of the building where there is a loading yard equipped with overhead traveling cranes. Blooms intended to be further reduced after being sheared are sent through the twenty-four-inch continuous mill, which consists of six stands driven by a 6,000-horse-power motor, reducing the blooms to four or five inches square. At the end of the twenty-four-inch mill is placed a roller table. The billets may be transferred to an eighteen-inch continuous mill to be further reduced or, if for sale, to a shear and from thence to overhead billet pockets from which they may be loaded directly into cars.

For the further reduction of billets taken from the above-mentioned transfer skids the billets are run through an eighteen-inch six-stand continuous mill, driven by a 6,000-horse-power motor and equipped with flying shears.

All of the machinery is electrically driven, General Electric, Crocker-Wheeler and Westinghouse motors being used. This machinery was also furnished by the United Engineering and Foundry Company.

The additional mills to be built are a sixty-inch universal plate mill, which will be the largest of its kind in the world, and a forty-four-inch by 160-inch sheared-plate mill. These two mills will each be served by a thirty-two-inch slabbing mill. Further extensions to the Gary works include an axle mill, structural mill and eighteen-inch, fourteen-inch, ten-inch and eight-inch merchant mills.

The plant for handling ore from the vessels consists of Hulett unloaders and Hoover & Mason bridges of sufficient capacity to furnish material for the eight blast furnaces already built, each of which will deliver 500 tons of pig-iron daily, and for the eight additional furnaces yet to be constructed.

The ore bins and auxiliary apparatus were constructed by the Brown Hoisting Machinery Company, of Cleveland, Ohio, except the electric hoists operating the skids to the blast furnace tops, which are of the Otis Elevator Company's standard design for this service.

In connection with the furnaces and mills of the steel plant proper there have been erected a group of buildings of general utility, consisting of a machine shop, foundry, boiler shop, blacksmith shop, pattern and carpenter shop, pattern storage building, roll shop, electrical repair shop, brick storage house and a very well-equipped general store house. There has also been provided a yard-locomotive house, which is rectangular in shape, with tracks running through on an angle from one side to another, thus avoiding the use of a turn-table.

With all of the power economies which the plant of the Indiana Steel Company possesses, ridding it of gas and smoke, Gary will be one of the few examples of a clean city located near iron and steel works, and every effort is being exerted to make it a model town of its class. The steel company, through its real estate department, the Gary Land Company, has already built about 500 houses of various types and sizes. At present Gary has about 8,000 residents, and it is an incorporated city.

In addition to seven steam roads, most of which are trunk lines, there is a street and interurban electric railway running east and west and north and south through the town, connecting it with the various manufacturing centres located along the southern shore of Lake Michigan, as well as with lines running directly into Chicago.

In practically all respects Gary will be quite different from other communities built under somewhat similar conditions. There will, as a recent writer has said, "be a marked absence of the hovels, dirt and squalor so pronounced a feature of most manufacturing cities." It is to be a clean city, free from smoke and soot, principally because a great corporation has learned how to conserve the appalling misuse of fuel from which these evils spring; and, with the magnificent start which has been given the community, both civic and individual pride will undoubtedly keep municipal affairs upon a higher plane than is common to large industrial centres. Gary stands for a long step ahead in the great economic movement toward elimination of waste, whether material, mental or moral; and its welfare is of genuine concern, not only to the Indiana Steel Company and to its inhabitants, but also to the nation at large. The officers of the Indiana Steel Company are: E. J. Buffington, president; G. C. Thorp, vice-president; T. J. Hyman, secretary and treasurer; K. K. Knapp, general counsel.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Influence of Electricity on the Growth of Plants.

Among the manifold methods for advancing the growth of plants by electricity that of Lemstroem is again attracting particular attention. The investigations of Professor Lemstroem, of the University of Helsingfors, who died two years ago, have extended over more than a lifetime. His observations of plant growth in northern regions, which is striking on account of its unusual rapidity and luxuriance, led him to the conclusion that special causes must be at work here, which partly substitute warmth, the principal factor in plant growth. He found the cause in the stronger atmospheric discharges in northern regions, of which the aurora borealis is a notable example. After some successful experiments with plants in pots, Lemstroem erected a net of wires over larger surfaces of land, which in most cases he charged positively by means of a static machine, while the negative pole was connected to the ground, and permitted a dark discharge to influence such an experimental field during the entire period of vegetation, while a control field nearby remained uninfluenced. The experiments were carried on in different latitudes, and with correct treatment always resulted either in an increase of the crop varying between eighty and 100 per cent, or a shortening of the period of ripening, or else in a marked improvement of the quality. The largest surface experimented upon by Lemstroem was 3.5 hectares (about eight acres). A remarkably small quantity of electrical energy was necessary, a one-tenth-horse-power motor being sufficient to drive the static machine. Lemstroem considered electroculture ready to play an important part in agriculture and horticulture on a large scale, for improving the quantity and quality of crops, but there were still a number of practical considerations in the way of putting the method into practice. One was the imperfect way of producing static electricity by the unreliable and inefficient static machine; another the inconvenience caused by the presence of the wire net during the cultivation of the soil. It was necessary for the technical man to perfect this part of the process. This was done three years ago by Mr. Newman, in England, who tested the method practically on a much larger scale. He succeeded in interesting Sir Oliver Lodge, who proposed the use of special mercury rectifiers patented by him for obtaining the necessary high-tension direct current from alternating current transformed to a high pressure. The tension used is 100,000 volts, but is entirely harmless on account of the extraordinarily small amperage of the current. According to a recent report of Sir Oliver Lodge the experiments have been extended during the years 1906 to 1908 to a surface of ten hectares (about twenty-five acres), and it was demonstrated that with the high tensions employed the wire net may be at a height of five metres above the ground without destroying the beneficial effect. This height will not interfere with any agricultural labors; Lemstroem was obliged to prescribe a height of not more than forty centimetres because of the ineffective apparatus employed by him. Improvements have also been made in the construction of the wire net without apparently decreasing the effect, so that the entire method now seems to be ready to be successfully put into practice.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), September 17.*

New Facts About the Quartz Lamp.

Some peculiarities of these lamps, which have been extensively adopted since their introduction in the fall of 1907, are pointed out by Oskar Bussmann. The quartz lamp is a mercury vapor lamp made of pure fused quartz. As this material can withstand extraordinarily high heat without softening, the mercury vapor arc can be brought to much higher temperatures than in glass tubes. It has been shown that the economy of the mercury arc in glass tubes increases with the rise of temperature up to a certain degree and then diminishes again; but when the fused quartz is substituted for glass and the temperature raised still higher than is practicable in glass tubes, it is found that a great increase in economy takes place before the quartz begins to soften and far exceeds that of common arc lamps. Quartz also has the advantage of being absolutely insensitive to temperature changes, as its expansion coefficient is almost equal to zero, and therefore red-hot quartz can be plunged into cold water without cracking. This property contributes greatly to the strength and life of the lamp. The burner consists of a quartz tube six centimetres to twelve centimetres long and one centimetre to one and one-half centimetres in diameter. It is arranged in a nearly horizontal position. Two small tubes are fused across the ends and contain the mercury into which the terminals are led. The real source of light is the arc passing between the mercury poles through the tube. The arc is started by bringing the mercury electrodes in contact with each other and then separating them. This is done automatically by an electromagnet which tilts the lamp when it is switched on. The quartz tube must be highly evacuated, as otherwise it is difficult to produce an arc. When the arc is started mercury is vaporized at the poles in large quantities and the vapor pressure increases according to the load. In glass tubes the pressure rises to two millimetres to three millimetres under normal conditions, but the quartz burner is strained to 760 millimetres mercury column (one atmosphere) which equals the atmospheric pressure outside, and so there is no strain on the burner during operation. The economy of the quartz lamp is the higher the greater the pressure inside of it. But it is undesirable to use pressures above one atmosphere as the quartz might crack. In glass tubes the bluish mercury vapor arc fills the entire interior uniformly. Its temperature is only 300 degrees to 400 degrees centigrade. When a quartz lamp is started the arc also fills the entire tube, but after a few minutes, as the vapor pressure rises, it recedes from the walls and contracts toward the middle of the tube, until finally it forms a band in the centre about five millimetres in diameter. At the same time the violet-blue tint of the light changes to a yellowish green and its intensity increases enormously. During the starting period the lamp absorbs only twenty-five to thirty volts, but when the pressure has increased to one atmosphere the tension is about 180 volts. The time necessary for attaining the definite vapor pressure and full light intensity naturally depends on the amount of energy supplied to the lamp. If 3.5-ampere lamps were supplied from the beginning with 3.5 amperes, they would absorb only $3.5 \times 25 =$ about ninety watts, which is not sufficient to bring the mercury to boiling temperature; therefore the initial current intensity must be as high as the operating conditions will permit, which may be considered to be ten amperes for 3.5-ampere lamps. This requires a resistance of at least nineteen ohms on 220-volt circuits. The gradual regulation of the resistance is effected automatically by employing resistances of iron wire. Iron has a high temperature coefficient and its resistance quadruples when it is brought to a light-red heat. The dimensions of the wire are so chosen that the high initial current intensity of the lamp will bring it to a light-red heat, and it therefore takes up about 130 volts, but at the definite current intensity of 3.5 amperes it is only slightly heated and absorbs no more than fourteen volts. The quartz lamp is furthermore provided with an adjustable resistance in order to adapt it to the different pressures in use, 220 to 240 volts.

The metallic conductors through the quartz walls of the mercury vessels must have the same coefficient of expansion as quartz and must not be attacked or dissolved by the mercury; and the only material suitable for this purpose was found to be the nickel steel discovered by Guillaume, of Paris. The right temperature of the pole vessels is essential to the proper working of the lamp, as it determines the vapor pressure in the lamp and the intensity of the current flowing through it. In order to adjust the cooling of the pole vessels according to the conditions under which the lamp is used —exterior or interior lighting—they are surrounded by peculiar coolers of copper sheet, whose radiation surface may be varied. Quartz lamps should be used without a globe only when their ultra-violet rays are to be utilized, and in such cases employés near them should protect themselves from these rays which produce skin inflammation. If light of better color is desired, it can only be obtained by using incandescent lamps in connection therewith. The fact that the Koerting & Mathiesen Actien Gesellschaft, the Illgemeine Electrizitäts Gesellschaft and the Siemens-Schuckert Works have united in introducing these lamps would seem to indicate that they are considered of importance. — *Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), September 10 and 17.*

MEASUREMENTS WITH PORTABLE INSTRUMENTS.[1]

BY F. P. COX.

Inaccuracies in reported values may be divided into two classes—those due to errors of the observer and those due to the errors of the instrument. Under the former must be included errors due to incorrect connections, which are by no means unusual in the measurement of polyphase circuits, errors due to not noting and allowing for zero errors in the instrument and errors due to parallax which may be avoided by properly using the image of the needle reflected from the mirror under the scale.

The personal equation of an observer which causes one man to read the needle as above and another as below the true position, need not be taken into account in commercial measurements. When a needle is fluctuating through a considerable angle, it is sometimes difficult to estimate its true position. If the most dead-beat instruments available are used, no further precautions are possible, except to take the average of a considerable number of readings. These readings should be jotted down as fast as they can be taken and no attempt made to obtain the average reading by estimating with the eye the mean position of the needle. Even with this precaution, great reliance must not be placed on observations taken under unfavorable conditions. The results, at best, are approximate.

A fruitful source of error is the habit of reading instruments when the deflection is small. The average observer, using a reasonable amount of care, can not be relied upon to estimate the position of a needle much closer than one one-hundredth of an inch, and at one-fifth scale the error introduced is five times the magnitude of a corresponding error at full scale. It is recommended that deflections of less than twenty per cent of the full scale be classed as approximate. All instruments have errors due to temperature changes and are affected by local magnetic fields. The errors so introduced may be a very small fraction of a per cent or they may amount to several per cent, depending upon the design and type of instrument. Local field errors may be noted and, if not too great, allowed for, by reversing the leads to the instrument or by turning it through 180 degrees. The mean value of the observations should be taken as the correct reading. It must be remembered that local fields are found, not only in the immediate vicinity of buses carrying large currents, but also some distance away where they have been carried by the iron framework of the switchboard or of the building. Sometimes an unshielded instrument is read when resting on the iron grating of a switchboard gallery or on a hand rail, and errors of considerable magnitude may result. Such errors can not be corrected by reversing the position of the instrument or by reversing leads, since they are due to the presence of a mass of iron in the vicinity of the instrument.

Scale errors, due to incorrect marking, are generally small, not amounting to over two-tenths of a per cent, and are most liable to be found in the subdivisions of the scale, since each subdivision is not an observed point. It is customary to observe and check the principal divisions, in some cases the half divisions, and to interpolate the intermediate ones.

Care of instruments or, rather, want of care, should be considered as a very important source of error. Shelves provided with a thick felt covering should be used for storing them. Such shelves are inexpensive and pay for themselves in reduced repair bills and improved accuracy. The instruments should be in charge of one competent man who will examine their condition when they are returned to his stock. He should see that they are compared with suitable standards once or twice a month and frequently cross-checked. He will soon determine which employés are treating the instruments properly and which are abusing them. Such abuse may consist in careless handling in use or in transportation. In riding in street cars the careful instrument man will keep his instruments in his lap or on the cushioned seat. The careless man will drop them on the floor. In sending instruments out by wagon felt-lined boxes should be provided to protect them in transit. It is well to purchase instruments of high torque and robust constitution, but it should be remembered that the term "robust" is only comparative. Instruments should be given the same care which is given to a valuable watch, and no matter how strong the instrument may be, it will not be improved by rough handling.

The measurements which are most commonly made by lighting or power companies are of potential, current, energy and time. Perhaps the latter might seem rather beyond the scope of this paper, but it is an important factor in the calibration

[1] A paper read at the twenty-fourth annual meeting of the Association of Edison Illuminating Companies, held at Lenox, Mass., September 15, 16 and 17, 1908.

of meters and it seems advisable to make some mention of probable errors in this measurement.

POTENTIAL.

In considering the subject of errors in measurement of potential, it is necessary to divide this subject into two types of circuits, continuous and alternating currents. It is well recognized that the best type of instrument for measuring continuous-current circuits is the D'Arsonval. For economy of energy absorbed and deadbeat qualities, this instrument is a most satisfactory one. The best instruments of this type have a resistance of about 100 ohms per volt of scale reading. The errors introduced by temperature changes are insignificant, except in those multiple-scale instruments which have a tap for one and one-half or two volts full-scale reading. Where this tap is used the accuracy of the low-reading scale should be regarded with suspicion, since it is liable to have a temperature error of about one-tenth of one per cent per degree centigrade. This type of instrument, when provided with a iron case, is practically shielded from all ordinary magnetic fields. Normal earth's field introduces an error of about one-tenth of one per cent in unshielded instruments and such instruments should not be used nearer together than eighteen inches. If placed side by side these instruments react on each other and an error of one per cent may very readily be introduced.

The generally accepted model of voltmeter for measuring alternating potential is of the dynamometer type. Those designed for 110-volt circuits have a resistance of from 1,500 to 2,000 ohms or about twelve to fifteen ohms per volt. The resistance of the instrument is somewhat affected by temperature on account of the percentage of copper which it contains, but this is almost exactly compensated for by a corresponding temperature effect on the spring. Double-scale instruments of this type should be limited to a ratio of 2 to 1 between scales, or with special designs, 4 to 1. When designed for the higher scale, bringing out a tap for less than half scale introduces more copper in the circuit than the spring will compensate for, and frequency errors must be expected on account of the change of the instruments' time constant. In building double-scale instruments with a ratio of 4 to 1 between scales, it is customary to design them so that frequency and temperature errors are negligible on the lower scale. The result is an instrument which takes a large current, and the key must not be permanently depressed on the high voltage. Even special design will not permit self-contained instruments to be made with a ratio of more than 4 to 1 between scales, and greater ratios should be obtained by means of external multipliers. These dynamometer instruments should be protected by means of a suitable shield from any ordinary magnetic field, since, unshielded, they have an error of about one per cent, due to normal earth's field.

Although designed primarily for alternating currents, when there is no very marked difference between reversed readings they may be used on continuous-current circuits by considering the correct reading as the mean of the reversed observations. When used with potential transformers the errors of the transformers must be added to the normal instrument error. Account must be taken of the regulation of the transformer, as affected by the connected load and also by the frequency of the circuit on which it is used. A regulation of from one and one-half to two per cent between voltmeter load and full load is not improbable. The correction factors for the transformers can be supplied by the builders and should be taken into account where best accuracy is desired.

CURRENT.

The D'Arsonval ammeter for measurements on continuous-current circuits differs from the voltmeter only in regard to errors due to temperature. In this respect, however, it differs materially and is often credited with an accuracy which it does not possess. Temperature changes affect the accuracy of the instrument in three different ways.

First, in those types of instrument where an attempt is made to avoid errors on account of change in room temperature, it is necessary that the shunt should have the same temperature coefficient as the instrument itself; and, since this coefficient is not low, five or ten minutes after such instruments have been connected, errors of two or three per cent, or even more, may be noted. These errors are due to the fact that the shunt is absorbing energy and increasing in temperature more rapidly than the measuring circuit.

Second, where an attempt is made to avoid the error by making the shunt of zero temperature coefficient material, an error, due to change of room temperature, is introduced. Since the temperature coefficient of the measuring circuit is practically half that of copper, an error of one-tenth or two-tenths of a per cent is caused by each degree centigrade, which the room temperature changes. This error may, however, be reduced to a negligible quantity by using shunts which have a drop of 200 millivolts in place of the forty or sixty millivolts used in switchboard shunts. The extra size and weight are well warranted on account of the improved accuracy obtained.

The third error is found in those shunts which have zero coefficient materials and is due to thermoelectric currents set up in the measuring circuit. These currents are caused by difference in temperature of the shunt terminals. Such differences in temperature may be due to improper contact with the bus, to a difference in circulation of air at the two ends, or more usually, it is due to the Peltier effect. Such thermoelectric currents may be avoided by using materials which have practically no thermoelectric difference of potential between the metals of the terminal and the shunt strip, or by adding a thermoelectric compensator which sets up a thermoelectric effect of equal magnitude and opposite sign.

Ammeters for the measurements of alternating currents are usually of the iron-vane type. The only error which is characteristic of this type of instrument is that due to variation in wave form and this error is within one-half per cent. When used with current transformers, errors of considerable magnitude may be introduced. These errors increase as the impedance of the secondary circuit of the transformer increases and as the primary current diminishes. Where a five-ampere instrument is used as the only load on the secondary circuit of the transformer, above one-fifth scale inaccuracies greater than one-half per cent are not liable to be found. It is not permissible to substitute a two-ampere instrument for lower readings unless the corresponding curve of the transformer under the new condition is at hand, for the inductance of the two-ampere instrument is more than six times that of the five-ampere and this additional load on the secondary introduces considerable error. Where transformers, in addition to the portable ammeter, carry a load of one or two stationary instruments and a tripcoil, an error of three per cent to five per cent at one-tenth load is by no means improbable and an error of one-half per cent at full load is to be expected.

ENERGY.

Portable indicating wattmeters for the measurement of energy are of the dynamometer type and on continuous-current circuits, or non-inductive alternating circuits, their characteristics do not materially differ from those of the dynamometer type of voltmeter. But when used on highly inductive circuits, or with transformers, additional errors are introduced. Errors due to mutual induction of the two circuits are small and may be neglected in commercial measurements. Errors of self-induction may not be neglected in measuring highly inductive circuits such as core losses of some transformers. The best instruments have an inductance of potential circuit of about one one-hundredth henry and at sixty cycles a displacement of potential current of approximately five minutes. Consequently, when used in connection with inductive circuits of power-factor one-tenth, the instruments indicate one and one-half per cent higher than the true watts and at one-quarter power-factor, half of one per cent. Instrument connections should be so made that the loss of the potential circuit, rather than that of the current circuit, is included in the reading, and this loss should not be deducted until after the correction factor mentioned above has been applied. Although this error on low power-factor tends to cause the instrument to read too high on lagging load, yet it is not unusual to find an instrument reading low on low power-factor and the magnitude of such error is sometimes greater than that due to self-induction of the potential circuit. This error is usually due to eddy currents in the metal parts of the instrument. It varies with the frequency, current and power-factor of the circuit and with the position of the moving coil at the time the measurement is made. No correction factor can be given, but with proper design the disturbance may be reduced to a negligible quantity. In these low power-factor measurements, care must be used not to overload the current coil of the wattmeter, for its capacity is often very much exceeded before the instrument is at one-half scale deflection. A short-circuiting switch across the current coil is recommended.

When used with either current or potential transformers, or with both, the errors mentioned in connection with voltmeters and ammeters must be allowed for, and, in addition, the phase displacement between the primary and secondary circuits of the transformers must be taken into account. The magnitude of this displacement depends principally upon the design of the transformers and the time-constant of the devices in the secondary circuits. In well-designed potential transformers, this phase displacement will not amount to more than five of six minutes at light secondary load, and the secondary potential leads the primary. As the full secondary load is approached, if the load is non-inductive, such as potential circuits of indicating instruments, the displacement may become ten minutes lagging, while if the load is mostly inductive, as for example, the potential circuits of induction meters, it may become thirty to thirty-five minutes leading. If the current being measured is non-inductive, no appreciable error is introduced by this change, but with power-factor one-half and a fully loaded potential transformer, the instrument may read one-half per cent high or one and one-half per cent low, depending on whether such load is principally non-inductive or highly inductive. With lightly loaded potential transformers this error would not amount to more than one-half per cent.

In current transformers this displacement of phase between primary and secondary current is usually greater than in the potential transformers. With one or two instruments on the secondary and full current in the primary, it may amount to thirty or forty minutes, and the secondary current leads the primary. As the primary current decreases, this angle increases. At one-quarter load it is about one degree and at one-tenth load, about one and one-half degrees. This means an error on a non-inductive load of one one-hundredth per cent at full load, one-fiftieth per cent at one-quarter load, and one-thirtieth per cent at one-tenth load, the instrument reads low. At power-factor one-half these errors become one and one-half per cent at full load, three per cent at one-quarter load and four and one-half per cent at one-tenth load, and the instrument reads high on inductive load. It is therefore evident that combinations of transformer and instrument errors may not infrequently occur in which the error of the wattmeter reading may exceed five per cent at power-factor as high as one-half and that an accuracy better than three per cent is not to be relied upon without taking all possible precaution and having at hand the correction factor for each individual piece of apparatus used. With such correction factors applied, errors greater than one to one and one-half per cent need not be expected.

TIME.

The accuracy of stop watches is generally very much overestimated. Watches with compensated balances and well-jeweled bearings are purchased. It is a poor watch which can not be adjusted to keep time with an error not greater than one minute per week. That is, as a timepiece, its error is within one hundredth part of one per cent. The balance wheel of a watch completes its excursion of approximately 250 degrees in one-fifth of a second. It is necessary for good timekeeping qualities that its motion should be free as possible and that it should be entirely disconnected from the train for the greatest possible portion of this excursion. It swings entirely free for approximately 240 degrees, during which time the train drives the hand forward one-fifth of a second division and again locks it from any movement during the 240 degrees of the balance wheel excursion. In other words, the hands of a watch are absolutely stationary during ninety-five per cent of any interval of time and it makes no difference in the movement of the stop hand, whether it is thrown in mesh at the beginning or the end of an excursion of the balance. Therefore, with a perfect timepiece, a perfect stop mechanism and absolutely no error on the part of the observer, an error of practically one beat or one-fifth second may easily occur in measuring time. In thirty-second observations, this error may amount to two-thirds per cent. When we add to this error those due to imperfect stop mechanisms, a throw of the hand in the interval between freeing it from the friction clamp and meshing it with the train, a similar throw in disconnecting from mesh and again clamping it, and the inaccuracy of the meshing itself, it is not difficult to realize that an additional error of one-half per cent may be introduced. The only precautions which can be taken are to use two stop watches, one in each hand, to practice operating the stop mechanism with as little jar as possible to the watch, to reject any observation in which the watches do not agree within two-fifths second, and to refuse absolutely any measurement covering a period of less than fifty or sixty seconds.

In conclusion permit me to express the hope that nothing in this paper may be considered as a reflection on reasonable accuracy of portable measuring instruments. I have sought only to show that laboratory accuracy may not be obtained under other than laboratory conditions, that errors of one or two per cent represent reasonable commercial accuracy and that even this may not be relied upon unless the best judgment is exercised in the selection, care and use of portable instruments. Purchase those instruments which are best adapted to the conditions under which they are to be used, place them in the custody of an experienced instrument man and give him facilities and authority in control of them which will insure their proper use.

INDUSTRIAL SECTION

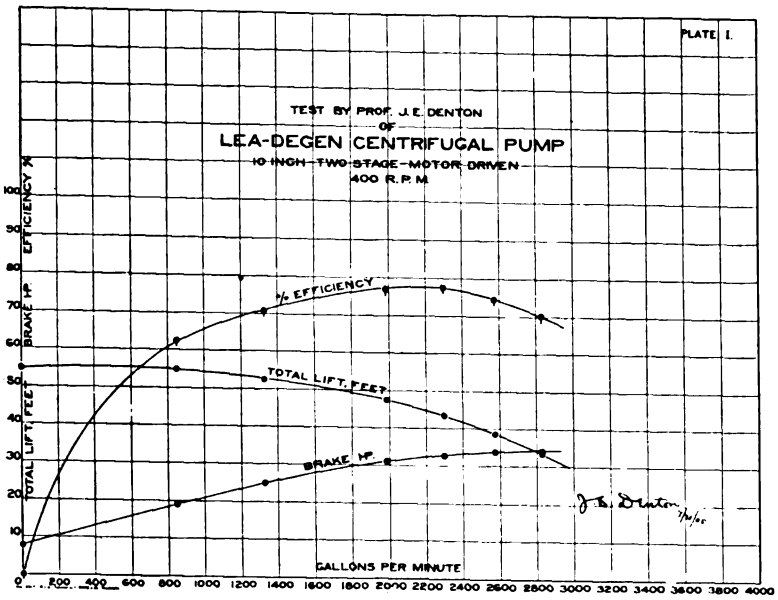
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Lea-Degen High-Duty Turbine Pump.

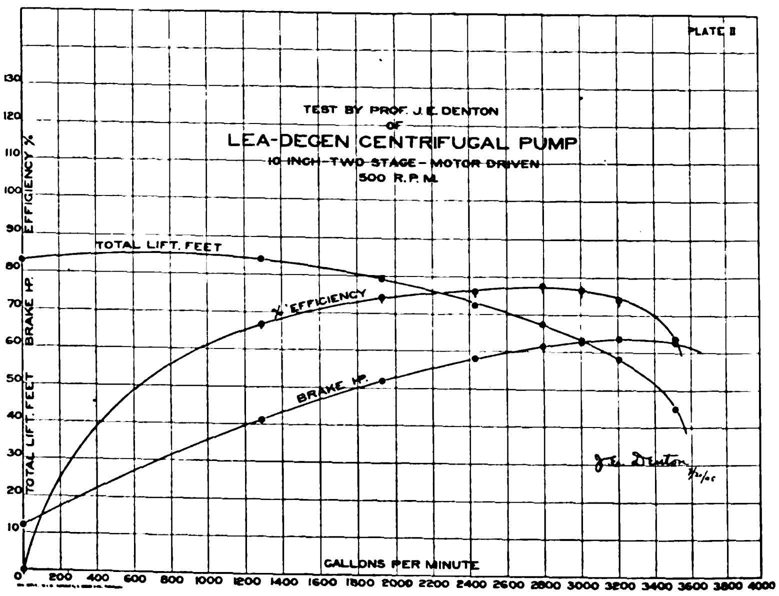
The Lea Equipment Company, 136 Liberty street, New York city, has placed on the market a motor-driven high-duty turbine pump, illustrations of which are shown herewith. The complete line of pumps is made of separate units that are designed for heads from seven to 1,000 feet or higher, and their capacities range from seventy-five gallons to 30,000 gallons per minute. The general design of the pump is indicated in the illustrations. It consists essentially of two shrouded runners or pump wheels mounted on the same shaft in a double case. The case is so proportioned that the water is drawn from the source of supply and put under pressure by the first wheel and then delivered to the suction chamber of the second wheel. The second wheel imparts to the water the same amount of energy it receives from the first wheel, thereby increasing the pressure, and then delivers the water into a spiral discharge conduit terminating in a diverging nozzle connecting with the main pipe.

The case is divided through its horizontal diameter by bolted flanges, so that its top half can be quickly freed and lifted off without disturbing either suction or discharge connections. By means of bolted circumferential divisions of the case provision is made for either using the suction and discharge end of a case together as a single-stage pump or adding as many intermediate sections as may be necessary to afford any desired pressure at any fixed speed. Additional stages can therefore be installed after a pump has been in operation, without wasting any parts of the existing case.

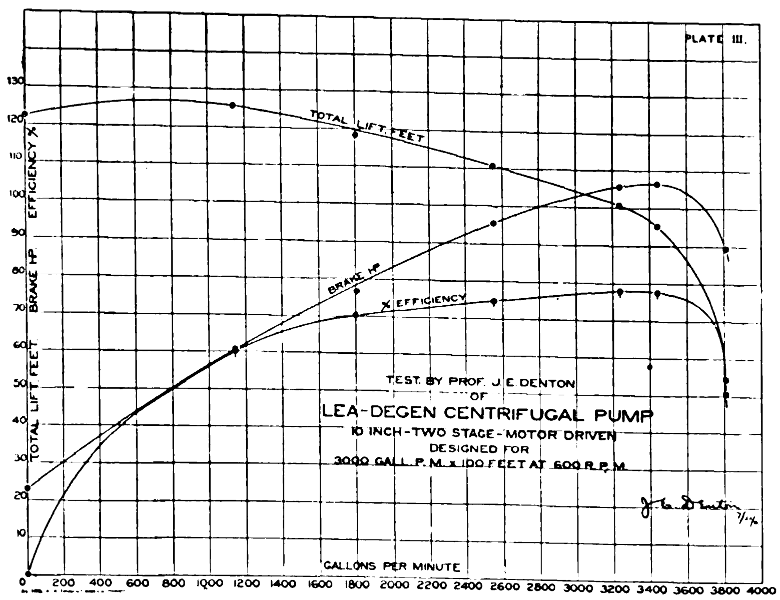
The curves herewith show the results secured under a test conducted by Professor James E. Denton, of the Stevens



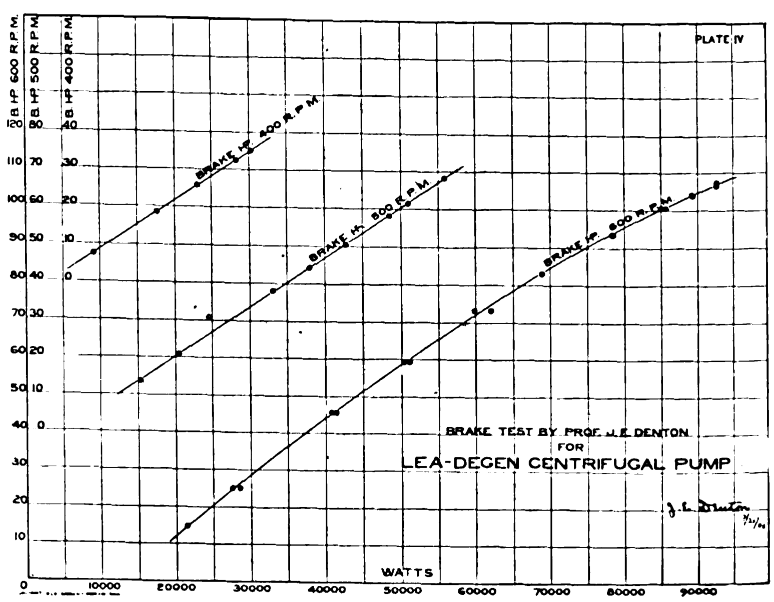
"GALLONS-LIFT" CURVE FOR 400 REVOLUTIONS PER MINUTE TURBINE PUMP.



"GALLONS-LIFT" CURVE FOR 500 REVOLUTIONS PER MINUTE TURBINE PUMP.

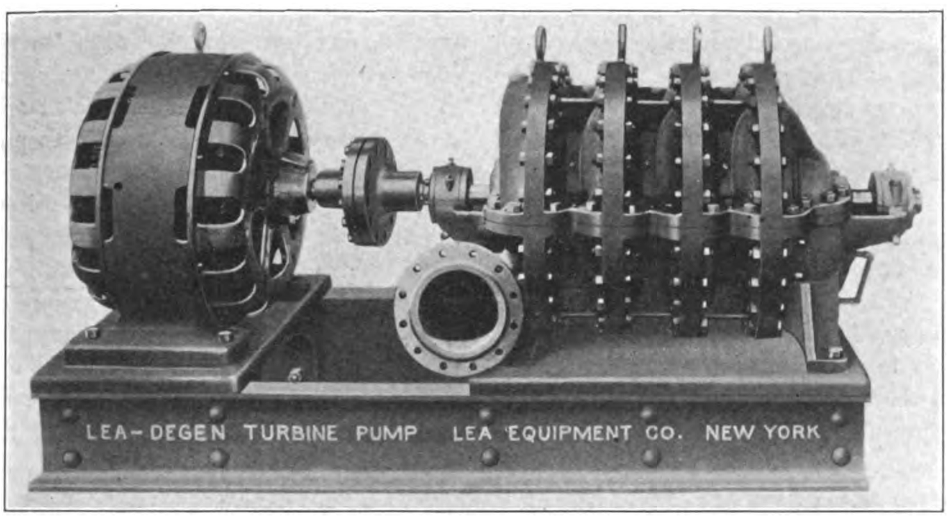


"GALLONS-LIFT" CURVE FOR 600 REVOLUTIONS PER MINUTE TURBINE PUMP.



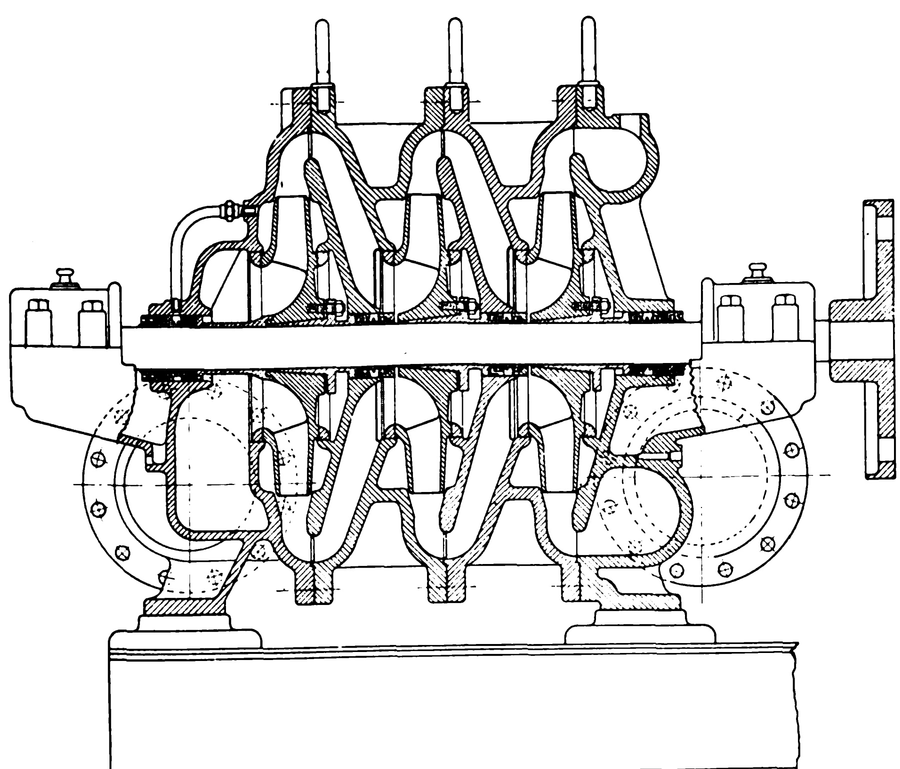
"BRAKE-HORSE-POWER-WATTS" CURVE, TURBINE PUMP.

Institute of Technology. This test was conducted on a Lea-Degen two-stage centrifugal pump driven by a 220-volt, direct-current General Electric motor. The test



The Lea-Degen Motor-Driven Turbine Pump.

shows that the pump gave the following results, under conditions of maximum efficiency: At 400 revolutions, seventy-seven per cent efficiency with a capacity of

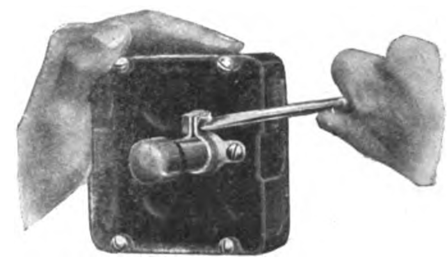


Sectional View of Two-Stage Lea-Degen Pump.

2,296 gallons under 43.6 feet lift; at 500 revolutions, 77.6 per cent efficiency with a capacity of 2,794 gallons under 67.4 feet lift; at 600 revolutions, 77.97 per cent efficiency with a capacity of 3,235 gallons under 100.7 feet lift. In round numbers, therefore, the capacity at maximum efficiency is directly proportional to the revolutions, and the lift, or head, is proportional to the square of the revolutions. At each speed the efficiency averaged more than seventy-six per cent over a range of 600 gallons of capacity for the two lower speeds, and 900 gallons at the highest speed, the head remaining nearly constant.

A Clamp for Ceiling Outlet Boxes.

A neat little device for fastening ceiling outlet boxes to the dummy or gas pipe has recently been put on the market which bids fair to eliminate many of the difficulties experienced in installing boxes in the old way.



Clamp for Ceiling Outlet Boxes.

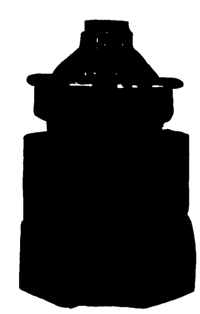
The outlet box is held firmly in position at right angles to the pipe, so that there is no chance of breaking the plaster by swaying fixtures. The opening where the pipe passes through the box is also filled up, thus preventing flames from being drawn up through it in case of fire being started by a short-circuit or loose contact.

The clamp is made in two sizes, three-eighths-inch and one-half-inch, with two lugs for ordinary purposes, and three lugs for heavier work, such as in fire-proof buildings.

It is manufactured by the Federal Electric Company, of Chicago, and is approved by the Underwriters' Laboratories.

The Lang "Quixet" Floor Box.

The accompanying illustration shows the Lang "Quixet" floor box, made by the J. Lang Electric Company, 116 Lincoln



The Lang "Quixet" Floor Box.

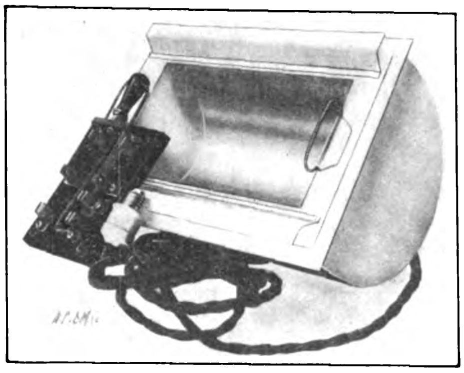
street, Chicago, Ill. This box is designed to overcome all of those disadvantages with floor boxes which have proven expensive and annoying in their use. In installing this box it is not necessary to cut out or adjust the floor in any way. The box adjusts itself to the floor without the use of screws, gaskets or other devices. It is smaller than the ordinary floor box, and will fit into installations where the ordinary box would not be permissible.

Electrically Heated Chocolate Warmer.

Among the industrial applications which are being successfully met with electrically heated devices, the confectioner's chocolate warmer or dipping pan is an example. The Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa., is making the Hadaway electrically heated dipping pan, an illustration of which is shown herewith, and which is being used by a large number of prominent candy manufacturers in this country and abroad.

The pan consumes about the same amount of current as a sixteen-candle-power lamp. The heater is placed in operation by closing a switch. A further advantage of the Hadaway electrically heated chocolate warmer for refrigerated rooms arises from the fact that the dry, flameless heat results in a great reduction in the expense for cooling.

Hadaway electrically heated chocolate warmers are usually made with a high and low heat, the change from one to



ELECTRICALLY HEATED CHOCOLATE WARMER.

the other being made by a small switch. The low heat is sufficient to maintain the chocolate at the proper working consistency, while the high heat is designed to bring the chocolate to the working temperature in a short time. When desired, warmers can be supplied having only the low heat. These are used in connection with chocolate melters, but it occasionally happens that the chocolate cools in the pan, causing loss of time and delay in the work. This can be avoided by using the two-heat apparatus with which the high heat will be available whenever required.

The warmer is made in two standard sizes. The large size is fourteen and one-quarter inches long, seven and five-eighths inches wide and six inches deep. The small size is twelve inches long, six and one-quarter inches wide and five inches deep. These dimensions refer to the pan in which the chocolate is placed. The heating element is upon the outside of a receptacle in which the chocolate pan is placed and is hermetically sealed in by an outer jacket. The heater and wires are shielded so that accidental contact with them can not be made and the operators are absolutely protected from all danger of an electric shock.

The warmers can be set in the top of a table and connected with the heat-control switch by the engineer on the premises according to a simple wiring diagram sent out with the apparatus. The chocolate warmer can be connected to a lamp socket, but permanent wiring is recommended for factories. The entire method of mounting them can be arranged to suit the individual preference of the purchasers. The dipping pans are shipped all ready to place in a table and connect up, and the tables for mounting the pans can be procured or made by the purchaser without difficulty.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on October 20 for the following electrical material: Sixteen hundred and fifty incandescent lamps for delivery at Annapolis, Md.; twelve starting panels for delivery at Norfolk, Va.

Bids will be opened on October 27 for 100 dry batteries, 3,000 wood blocks, nine dozen brushes, 20,000 feet lighting cable, 12,000 carbons, 4,000 feet silk-covered cord, miscellaneous fittings, miscellaneous inner and outer globes, 3,000 wire lamp guards, 200 insulators, 19,100 incandescent lamps, four direct-current motors, 2,300 porcelain receptacles, 35,000 feet rubber-covered wire, and 8,000 feet twisted wire, for delivery at Brooklyn, N. Y.; one Wheatstone bridge, six desk-type fans, miscellaneous electrical supplies for delivery at Annapolis, Md.; miscellaneous electrical supplies for delivery at Norfolk, Va.

New Holophane Reflectors for Tungsten Lamps.

The Holophane Company, New York city, has completed the designs for an entirely new line of reflectors for tungsten lamps.

The new tungsten reflectors are of three types which will be known to the trade as the "Extensive," "Intensive" and "Focusing" types. In appearance all are similar to the original "bowl type" Holophane reflectors designed for Gem lamps, but each of the three new types above named gives a distinctive distribution of light. In the preliminary engineering work connected with these new types, the engineering department, Holophane Company was ably assisted by A. J. Sweet, of the Westinghouse company.

In the designing of the reflectors an entirely new principle was evolved—that of the "merging prism." As is well known, Holophane reflectors having a continuous prism from the collar to the edge lose considerably in efficiency, owing to the fact that the prism is much larger at the bottom than at the neck. To prevent this the Holophane Company designed what is known as the "equal prism" reflectors, in which prisms of practically equal size are run in several banks from neck to top. In the new types, instead of an abrupt step between the banks of prisms the several banks are merged one into the other, which not only adds greatly to the beauty of the reflectors but at the same time gives the maximum of efficiency.

The new "merging prism" reflectors are made for forty, sixty and 100-watt tungsten lamps, three types, as above de-

NEW HOLOPHANE REFLECTOR.

scribed, for each size of lamp. This makes a very compact line and one which is uniform in appearance.

A new Holophane bulletin descriptive of this line of high-efficiency reflectors is now in press. In addition to technical description, photometric curves, etc., this bulletin will contain a few simple rules by following which even a novice may be sure of selecting proper size of lamps and correct Holophane reflector and of spacing these rightly in any ordinary lighting installation. The new "flux of light" method of calculating illumination, it is stated, enables the Holophane Company's engineers to reduce the salient features of practical illuminating engineers to a few simple "rules of thumb" which are applicable wherever the installation is not complicated by æsthetic or architectural difficulties or restriction.

The new line will be handled not alone by the Holophane Company, but also by the General Electric Company, Westinghouse Electric and Manufacturing Company, Franklin Electric Manufacturing Company and the companies comprising the National Electric Lamp Association.

Current Electrical News

DOMESTIC AND EXPORT.

ARKANSAS INTERURBAN PLANNED—A project to build a third-rail interurban line from Little Rock south to Sheridan, branching out from that place to Hot Springs and Pine Bluff, all in Arkansas, the entire road to be built at an actual cost of $2,700,000, has been planned by the Central Arkansas Electric Railway Company, of Pine Bluff, and is now being considered, it is stated, by Chicago capitalists, who will probably reach a decision in regard to the project by the first of the next year. Preliminary surveys and plans for the railroad have already been made. Sheridan is thirty or thirty-five miles south of Little Rock. Hot Springs is about forty-five miles west of Sheridan and Pine Bluff about thirty miles east of the same place.. A. M. Van Auken is chief engineer of the company.

TELEPHONE COMPANIES UNITE—At a meeting of the stockholders of the United States Telephone Company, the Cuyahoga Telephone Company, of Cleveland, Ohio, and the Citizens' Telephone Company, of Columbus, Ohio, the three companies were merged. The new company, which has not been named, will act as an operating company with a capitalization of between $5,000,000 and $10,000,000 and will take over the three independent companies on a lease for 999 years. Other Ohio independent companies will, it is stated, be added from time to time. The merger places under the control of the operating company over fifty per cent of the independent telephones and about 75,000 of the 325,000 telephones in the state of Ohio. The United States company has extensive long-distance lines in Ohio and adjoining states.

MEXICAN ELECTRICAL NOTES—The Guanajuato Power and Electric Company has arranged for the construction of a new line eighty-five miles in length to be used as a reserve line in case of accident. The wire for this new line will be strung on steel towers beginning at Penjama and terminating at the station at Guanajuato. There will be substations every twelve miles. Work will be begun at once. The Atotonilco Light and Power Company, a concern recently organized by Guadalajara men to furnish current for light and power in the town of Atotonilco, the centre of the orange district of Jalisco, has placed an order with Siemens-Schuckertwerke, of Berlin, for hydroelectric machinery, transmission lines and substation equipment. The value of the order is $14,000. The Guadalajara company will utilize a waterfall near the town.

OMAHA MEN INCORPORATE INTERURBAN COMPANY—The Nebraska Traction and Power Company, of Omaha, is the name of a new corporation that has filed articles with the secretary of state under the interurban law passed two years ago. It has an authorized capital stock of $2,000,000 and the incorporators are: Mel Uhl, N. P. Dodge, Jr.; William D. Crist, F. A. Howard and J. F. Emmert, all of Omaha. The company proposes to build a line from South Omaha in a westerly direction through Douglas County to the town of Ralston, thence in a southerly direction through Sarpy County and in a northerly direction from Ralston through the counties of Douglas, Dodge, Washington, Burt, Cuming, Thurston and Dakota, Neb. It is to be either a single or double-track road, and operated by electricity or any other motive power. The company proposes to operate telephone or telegraph lines and to transmit power, light and heat for itself or other persons, and to carry passengers, baggage, express and mail. The $2,000,000 capital stock is to be divided into shares of $100 each, 15,000 shares to be preferred and 5,000 common.

NEW ELECTRIC COMPANY FILES ARTICLES—The Des Moines (Iowa) Electric Company has filed articles of incorporation. The charter of the company gives it the right to own lighting plants and all appurtenances and property in connection therewith and railways. Its capital stock is $5,000,000, of which $3,500,000 is common and the rest preferred. Of the common stock fourteen shares, representing $1,400 par value, has been issued. None of the preferred has been issued. The officers of the company are: J. Berry, president and treasurer; Lewis A. Burleigh, clerk; Joseph Williamson, Ernest L. McLean, Walter M. Sanborn, E. M. Leavitt and M. M. Spinney, with the officers named, forming the board of directors. All of the officers except Mr. Leavitt of the board live at Augusta, Me. He lives at Winthrop. Five of the common stock shares of the company are held in New York city, six at Augusta, Me., and one each at Ridgewood, N. J., at Brooklyn, and at Winthrop, Me.. The purpose of the new organization, which now has a right to do business in Iowa, is to take over the Edison Light Company, of Des Moines. The Edison Light Company operates under the laws of the state of Iowa.

IDAHO-OREGON LIGHT AND POWER COMPANY—All business of the subsidiary companies of the Idaho-Oregon Light and Power Company will hereafter be transacted in the name of the owning company, recently formed for the purpose of perfecting a merger. The Oregon-Idaho company, which is incorporated with a capital stock of several million dollars, and in which the Mainland brothers, of Oshkosh, Wis., are interested, has now absorbed the Capital Electric Light, Motor and Gas Company, the Boisé-Payette River Electric Power Company, the Electric Power Company, of Boisé; the Interstate Light and Power Company, of Meridan, and the Emmett Electric Light Company, of Emmett. This company is at present furnishing light and power to Boisé, South Boisé, Pearl, Horseshoe Bend, Neal mining district, Meridian, Emmett and Ontario, Ore., and is constructing lines to New Plymouth and Weiser. Power is supplied from the Horseshoe Bend plant on the Payette River, the Barber plant on the Boisé River and a smaller plant on the Ridenbaugh canal in South Boisé, with a total capacity of 5,000 horse-power. The company is building a large power plant on the Snake River, sixty miles north of Huntington, which will have a capacity of 30,000 horse-power. One hundred and thirty miles of transmission line is now supplying the district south and east of Weiser, Ida., and some 200 additional miles will be built next year.

NEW MANUFACTURING COMPANIES.

RICHMOND, VA.—The corporation commission has issued a charter to the Southern Electric and Manufacturing Corporation, Richmond, with B. B. Brauer, president; E. D. Moore, vice-president, and J. W. Church, secretary and treasurer—all of Richmond. The maximum capital is $50,000; minimum, $25,000. The company will manufacture and sell the Brauer automatic time switch.

SEATTLE, WASH.—The United Wireless Telegraph Company has purchased the factory of the Nelson Metal Specialties Company. It will be taken over by the operating department of the company, headed by C. C. Galbraith, and work will begin at once in the manufacture of wireless apparatus for use on the Pacific Coast. The first wireless instruments to be turned out will be for a demonstrating wireless station at the Spokane fair.

SALINA, KAN.—The Anderson Electric and Manufacturing Company has been incorporated with a capital of $200,000 to manufacture the inventions of John Anderson, of Salina, Kan., including the Anderson lockout system for telephone circuits and other telephonic appliances and improvements. The officers are: R. T. Blair, of Emporia, Kan., president; C. E. Carlson, of McPherson, Kan., vice-president; R. G. Henderson, of McPherson, secretary, and J. K. Bremyer, of McPherson, treasurer. The temporary headquarters of the company are at Salina.

DATES AHEAD.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October 20-23.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Association of Car-Lighting Engineers. First annual meeting, Chicago, Ill., November 18.

National Society for the Promotion of Industrial Education. Annual meeting, Atlanta, Ga., November 19-21.

American Roentgen Ray Society. Annual meeting, New York city, December 28-30.

ELECTRIC LIGHTING.

SHERMAN, TEX.—The city has voted on the issuance of $16,000 light-betterment bonds.

OTTAWA, ILL.—Ground has been broken for the interurban between Streator and Grand Ridge.

GADSDEN, ALA.—The Sand Mountain Electric Company has been organized to install an electric light plant at Albertville.

WAVERLY, IOWA—The municipal light and water plants at Waverly were destroyed by fire on September 22, involving a loss of $50,000.

NASHVILLE, TENN.—The Chattanooga Electric Company, chartered under the laws of Maine with $3,000,000 capital, has filed its charter.

FLORESVILLE, TEX.—The city council has granted permission to Dr. Largen, of San Antonio, to establish an electric light plant at Floresville.

WINCHENDON, MASS.—The town selectmen have granted the Connecticut River Transmission Company permission to erect towers for the support of high-tension wires.

EL PASO, TEX.—Richard Caples and W. B. Latta have been granted a franchise to build an electric line through El Paso County. The grantees must build at least ten miles of road in two years.

SPRINGFIELD, ILL.—The Springfield, Clear Lake & Rochester Interurban Railway Company has been given the right to operate cars over the lines of the Springfield Consolidated Railway Company.

DOUGLASVILLE, GA.—M. L. Hathcock has purchased the old Arnold mill property and it is said will build a dam and generate sufficient power to operate an electric plant to supply nearby towns.

BALTIMORE, MD.—At the annual meeting of the Consolidated Gas, Electric Light and Power Company, of Baltimore, the seventeen retiring directors were re-elected, with the addition of W. H. Cassell.

LORAIN, OHIO—The service board has decided to employ F. C. Werk, a Cleveland contractor and engineer, to submit preliminary estimates on a municipal lighting plant for the city as requested by the council.

KENNETT, CAL.—The new power line of the Northern California Power Company, directly from the Volta power plant to Kennett, a distance of forty miles, is in operation. The line will carry 60,000 volts.

STEVENSON, ALA.—The board of aldermen has granted an electric light franchise to Fred A. Howe, of Huntsville. The business men are subscribing liberally for lights, both in their homes and business houses.

SEATTLE, WASH.—The finance committee of the city council has authorized Superintendent L. B. Youngs, of the light and water department, to complete the present extension of the lighting system from Cedar Lake to the city.

FREDERICKSBURG, VA.—Work on the new steel dam of the Fredericksburg Power Company on the Rappahannock River, above this city, is progressing rapidly. The first section of the dam will be completed within the next thirty days.

MONTGOMERY, ALA.—General Manager R. L. Pultz, of the Birmingham & Gulf Navigation Company, says that it is the intention of the company to build electric lines from Gadsden to Birmingham and Tuscaloosa in a short time.

WOONSOCKET, R. I.—The Woonsocket Realty Company has sold to the Woonsocket Electric Machine and Power Company valuable water rights on the old Ray Mill property. The company will use the power for operating its No. 2 station.

MILLEN, GA.—J. B. McCrary & Company, of Atlanta, have been awarded the contract for a lighting plant and water works for Millen. W. O. Lumpkin will have charge of construction and will commence work as soon as material can be had.

OGDEN, UTAH—The preliminary work on the proposed power plant in South Fork cañon has been started. It is the purpose of the builders to put in a pipe-line and a plant that will generate 10,000 horse-power which will be brought to this city by a pole-line.

PONTIAC, MICH.—The title to the Clinton River Power Company at Amy has passed into the hands of William H. Osmun. Mr. Osmun says he expects to utilize the Clinton River to secure 1,000 horse-power. Electric light and power will be furnished to Pontiac.

DURHAM, N. C.—The East Durham Cotton Mills announce that as soon as the installation of the new machinery can be made the mills will be run by electric power. Two of the engines with eight boilers will be removed for the erection of new boiler and engine houses. The change will involve an outlay of $75,000 or more.

LEBANON, PA.—A meeting of local capitalists was held in this city for the organization of a trolley company. A line will be built from Womelsdorf, Berks County, to Campbelltown, Lebanon County. A committee was appointed to secure a charter and to have surveys made. Most of the rights of way of the company have been secured.

ASHBURN, GA.—Bonds to the amount of $50,000, issued by the city of Ashburn, for the purpose of putting in electric lights and waterworks, have been sold and the contract let for the work, J. B. McCrary, of Atlanta, being the successful bidder. The work will be commenced as soon as the necessary preparations can be made.

ALBION, N. Y.—At a meeting of the village board of trustees a resolution was passed entering into a contract with the Albion Power Company to furnish the village with sixty-eight street arc lamps at $70 each. The company has expended $20,000 in improving its plant. Hereafter this village will receive an all-night service.

SACRAMENTO, CAL.—Work is progressing on the new dam of the Folsom Power Company on South Silver Creek in El Dorado County, and a force of men is employed clearing the right of way which has been secured over state and private lands. It is estimated that the new plant will give the company an additional 10,000 horse-power. The new plant will be installed within the next few months.

MONTPELIER, VT.—The Molly Falls Electric Light and Power Company has purchased all the right and interest which the late Perrin P. Kellogg, of Whitefield, N. H., had in the Molly Falls water power under a lease and contract given to Mr. Kellogg in 1903. The company leased its water rights and privileges for a period of ninety-nine years at $900 a year, reserving 400-horse-power with which to furnish lights to Cabot, Plainfield, Marshfield and North Montpelier.

COLUMBUS, OHIO—At meetings of the board of directors of the several companies concerned, held in Springfield, the merger of the People's Light, Heat and Power Company and the Home Light and Power Company, of Springfield, under the new name of the Springfield Light, Heat and Power Company was completed. Officers of the new company were provided for and the first payment of $50,000 made on the properties of the Home company. The new company will issue $500,000 of bonds, to be sold at ninety, the proceeds of which will be used to purchase the Home plant and retire the outstanding bonds of the People's company. An exchange of stock will be made for that of the People's company now outstanding. The capitalization of the new company is $1,000,000.

MISSOULA, MONT.—The Idaho Railway and Navigation Company has been incorporated in Washington with a nominal capital of $100,000 to build an electric line from Dead Man's Creek, in the northern part of Garfield County, through Asotin County and around the Blue Mountain range to the Seven Devils mining district, in Idaho, seventy-seven miles. The incorporators are: D. Van Arsdale, president; Samuel L. Tate, secretary; C. W. Hadley, general manager; M. Wood, engineer; Lester P. Edge and Fred Larson. Eleven directors and a council of five will be elected in November, at which time it is expected to have twenty miles of line completed. The single-phase system will be installed. The power-house, to be erected on Snake River, and the distributing stations, will cost $64,000, while the line will cost $40,000 a mile. The line will tap coal, cement and mineral deposits, and also run through agricultural, orchard and stock districts, not now served by railroads.

PERSONAL MENTION.

MR. PATRICK B. DELANY has been awarded the Elliott-Cresson gold medal for his invention of a system of rapid telegraphy.

MR. ALLEN L. HASSE has resigned as sales manager of the Pierce Company, and joined forces with the Harvard Electric Company, Chicago, Ill., as general sales manager.

MR. G. L. CONKLIN, who has been assistant manager of the Mankato Electric Traction Company, of Mankato, Minn., for some time, has been made general manager of the company, succeeding H. E. Hance, who will become connected with a proposed electric road to St. Peter.

MR. FRED W. GODFREY, for the past six years representing the Bryan-Marsh Company, and manager of the Cincinnati, Ohio, branch for the past two years, has organized the Godfrey Sales Company, with an office in the Perin Building, Cincinnati. Mr. Godfrey will continue to represent the Bryan-Marsh Company, as well as the Ambos-Cudmore Company, of Cleveland, Ohio. Among the lines represented by the Godfrey Sales Company are Bryan-Marsh Company lamps, Duncan wattmeters, Duncan transformers, Wheeler reflectors, Weston instruments, Bristol recording instruments. Aladdin specialties, Detroit rubber-covered wire, Hartford automatic time switches, Condit circuit-breakers and oil switches.

NEW PUBLICATIONS.

CALCULATIONS FOR POWER DISTRIBUTION—The Association Amicle des Anciens Elèves has reprinted in pamphlet form the treatise by J. H. Jacobsen, entitled "Calcul Electrique et Mécanique des Distributions d'Energie."

DEPARTMENT OF EDUCATION, CITY OF NEW YORK—The Department of Education of the city of New York has published its announcement of public lectures to be given in Manhattan and The Bronx for the October-December course. The department has also published the annual report of the supervisor of lectures of the board.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES—The Brooklyn Institute of Arts and Sciences has published its prospectus for 1908-1909. In science the department of electricity will conduct a series of illustrated lectures on electrical engineering on Thursday evenings. Professor Samuel Sheldon is president, and Hubert S. Wynkoop is secretary, of the department. The department of engineering will conduct a series of illustrated lectures on engineering on the third Thursday evening of each month. Nelson P. Lewis is president, and Arthur S. Tuttle is secretary, of the department. The central office of the institute is now established in the Academy of Music on Lafayette avenue.

NEW INCORPORATIONS.

AUSTIN, TEX.—The Godley Independent Telephone Company, Godley, Johnson County. $3,200. Incorporators: B. B. Robinson, J. A. Dalton, C. D. Odom, John R. Beaver.

MADISON, WIS.—Cady Telephone Company, village of Wilson, St. Croix County. $5,000. Incorporators: S. L. Pickett, G. W. La Pointe, Jr., Martin D. Erickson, Frank Smith, David Cushing and Peter Simonson.

MOSCOW, IOWA—E. S. Johnson Company, of Davenport, Iowa, $100,000. To do general construction work, operate and build manufacturing plants, deal in stocks and real estate and build and operate steam and interurban railways. Officers: E. S. Johnson, president; John C. Sessor, vice-president, and Julius E. Burmeister, secretary and treasurer.

HARRISBURG, PA.—Lost Creek Valley Rural Telephone Company. $5,000. To build a line from Mifflin to Selins Grove and Middleburg; from Mifflin to Blain, Newport, Millerstown and New Bloomsfield, and from Mifflin to Liverpool. Incorporators: A. J. Beyers, Mifflin; H. J., J. H. and Leo Shallenberger, and A. W. Herr, McAllisterville; J. O. Smith and J. H. Carney, Bunkertown.

ELECTRICAL SECURITIES.

The market suffered during the week, by reflection from foreign financial centres, from the disturbances created by the boiling over of the Balkan cauldron. For a few days even the political situation here was overshadowed, but when the first-mentioned matters were analyzed and discussed it remained to be seen that the latter was still the predominating factor in stock market influences. Industrial betterment seems to be more generally recognized, and with the better prices than usual prevailing and posted for futures it appears as if our agriculturists would be richer by some billion of dollars when the season's crops shall have been harvested and disposed of.

Dividends have been declared upon the following electrical securities: Electric Bond and Share Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable November 1. Commonwealth Edison Company; quarterly dividend of 1½ per cent, payable November 2 to stock of record October 20. The rate previously was 1¼ per cent quarterly. Central District and Printing Telegraph Company; regular quarterly dividend of 2 per cent, payable October 31 to stock of record October 24. American Light and Traction Company; regular quarterly dividends of 1½ per cent on the preferred stock and 1¾ per cent on the common stock, both payable November 2. Books close October 21 and reopen November 2. Mexican Telephone and Telegraph Company; regular semi-annual dividend of 2½ per cent, payable November 2 to stock of record October 16. Edison Electric Illuminating Company of Boston; regular quarterly dividend of 2½ per cent, payable November 2 to stock of record October 15. East St. Louis & Suburban Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable November 2 to stock of record October 15. Columbus Railway Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable November 2 to stock of record October 15.

ELECTRICAL SECURITIES FOR THE WEEK ENDED OCTOBER 10.

New York:	*Closing.*
Allis-Chalmers common	11¼
Allis-Chalmers preferred	35½
Brooklyn Rapid Transit	48¼
Consolidated Gas	145¼
General Electric	140
Interborough-Metropolitan common	10½
Interborough-Metropolitan preferred	31
Kings County Electric	125
Mackay Companies (Postal Telegraph and Cables) common	68
Mackay Companies (Postal Telegraph and Cables) preferred	67¾
Manhattan Elevated	135
Metropolitan Street Railway	26
New York & New Jersey Telephone	110
Western Union	58½
Westinghouse Manufacturing Company	74

The annual meeting of the Manhattan Railway Company will be held at 195 Broadway, New York city, on November 11.

Boston:	*Closing.*
American Telephone and Telegraph	126¾
Edison Electric Illuminating	225
Massachusetts Electric	51
New England Telephone	119½
Western Telephone and Telegraph preferred	75

The number of stockholders of the American Telephone and Telegraph Company now amounts to better than 25,500, an increase of over 2,000 since the beginning of the year. This is a gain of 8 per cent in the nine months. Less than two years ago the American Telephone Company had barely 18,000 stockholders, so that there has been an average yearly increase of over 3,500 names in the past two years.

Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	34½
Electric Storage Battery preferred	34½
Philadelphia Electric	10
Philadelphia Rapid Transit	22⅜
United Gas Improvement	86

Chicago:	*Closing.*
Chicago Telephone	125
Commonwealth Edison	108¼
Metropolitan Elevated preferred	40
National Carbon common	67
National Carbon preferred	110

For September the Chicago Telephone Company gained 2,095 telephones, making a gain for nine months of 21,443, and a total in service of 175,075.

The annual meeting of the Commonwealth Edison Company will be held November 9. Proxies run to Robert T. Lincoln, Samuel Insull and William G. Beale.

ELECTRIC RAILWAYS.

WACO, TEX.—The survey of the proposed Waco, Temple & Marlin interurban has been begun out of Temple. Construction will start in a few weeks.

MILWAUKEE, WIS.—The first through electric car over the Chicago & Milwaukee Electric road, from Evanston to Milwaukee, arrived at the southern city limits of Milwaukee on September 30.

MONTGOMERY, ALA.—It is understood that in a short time the Montgomery Traction Company will begin the work of generally extending its lines. At a meeting of the directors, held in Philadelphia, it was decided to take up the matter.

WEATHERFORD, TEX.—Mayor Moseley announces the completion of the Weatherford interurban survey subscriptions. The expenses to survey the line to Mineral Wells were guaranteed by Fort Worth, Mineral Wells and Weatherford. The work will cost $3,500.

SPOKANE, WASH.—Announcement is made that about the middle of December the new Brookville-Puyallup branch of the Puget Sound Electric Railway will be opened for traffic. The completion of this line of electric railroad will enable the people of the Puyallup Valley to come direct to this city.

DOWAGIAC, MICH.—Articles of incorporation have been filed for the Dowagiac Railway Company, the incorporators being C. K. Minary, H. S. Grey and Henry Mason, of Benton Harbor, and the capital stock being $200,000. These gentlemen are identified with the Benton Harbor & St. Joseph Street Railway and Power Company, and it is their purpose to extend the electric line from Eau Claire to Dowagiac.

BUFFALO, N. Y.—The last link connecting Erie with Buffalo by trolley will be completed by January 1, 1909, according to General Manager Calisch, of the Buffalo & Lake Erie Traction Company. The only gap now remaining is at Westfield, and this will soon be closed under action taken by the village taxpayers, who have voted $35,000 toward the expense of a viaduct to connect the hills on the opposite sides of Chautauqua Creek.

SPRINGFIELD, ILL.—The construction of the interurban line from Springfield to Quincy by way of Petersburg is an assured fact, according to the officials of the Springfield-Rochester line, who have charge of the proposed new line. Practically all of the right of way has been secured, and grading from the entrance of the Zoo park west has been carried a considerable distance. The extension of the city street railway line to the Zoo park next spring will assure an entrance into the city for the new line.

GREELEY, COL.—At a meeting of the directors of the Burlington Interurban Railway Company, which is building a line from Hudson, on the Burlington, to Greeley, Pleasant Valley, Ault and Fort Collins, the resignation of F. O. Olson as president was accepted and John P. Klug, one of the wealthiest stockmen and land owners in Weld County, was elected to the vacancy. C. I. Moore, a merchant of Greeley, was elected treasurer. All surveys are made and grading is expected to be begun in a few days.

GUTHRIE, OKLA.—A charter has been issued by the secretary of state to the Oklahoma, Kansas & Missouri Interurban Railway Company, of Miami, with $200,000 capital stock. The company proposes to build an interurban line from Miami through Hattonville and Lincolnville to Baxter Springs, Kan., twenty-two miles, at an estimated cost of $20,000 per mile. The proposed line goes through the heart of the Miami-Baxter zinc field and proposes to haul ore as well as passengers. The incorporators are: Franklin Smith, of Joplin, Mo.; F. O. Freeman, R. H. Holton, John Hall and D. W. Cooter, of Miami.

BALTIMORE, MD.—Work on the new line of the Baltimore, Halethorpe & Elkridge Electric Railway is being pushed, and it is probable that cars will be in operation over the route early in December. The portion of the road now in course of construction reaches from the terminus of the Wilkens avenue car line to Halethorpe, a distance of three and a half miles. The line branches off from Wilkens avenue and runs almost parallel with the Pennsylvania tracks to Halethorpe. The road is being built over a private right of way, and the development will be carried only to Halethorpe for the present. The total cost of the line to Halethorpe will be about $125,000, and when completed it will be operated by the United Railways.

STOCKTON, CAL.—The electric road between Stockton and Modesto will be commenced at an early date, the financing of the road having been completed by Morris L. Brackett, of New York. Surveyors are now in the field, running the first lines between the two cities. It is proposed to build the road from the water front in Stockton out Lincoln street alongside the French Camp toll road through French Camp, Manteca, Ripon and on to Modesto. The South San Joaquin Improvement Company some weeks ago closed up the rights of way with the farmers on the understanding that they were to be transferred to the first corporation or firm that would build the road. The company turned over these rights of way to Brackett, who interested $500,000 capital.

INDUSTRIAL ITEMS.

THE BIRD-ARCHER COMPANY, New York city, has published a bulletin devoted to boiler troubles and their prevention.

STANLEY & PATTERSON, INCORPORATED, 23 Murray street, New York city, is distributing a folder calling attention to the advantages of Marshall fuse plugs.

THE RAIL JOINT COMPANY, New York city, announces that at the close of September business the total output of its base-supporting rail joints amounted to over 50,000 miles equipped during the past fourteen years.

THE FRANKLIN ELECTRIC MANUFACTURING COMPANY, Hartford, Ct. has published some interesting information in its bulletin No. 7, concerning the Franklin tungsten lamp. Copies of this bulletin will be furnished to those interested upon request.

THE HILL CLUTCH COMPANY, Cleveland, Ohio, manufacturer of power-transmitting, elevating, conveying and cement machinery, has issued a catalogue devoted to its collar oiling bearing. Copies of this catalogue will be furnished to those interested upon request.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., in the October issue of "Trumbull Cheer," gives some interesting information concerning the manufacture of switch clips, and illustrates the Trumbull type "A" switch for 4,000 amperes, 250 volts.

THE NERNST LAMP COMPANY, Pittsburg, Pa., has issued bulletin B, devoted to a description and illustrations of the Westinghouse Nernst multiple-glower lamps. These new types of Nernst lamps have attracted a great deal of attention, and the data contained in this bulletin will be found of value by all those interested in problems of illumination.

THE TAUNTON-NEW BEDFORD COPPER COMPANY, Taunton, Mass., has purchased the manufacturing interests of the W. S. Hill Electric Company, of New Bedford, Mass. The Hill company will become the electrical department of the Taunton-New Bedford Copper Company, and the Hill factory at New Bedford will be used until new quarters are prepared in Taunton. Charles S. Mendell, formerly treasurer and general manager of the W. S. Hill Electric Company, will be manager of the electrical department.

THE CONSOLIDATED SUPPLY COMPANY, 321 Dearborn street, Chicago, Ill., has issued its loose-leaf catalogue No. 15. In distributing this catalogue the company calls especial attention to the patented metal car roof which has just been placed on the market after having been tested out on a car for the past five years. The roof has special features fully covered by letters patent. The company is also calling attention to a new malleable tie plate which has had considerable sale, and on which patent is now pending.

THE WHEELER CONDENSER AND ENGINEERING COMPANY, Carteret, N. J., manufacturer of the well-known Wheeler surface, jet and barometric condensers and Wheeler centrifugal pumps and water-cooling towers, announces that Harry Pennington, of the Lumbermen's National Bank Building, Houston, Tex., has been appointed its agent for Texas. Mr. Pennington has been engaged in the practice of mechanical engineering in Houston for a number of years, and has been identified with many of the large enterprises in that section. He is at present consulting engineer for the Galveston waterworks, engineer for Houston and Fort Bend counties, president of the Southwestern Engineers' and Architects' clubs, and chief engineer of the state of Texas.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has published an attractive bulletin entitled "Steady *versus* Unsteady Voltage." This bulletin, No. 4,619, refers particularly to the use of automatic feeder regulators for incandescent lighting on alternating-current systems. Bulletin No. 4,622 is devoted to a description and illustrations of polyphase maximum-watt indicators, and bulletin No. 4,616 contains a detailed description of high-voltage type H transformers. An attractive booklet, descriptive of the General Electric "Multi-catch" socket has been issued, and bulletin No. 4,618 describes the company's new form PB polyphase generator for use in small power plants and isolated lighting plants where rapidly increasing inductive loads and low power-factors are encountered.

Record of Electrical Patents.

Week of October 6.

900,165. PROGRESSIVE CUTOUT MECHANISM. Jay H. Hall, New York, N. Y., assignor to the Electric Controller and Supply Company, Cleveland, Ohio. Filed March 18, 1908. Means are provided for rendering the cutout driving member inoperative for a predetermined travel of the driving mechanism after each cutout operation.

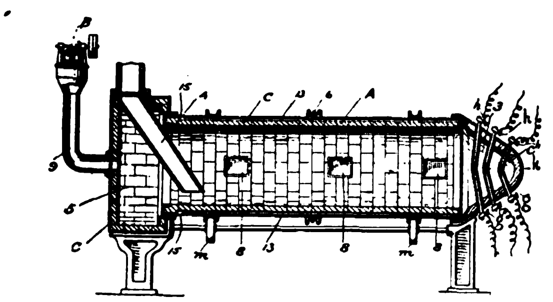
900,169. APPARATUS FOR ELECTROPLATING METAL SHEETS. Henry L. Hollis, Chicago, Ill. Filed August 1, 1907. Means are provided for conveying sheets of metal vertically from one end of the vat to the other.

900,192. ELECTRIC FURNACE. Robert McKnight, Pittsburg, Pa. Filed August 28, 1906. A rotating tubular furnace is heated by passing a draft through an electrically heated firebox.

900,207. ELECTRIC FURNACE. James H. Reid, Cornwall, Ontario, Canada, assignor of one-half to Stephen Lemuel Tingley, Ottawa, Canada. Filed April 1, 1907. The material under treatment comes in contact with serially-arranged electrodes, and means are provided for varying the chemical conditions in each electrode chamber.

900,208. ELECTRIC LAUNDRY IRON. Earl H. Richardson, Ontario, Cal., assignor to Pacific Electric Heating Company, Ontario, Cal. Filed December 2, 1907. There is a thermic fuse in circuit with the heating unit.

900,214. VENT-VALVE FOR AUTOMATIC TRAIN STOPS. Hiram G. Sedgwick, Mill Valley, Cal. Filed June 29, 1907. Means are provided for giving the valve a differential movement.



900,192.—Electric Furnace.

900,215. AUTOMATIC TRAIN STOP. Hiram G. Sedgwick, Mill Valley, Cal. Filed September 4, 1907. Means are provided for manually operating the circuit-breaker and for automatically restoring the circuit-breaker to a normally closed position. A registering device is operated every time the circuit-breaker is released.

900,216. AUTOMATIC TRAIN STOP. Hiram G. Sedgwick, Mill Valley, Cal. Filed October 28, 1907. An eccentrically geared mechanism imparts to the valve a quick and slow movement.

900,217. AUTOMATIC TRAIN STOP. Hiram G. Sedgwick, Mill Valley, Cal. Filed January 4, 1908. A supplemental vent is operated after the main vent is closed. Means are provided for manually closing this supplemental vent.

900,238. TELEGRAPH KEY. James Z. Tucker and Lawrence V. Tucker, St. Louis, Mo. Filed December 16, 1907. The throwing-in switch is adjacent to the key-button.

900,266. HOOD AND REFLECTOR. George Cutter, South Bend, Ind. Filed October 30, 1907. A weatherproof cluster reflector.

900,273. ELECTRIC RAILWAY SIGNAL SYSTEM. Thomas M. Freeble, Latrobe, Pa. Filed June 7, 1907. A lever arm and contacts are actuated by the passage of the trolley wheel.

900,278. ELECTROLYTIC ALTERNATING-CURRENT RECTIFIER. Arthur S. Hickley, Manasquan, N. J. Filed November 12, 1907. The electrolyte contains a substance for preventing oxides and precipitates forming and collecting in the cell.

900,279. ELECTROLYTIC ALTERNATING-CURRENT RECTIFIER. Arthur S. Hickley, Manasquan, N. J. Filed January 16, 1908. One electrode extends across the cell near the bottom and through one wall.

900,289. SYSTEM OF CONTROL FOR ELECTRIC MOTORS. Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed December 4, 1905. An auxiliary field magnet winding remains open-circuited when the motor is operated by alternating currents, but is closed-circuited on itself when the motor is operated by direct currents.

900,292. ELECTRIC CURLING-IRON HEATER. Wynn Meredith, San Francisco, Cal., assignor to Pacific Electric Heating Company, Ontario, Cal. Filed September 25, 1907. The heating element is adapted to receive a curling iron.

900,295. ELECTRIC HEATING DEVICE. William C. Mortensen, Salt Lake City, Utah, assignor of one-half to Joseph R. Harris, Woodruff, Ida. Filed April 6, 1908. Resistance lamps are contained between an outer and inner cylinder.

900,304. ELECTROMAGNET FOR TELEGRAPHONES. Peder O. Pederson and Valdemar Poulsen, Copenhagen, Denmark, assignors to American Telegraphone Company. Filed April 9, 1902. Means are provided for directing an effective number of lines of force outside the coil.

900,320. CIRCUIT-INTERRUPTER. Cullen B. Snell, Bradford, Mass. Filed February 18, 1907. The circuit-operating device is yielding supported by a plurality of contact springs.

900,340. APPARATUS FOR ELECTROPLATING. John A. Yunck, South Orange, N. J. Filed November 8, 1906. The cathode, or negative pole, is adapted to hold an incandescent electric lamp. The anode has its operative face shaped to conform to the adjacent surface of the lamp bulb.

900,344. MAGNETIC OPERATING MEANS FOR CAMERA SHUTTERS. Arnold Bartels, Los Angeles, Cal., assignor of one-half to Rosa Hug, Los Angeles, Cal. Filed June 10, 1907. The shutter-operating arm is actuated by means of an electromagnet.

900,359. CHANGING BATTERIES IN ELECTRICALLY PROPELLED VEHICLES. Albert J. Doty, Mount Vernon, N. Y., assignor of one-half to Charles Berg, Philadelphia, Pa. Filed February 3, 1908. Battery trucks are disposed on opposite sides of the vehicle, in position to deliver a battery to one side of the battery receptacle, and receive a battery from the other side.

900,370. BLOCK-SIGNALING SYSTEM. John S. Holliday, Wilkinsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed February 21, 1908. The track rails are electrically continuous for all currents and equipped with synchroscopic relays having a movable element connected across the track rails.

900,372. ANTISEPTIC MOUTHPIECE FOR TELEPHONES, SPEAKING TUBES, ETC. Milton S. Hufschmidt, San Francisco, Cal. Filed April 7, 1906. A porous disc extends transversely across the interior of the mouthpiece.

900,382. MOISTURE-PROOF CASE FOR INSULATED WIRES. Adrian L. Joynes, Paducah, Ky., assignor of one-third to Charles L. Meyers, St. Louis, Mo. Filed June 4, 1906. A terminal head adapted to be hermetically sealed by screw-threaded rims and sectional washers.

900,386. TELEPHONE TRANSMITTER. Adolph G. Kaufman and Leopold J. Lippmann, New York, N. Y., assignors to American Callaphone Company, New York, N. Y. Filed January 19, 1907. The diaphragm is actuated by a plurality of mouth-pieces.

900,387. TELEPHONE RECEIVER. Adolph G. Kaufman and Leopold J. Lippman, New York, N. Y., assignors to American Callaphone Company, New York, N. Y. Filed February 7, 1907. A loud-speaking receiver.

900,392. SOUND RECORDING AND REPRODUCING INSTRUMENT. Georg Kirkegaard, New York, N. Y., assignor to Stilson Hutchins, Washington, D. C. Filed November 18, 1899. Means are provided for successively magnetizing a number of bodies in accordance with sound waves and a diaphragm subjected to the successive action of said bodies.

900,404. TELEPHONE DESK SET. Rap H. Manson, Elyria, Ohio, assignor to Dean Electric Company, Elyria, Ohio. Filed August 23, 1907. Means are provided within the upright for securing the upper hinge member to the base.

900,416. ELECTRIC GLOW LAMP. Walther Nernst, Göttingen, Germany, assignor, by mesne assignments, to Nernst Lamp Company, Pittsburg, Pa. Filed March 29, 1898. The element comprises a mixture of zirconium oxide and another refractory metal oxide.

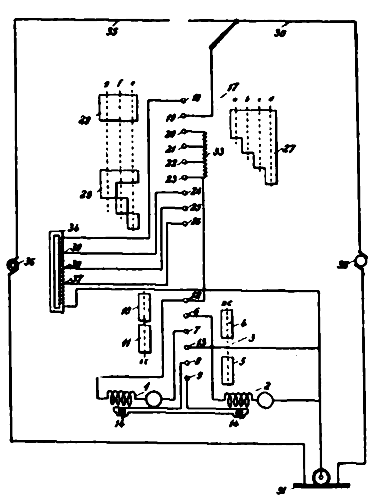
900,420. VARIABLE-SPEED MOTOR. Alvin A. Pifer and Charles E. F. Ahlm, Cleveland, Ohio, assignors, by mesne assignments, to F. B. Wagner, Cleveland, Ohio. Filed February 14, 1906. The regulator is equipped with two pole-shoe sections adapted to be moved from and toward each other.

900,426. SHADE AND SOCKET FOR INCANDESCENT LAMPS. Benjamin P. Rucker, Wilkinsburg, Pa. Filed June 21, 1906. The lamp socket is located entirely within, and sheathed by, the cap or dome of the shade.

900,429. ELECTROSONATOR. Ryusai Sakamoto, Tokyo, Japan. Filed April 11, 1907. A regulating socket is moved laterally to vary its point of contact on a spring plate.

900,447. ANTISEPTIC ATTACHMENT FOR TELEPHONES. Frank C. Tabler, St. Louis. Mo., assignor of fifty-one one-hundredths to Gus V. R. Mechin, St. Louis, Mo. Filed January 24, 1908. Fibrous material is arranged in front of, and parallel to, the diaphragm of the telephone. Means are provided for supplying said material with an antiseptic medium.

900,456. BLOCK-SIGNAL SYSTEM FOR RAILWAYS. James T. West, Rockingham, N. C. Filed March 25, 1908. A signaling circuit is adapted to be carried by a train or vehicle having a suitable signaling device therein responsive to current impulses through the track circuit.



900,289.—System of Control for Electric Motors.

900,458. TELEPHONE TESTING SYSTEM FOR PARTY LINES. Charles S. Winston, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed May 31, 1905. Means are provided whereby a special tone is produced in the operator's receiver when the busy circuit is closed.

900,476. COVER FOR ELECTRIC BATTERIES. Horatio J. Brewer, New York, N. Y. Filed May 29, 1908. The cover is arranged to carry the carbon and zinc elements and effect a moisture-tight cell.

900,478. ALTERNATING-CURRENT MOTOR. James H. Bryson, St. Louis, Mo., assignor to Wagner Electric Manufacturing Company, St. Louis, Mo. Filed October 7, 1907. Means are provided for shifting the pole phases.

900,486. ELECTRIC FURNACE. Erik Cornelius, Trolhättan, Sweden. Filed July 9, 1908. One electrode is fixed and the other is adapted to travel along the top of the chamber.

900,489. TELEPHONE EXCHANGE SYSTEM. William W. Dean, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. Filed October 18, 1906. An automatic ringing device comprising a ringing relay with line and generator connections.

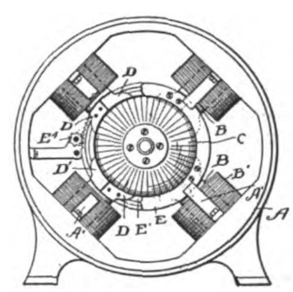
900,493. APPLIANCE FOR THE CURE OF RHEUMATISM AND OTHER DISEASES. Daniel R. Dewey, Hamilton, Ontario, Canada. Filed December 26, 1907. A blue-glass receptacle encloses an electric light filament, and is covered with a perforated non-combustible substance.

900,502. ELECTRODE FOR ELECTROLYTIC PURPOSES. Paul Ferchland, Berlin, and Joseph Nussbaum, Charlottenburg, Germany. Filed November 5, 1906. The conductors are dipped into a solution of lead sale, and current passed through said conductors and solution until a deposit of considerable thickness is formed.

900,529. PROGRAMME ATTACHMENT FOR CLOCKS. Julius W. Hansen, Princeton, Ind. Filed February 28, 1908. Means are provided to close an electrical circuit at any desired time.

900,542. ELECTRIC GENERATOR. Gottlob Honold, Stuttgart, Germany. Original application filed April 30, 1902. A high-tension spark generator.

900,553. TELEGRAPHIC RELAY. Isidor Kitsee, Philadelphia, Pa. Filed February 14, 1908. Means are provided to lower the resistance of a series of independent selenium cells through incoming impulses, and to move after each impulse the selenium cell formerly in the local circuit out of said circuit, and to move a selenium cell formerly out of said circuit in operative connection with said circuit.



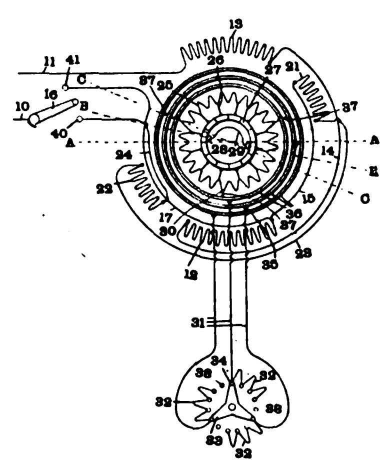
900,420.—Variable-Speed Motor.

900,555. CONTROLLING SYSTEM FOR ELECTRIC MOTORS. Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Original application filed December 4, 1905. Means are provided for arranging the circuit relations of the motors in accordance with the character of the energy supplied thereto.

900,571. SECONDARY BATTERY. William Morrison, Chicago, Ill. Filed June 8, 1903. A reversible electric galvanic battery.

900,597. PROCESS FOR PRODUCING AN ELECTROLYTIC DEPOSIT OF METALLIC CHROMIUM. Franz Salzer, Dresden, Germany. Filed January 16, 1908. Metallic chromium is produced by employing a bath containing a mixture of chromic acid and chrome oxide.

900,602. MASSAGE VIBRATOR. William G. Shelton, Chicago, Ill. Filed September 3, 1907. A motor operates the vibrating head.



900,478.—Alternating-Current Motor.

900,613. AUTOMATIC CIRCUIT-CLOSER FOR ELECTRIC-LAMP HOLDERS. William D. Tickner and Lucius C. Tickner, Blanchardville, Wis., assignors of one-half to Charles M. Crowell, Blanchardville, Wis. Filed February 3, 1908. The movement of the plunger closes the circuit and shifts the position of the lamp.

900,641. ELECTRIC FIRE ALARM. Harry Anderson, Haddonfield, N. J. Filed February 14, 1908. Fusible means are provided between a movable lug and a stationary lug.

900,658. REMOTE-CONTROL ELECTRIC SWITCH. Jay S. Bristol, Gillespie, Ill. Filed April 6, 1907. Means are provided for determining the direction of circuit closers.

900,676. TELEPHONE EXCHANGE SYSTEM. Ray H. Manson, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. Original application filed February 1, 1907. A plurality of ringing generators is adapted to supply current of different frequencies.

ELECTRICAL REVIEW

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CONTENTS

MUNICIPAL STREET LIGHTING CONTRACTS.

Among the problems of central station work which involve close appreciation of both technical and commercial elements for the largest success and most lasting satisfaction between a company and its customers the modern street lighting contract takes a prominent place. The taxpayer realizes that the cost of street lighting is a direct charge, and while he may be a power consumer in his private business, it is easy for him to look upon street lighting costs as sheer outgo, in comparison with the definite results which he obtains on his own premises for a given expenditure devoted to lighting or motor service. The approach of a renewal time in a street lighting contract is only too often the signal for unfair attempts on the part of the politicians to scale down the charges for service, and as everybody is interested in the quality and amount of illumination provided in the thoroughfares of a city buying central station current, it is easy to stir up public opinion on the rate question. A most important part of the central station manager's work is therefore the study of street lighting conditions in other communities, in order to meet unfair attempts to secure reductions by definite explanations of differences in local conditions that justify differences in rates or service, and to provide on the other hand the best service that is available in the art.

The form of street lighting contract desirable will naturally vary widely in different cities and towns, but in general the more definite the contract as to the service to be rendered, the price to be charged, the privileges of the two parties, and the inclusion of possible new conditions, the less opportunity there will be for future disagreement.

A well-drawn contract will, it would appear, state definitely the extent of service and its duration, with the course to be followed in case a named maximum number of lights are desired to be exceeded by the city. It is desirable from the city's standpoint to state in the contract that the price named covers the service, the company being required to bear the cost of generating the current, and as a rule paying for the supplying and maintenance of all lamps, poles, wires and attachments. The rating of the lights is obviously one of the most vital points to define, and all hazy specifications should be avoided on this point. Thus, in a recent contract the lighting unit is specified as of "not less than two thousand nominal candle-power, and as long as the present type of alternating-current lamps are used the current supplied shall be not less than seven and one-half amperes intensity, and the apparent watts shall be not less than 540 at the lamp." This particular specification wisely brings the lamp size down to accurately and easily measurable quantities, and still provides for future improvement in the art. Too close a specification on a single point tends to prevent the municipality from enjoying the advantages of progress in equipment manufacture, as in the case of an eastern city which required the company to supply incandescent lamps of a certain wattage each, regardless of their candle-power.

The privilege of installing testing instruments, either of the indicating or recording type, is sometimes allowed the municipality, and it is not considered unfair to the company to require recording ammeter charts showing the hours of service and the outages to be submitted with each bill. Either party may rightfully demand the recalibration of the recording meter at any time. The place where such meters may be installed, and the reduction allowed on outages should also be stated. In one recent contract of this character the bill is reduced two cents per hour per lamp for each ampere or fraction thereof that the current falls below 7.5 amperes, up to a total of four cents per lamp per hour. Right to use the public thoroughfares for construction of street lighting equipment and its maintenance may properly be incorporated in the contract, to save time and formality in regard to permits when work is to be done. No charge should be made by the municipality to the company for any pole or fixture work under the duties of the street lighting service.

Unless the terms of lighting and extinguishment are positively and definitely set forth in such a way that no possible misunderstanding can arise, the contract is faulty. If any lighting schedule or table is referred to it should either be included in the contract text or attached as an included supplement. Another wise provision is to specify the heights permissible for lamp suspension, the quality of fittings desired and the conditions under which tree trimming may take place. Continuous service is so essential to this class of work that generally a brief statement to the effect that the company shall maintain a patrol system and emergency force required to handle outages or defects at the earliest feasible moment on report from police officers or individuals is all that is needed. In some cases it is desirable for the company to furnish the city a map, showing the location of all poles, wires and lamps used in the arc service, filing a new and corrected map at the office of the city engineer whenever a change of any consequence is made. A fair appreciation of mutual conditions will do much to create good feeling and avoid disagreements. The right of the city to install and maintain fire-alarm and other municipal signaling wires on the lighting poles for street service is frequently considered fair by central stations. The day of the month upon which payments are due from the city may properly be included. If at any time the city desires new types of equipment for use in its street lighting service, the contract ought to provide the course to be followed in conference with the company, together with provision for appeal to an arbitrating authority in case of disagreement. The central station can request the inclusion of a provision for the extension of the contract for given period if it desires, without going to the trouble of rewriting the contract in detail.

ELECTRIC POWER IN SOUTHERN MILLS.

Cotton mills in the South are rapidly abandoning steam plants in favor of power from the hydroelectric companies. One of the hydroelectric systems in the Piedmont region of North and South Carolina, where the majority of the southern cotton mills are located, is now operating more than seventy of these mill plants, and most of the mills have been connected to its lines within the past two years.

As a rule, these cotton mills operate about 3,300 hours per year, when there is enough business, and electric power is usually sold to them at so much per kilowatt-hour, recorded by a meter, so that the only payment by a mill is for energy received.

Rates vary, but eight-tenth cent per kilowatt-hour, or about $26 per kilowatt for an operating year of 3,300 hours, is a common rate, while some mills do better than this. Lower rates are made to mills that own substations and receive their energy at the voltage of transmission than to mills that are supplied with current at motor voltages by the hydroelectric companies.

Formerly most of the motors in cotton mills were operated at about 550 volts, and substations were designed to distribute current at this voltage. As this practice tended too much to the multiplication of small substations, of less than 1,000 and even less than 500 kilowatts capacity each, with a high cost per kilowatt, the hydroelectric companies have offered some inducements in rates to mills taking current at about 2,000 volts, and many mills now operate motors at this voltage. Where a mill operates with individual motors of twenty-five-horse-power or less for its looms, it is often necessary to step down the 2,000-volt current to 550 volts.

Most, if not all, of the electric power supplied to cotton mills in the Piedmont region is three-phase at sixty cycles. The choice of sixty cycles by the hydroelectric companies appears to have been mainly influenced by the fact that mills using electric drive from local power plants, when the electric companies came into the field, were mostly equipped with sixty-cycle motors, that the power demands of the cotton mills were much greater than any railway loads in prospect, and that generators, transformers and motors are cheaper for sixty than for twenty-five cycles.

Cotton-mill loads are remarkably constant during the hours of each day when in operation, so that a large generating station driving dozens of these mills on a long transmission line shows a variation of less than ten per cent in load from 6 A. M. to 6 P. M., except at the noon hour. For this kind of load the highest points appear to be reached at about 9 A. M. and 3 P. M. The consumption of electric energy from day to day is also very uniform in cotton mills, the variation being usually less than ten per cent, except on Saturday when the hours of operation are less than on other week-days.

Southern cotton mills may be contrasted with those in the North as to the larger number of the former often found in one city or town, and as to their consequent small capacity. The average power required by the southern cotton mill is therefore small.

One of many illustrations on this line may be noted at Concord, N. C., a city of 7,910 people in 1900, where there are ten different cotton mills with a combined equipment of 149,310 spindles, 3,495 looms and electric motors and steam engines of 5,610 horse-power. The average equipment for each of these ten mills is thus 14,931 spindles, 349 looms, and driving apparatus of 561 horse-power. In five of these Concord mills the driving power is taken from the transmission lines of a hydroelectric company.

Records of operation here presented for two southern cotton mills show well the uniform character of their loads, and consequent high-load factors. One of these is a cotton-spinning mill operating sixty-six hours per week, and during one week of normal operation the total consumption of electric energy was 12,650 kilowatt-hours, giving an average load of 191.6 kilowatts. The meter indication of power in use at this mill was taken at about 2 P. M. on two days and was found to be 208 and 210 kilowatts respectively. During twelve months, frequent observations of the meter disclosed a maximum load of about 220 kilowatts at this mill. On this observed maximum the average of 191.6 kilowatts gives a load factor of eighty-seven per cent.

Another cotton mill is supplied with electric current at about 2,000 volts from transformers of 475 kilowatts total capacity, for motors of 445 aggregate horse-power, driving 14,000 spindles and 800 looms. This mill operates sixty-two hours per week, and driving one week of normal operation the energy consumed amounted to 19,050 kilowatt-hours, corresponding to an average load of 307 kilowatts per day. During a period of twelve months the maximum reading of the meter at this mill showed a load of 320 kilowatts, so that the load factor, on the basis of the average of 307 kilowatts noted above, was ninety-six per cent. Another normal week of operation at this last-named mill showed a consumption of 19,650 kilowatt-hours, corresponding to an average load during the hours of operation of 317 kilowatts and to a load factor of ninety-nine per cent. So high a load factor raises a doubt as to the accuracy of the reported maximum load of 320 kilowatts during the entire year, but in any event the load factor is very high. The load factor here considered is, of course, taken for the hours of operation only and not for the entire twenty-four hours of each day.

At the last-named mill the motor capacity of 445 horsepower is the equivalent of 333 kilowatts, and with an efficiency of ninety per cent the power demand with all motors at rated load would be 370 kilowatts. The average load of 317 kilowatts is thus about eighty-five per cent of the demand of all motors at normal load.

Several of the above features of its cotton-mill loads make the South an attractive field for the construction of hydroelectric plants. As the cotton factories are split up into rather small units that require only 500 to 600 horse-power each, on an average, the cost of steam power at each mill must be greater than it is in the larger plants at the North, and this tends to keep up the price of electric power. Besides this, few industries show better load factors than those indicated above.

MACHINERY DATA FOR PURCHASERS.

Whenever an intending purchaser of machinery asks a manufacturer for technical data regarding his product it is more important than is always appreciated to supply information of this character promptly. A well-conducted district office should usually be provided with all the important dimensions of standard apparatus, its capacity under clearly defined conditions of service and its approximate cost for preliminary figuring. Where special machinery must be designed and built or where standard equipment must be somewhat modified in order to effect a sale it is out of the question to expect the manufacturer to supply detailed figures at short notice, but certainly so far as regular products are concerned there is little excuse for delay.

There is no doubt that some prospective purchasers call for data with very little idea of awarding the contract to the company which supplies them, and sometimes even the buyer of apparatus will ask for the most minute details of the equipment-points which do not concern him in the slightest direct way in the matter of operation. In the sale of a new design of electric motor, for instance, a purchaser may call upon the manufacturer to give him a copy of the detailed design, showing the exact cross-sections of the magnetic circuits, the number of turns of wire on each coil, dimensions of commutator bars, bearing surface and many other facts. Whether the manufacturer gives out this sort of information willingly or not, most of it can be determined if the purchaser cares to take the trouble, so there is little reason to hold back such data from bona-fide purchasers. It may be well to request that the information be kept as confidential, and most buyers of machinery are willing to accede to a reasonable request of this sort, but after all, mere possession of the statistics of a machine design far from qualifies the holder to reproduce the actual apparatus. It is entirely proper, however, that the innermost details of a costly machine design should be difficult of access, protected though they may be by patent rights.

It is an actual fact that the failure to furnish such information as the capacity of apparatus, its over-all dimensions, weights, number and size of important parts, areas of working sections, etc., at an early stage of the negotiations with a prospective purchaser may result in serious delay to all parties concerned, and if these data are withheld after the apparatus is installed, considerable inconvenience may result. Particularly when sudden interruptions of service occur is it essential to know the principal technical data of a piece of machinery in order to expedite repairs and the replacement of extra parts that may often have to be ordered by wire. Among the loose ends which remain to be cleared up after a new installation begins service there is nothing of more importance to the purchaser than the possession of sufficient information to enable him to maintain as well as operate the apparatus. A narrow policy in supplying blue prints and other important data on the part of a manufacturer may easily prejudice the purchaser against him in future selections of equipment.

Street Railway Conventions.

Meetings of the American Street and Interurban Railway Association, the Accountants', Engineering, Claim Agents' and Transportation and Traffic Associations, Atlantic City, N. J., October 12-16.

THE annual meetings of the American Street and Interurban Railway Association and its affiliated organizations, the Accountants', Engineering, Claim Agents' and Transportation and Traffic Associations were held at Atlantic City, N. J., October 12 to 16. Sessions were held on the morning and afternoon of each day, and in addition to the exhibit of the Manufacturers' Association there were a number of entertainments which were greatly enjoyed.

On Monday the Atlantic City Business League held a carnival, with a military parade and industrial parade on Atlantic Avenue. In the evening there was a display of fireworks and a musical carnival near the city hall. Later in the evening an informal dance was given in the ballroom of the Marlborough-Blenheim Hotel.

On Tuesday evening the annual reception of the associations was held in the solarium of the Marlborough-Blenheim. The soloists were Miss Margaret Keyes and Oley Speaks.

On Wednesday afternoon the ladies of the associations were entertained at the Country Club of Atlantic City. On Wednesday evening the Manufacturers' amateur vaudeville and theatrical performance was given at the Savoy Theatre.

On Thursday afternoon the ladies of the convention were tendered an entertainment in the solarium of the Marlborough-Blenheim Hotel, Miss Amy Grant giving a series of musical readings. On Thursday evening there were theatre parties at the Apollo and Savoy Theatres.

On Friday evening there was an entertainment in the solarium of the Marlborough-Blenheim.

Headquarters were established for convention registration and other business on Young's million-dollar pier. The American association and Manufacturers' association established hotel headquarters at the Marlborough-Blenheim, the Accountants at the Chalfonte, the Engineering association at the Dennis, the Claim Agents at the Traymore, and the Transportation and Traffic association at the Traymore.

The morning of Monday was given over to the registration of the delegates and guests and to preparation for the technical sessions.

The American Street and Interurban Railway Association.

THE first meeting of the American Street and Interurban Railway Association was called to order at 3 P. M. on Tuesday by Vice-President Shaw, acting as chairman in the absence of President Calvin G. Goodrich. Mr. Shaw read a letter from the president expressing his regret at being unable to be in attendance at the convention.

The report of the executive committee was read and approved.

The secretary's annual report was presented and accepted.

The annual address of President Goodrich was read by Mr. Shaw. It contained several suggestions concerning the future policy of the association. The suggestion that the association appoint separate times and places for holding the annual conventions of certain of the affilated associations was discussed, and it was considered inadvisable on account of the importance of the subject to take immediate action. A resolution was introduced by W. G. Ross and adopted as follows: "That a discussion be held at Thursday's session with the idea of appointing a committee to study the question, this committee to make a report, which is to be distributed among the members."

The Committee on Badges reported that a badge for associate members had been adopted.

The report of the Committee on Membership was presented, followed by the report of the Committee on Subjects.

The final business of the session was the hearing of the report of the Committee on State and Federal Regulations.

The Wednesday session was called to order by Vice-President Shaw at 2.15 P. M.

The report of the Committee on Education was presented by Professor A. S. Richey, in the absence of the chairman, H. H. Norris. This report described the apprenticeship courses adopted by the New York Central Railroad Company, the Master Mechanics' Association, the Trustees' Gas Educational Fund, and the Edison companies. The results of the apprenticeship work have been very satisfactory, and the report concludes that the example being made by the railway and lighting industries in the training of employés indicates the importance and value of the work. Some form of cadet or apprentice plan seems necessary to the best development of employés, but the plan must be adapted to local conditions.

This report was discussed by Professor D. C. Jackson, who said that but few electric railway corporations had shops and construction organizations of such magnitude as to make it desirable to establish an apprentice course. On the other hand, there are many companies employing large numbers of men who are without advanced technical training. Such companies would find it well worth while to establish courses of training, and it seemed that the extension of the cadet system among the various electric railway companies would lead to an ultimate enlargement of the body of competent and able engineering and executive officers which the companies would have to draw from.

The report was also discussed by C. H. Hile, of the Boston Elevated Railway Company; Howard F. Grant, who described the system employed by Stone & Webster, and L. H. Storrs.

W. Caryl Ely delivered an address on the subject "How Can the American Street and Interurban Railway Association and Its Affiliated Associations Be Made of the Greatest Value to the Member Companies"?

Mr. Ely believes that the different classes of work should be subdivided and committed to the care of various committees, so that ample time could in that way be had for proper investigation.

A communication was presented from the *Electric Railway Journal*, offering to compile and publish, free of any cost to the organization, an electric railway dictionary, and requesting the association to name an editing committee, this committee to be an advisory committee on the publication of the dictionary. This proposition was approved and the following committee appointed by the chairman: H. H. Adams, New York; Paul Winsor, Boston; Richard McCulloch, St. Louis.

The constitution and by-laws of the American Street and Interurban Transportation and Traffic Association were approved, and a communication from the J. G. Brill Company was read, offering a prize to students in the technical schools of the country for the best thesis on city and interurban cars. It was decided to authorize the incoming president to appoint a judge to act in conjunction with S. M. Curwen and H. W. Blake.

The Thursday session of the American association was called to order by Vice-President Shaw at 2.50 o'clock.

The report of the Committee on Insurance was presented and accepted.

E. G. Connette, chairman of the Committee on Welfare of Employés, presented the report of this committee.

Following the discussion on this report, the report of the Committee on Nominations was presented and accepted as follows: President, James F. Shaw, Boston, Mass.; first vice-president, Arthur W. Brady, Anderson, Ind.; second vice-president, Thomas N. McCarter, Newark, N. J.; third vice-president, Gen. O. H. Harries, Washington, D. C.; fourth vice-president, Charles N. Black, San Francisco, Cal.

The Committee on Resolutions presented a report thanking the Manufacturers' association for bringing together the elaborate collection of railway appliances on exhibition. The report also presented resolutions thanking the mayor of Atlantic City, the Atlantic City Business Men's League, the Atlantic City Hotel Men's Association, the technical and local press, the officers and committees of the association, the committee which had carried out the conferences with the Interstate Commerce Commission on depreciation, and President Goodrich.

Resolutions of regret upon the death of C. Densmore Wyman and John A. Brill were also presented.

The convention of the American association was then adjourned.

The Accountants' Association.

THE twelfth annual meeting of the American Street and Interurban Railway Accountants' Association was called to order at the Chalfonte Hotel at 10 A. M. Wednesday by R. N. Wallis, acting president.

The records of the last meeting were read and approved, and Mr. Wallace delivered the annual address of the president.

Acting Secretary H. E. Weeks read the report of the executive committee, recommending an addition to Section 1 of the by-laws, as follows: "All past-presidents of the American Street and Interurban Railway Accountants' Association and its predecessor, the Street Railway Accountants' Association of America, shall be honorary members of the executive committee without the right to vote."

The appointment of a committee upon inter-line accounts was also recommended.

W. H. Forse, Jr., explained that the Central Electric Accounting Conference, an informal association composed of the accountants of various electric railways in the Central States, had been organized in order that the accountants might get together and discuss matters of mutual interest at more frequent intervals than the meetings of the national association afforded. At a meeting in Indianapolis recently the subject was brought up, and it was suggested that the American association be asked to act in the matter, so that it would be broader in its scope, and not only affect the railways in the Central States, but all the electric railways in the country that are interested in inter-line accounting. It was decided that the chair appoint a committee of five to act on this matter.

The report of the treasurer showed that the expenditures during the fiscal year were $1,794.66. Standard classifications sold during the year amounted to $119.50.

F. W. Sweney, special examiner Interstate Commerce Commission, addressed the meeting, and stated that the commission had issued three classifications which will become effective on January 1. He was satisfied that if there were any points in which the classifications were not clear they could be developed, and that the commission would be glad at any time to receive suggestions with regard to any points which might be disputed.

A. R. Patterson read a paper entitled "Organization of the Accounting Department of an Electric Railway and Light Company."

There was considerable discussion on this subject, and the meeting adjourned after the appointment of nominating and resolution committees.

The Thursday session of the Accountants' association was called to order at 10.20 A. M. Fred G. Simmons, president of the Engineering association, addressed the meeting, and his recommendation for the appointment of a joint committee was referred to the incoming executive committee.

Ellis G. Carpenter, representing the Claim Agents' Association, addressed the convention, followed by William H. Forse, Jr., who presented a paper entitled "Inter-Line Accounting of Interurban Railways."

Mr. Forse was followed by A. F. Weber, statistician for the Public Service Commission for the First District, New York, who made a brief address.

The Friday session of the Accountants was called to order at 10.20 A. M., and the paper by A. B. Bierck, entitled "Effect of Electrification on Accounting Methods of Steam Railways," was read by Acting Secretary Weeks.

Frank R. Henry, who resigned as president of the association during the year because of his resignation from the United Railways Company, of St. Louis, to engage in other business, was elected an honorary member of the association.

The incoming executive committee was directed to take up with the Transportation and Traffic association the desirability of the appointment of a joint committee to consider questions of interest to that organization and the Accountants' association. It was also proposed that similar committees be created with the Claim Agents' association and with the Engineering association.

It was voted to direct the incoming president to request the president of each of the various state electric railway associations to appoint one member to keep the member companies in such associations in touch with the work of the Committee on Standard Classification of Construction and Equipment Accounts and form of report of the Accountants' association.

Acting President Wallis appointed the following Committee on Inter-Line Accounts: W. H. Forse, Jr., Indiana Union Traction Company, chairman; Irwin Fullerton, Detroit United Railway Company; C. L. Wight, Interurban Railway Company, Des Moines, Iowa.

R. N. Wallis, treasurer of the Fitchburg & Leominster Street Railway, Fitchburg, Mass., was elected president for the ensuing year. The office of secretary and treasurer is purely honorary. H. E. Weeks, secretary and treasurer of the Tri-City Railway Company, Davenport, Iowa, was elected to fill this position.

The convention was then adjourned.

The Engineering Association.

THE American Street and Interurban Railway Engineering Association held sessions on Tuesday afternoon, Wednesday morning and Wednesday afternoon, and Friday morning and afternoon. The sessions were devoted entirely to the reports of committees, taking up the special work which comes under the jurisdiction of the engineering department, and on Friday afternoon the following officers were elected: President, Paul Winsor, Boston, Mass.; first vice-president, F. H. Lincoln, Philadelphia, Pa.; second vice-president, W. H. Evans, Buffalo, N. Y.; third vice-president, W. J. Harvie, Utica, N. Y.; secretary and treasurer, John W. Corning, Boston. Executive committee: William Roberts, Akron Ohio; E. O. Ackerman, Columbus, Ohio; L. L. Smith, Highwood, Ill.; Martin Schreiber, Newark, N. J.

TUESDAY AFTERNOON SESSION.

The first session of the Engineering association was called to order by President Fred G. Simmons at 2.45 P. M. on Tuesday. President Simmons then delivered his annual address. He stated that the idea of carrying on the work of the association by means of standing committees had been put into effect to such an extent that all the work presented by the association this year, excepting only the question box, was carried on by the standing committees. At the present time there were committees covering practically the entire field, but it will undoubtedly be found desirable to add, to change and to supplement these committees as further progress is made. It was advisable that the standing committees endeavor to make definite recommendations as their work progressed.

He called attention to the lack of co-operation on the part of some member companies with regard to filing complete answers to the data sheets distributed by the standing committees.

The report of the executive committee was presented, which was adopted.

The report of the secretary and treasurer was presented. This showed that the expenditures during the fiscal year ending October 16 were $1,983.86. There was a balance on hand of $4.37. The association received from the American association $1,950, and from miscellaneous sources $38.23.

The report of the Committee on Maintenance and Inspection of Electrical Equipment was presented. This report was prepared by L. L. Smith, chairman; E. T. Munger, C. C. Long, L. W. Jacques and F. P. Maize. It was abstracted briefly by Mr. Munger.

This report was developed along the same general lines as were followed last year. Specifications for important items of supplies were added and the rules governing the maintenance and inspection amplified. The general subject of the report was divided under various subheads and considered separately as follows: Carbon brushes for railway motors; Insulating materials for railway repair shop use; Recommendations of committee of last year—extent to which they have been approved and followed; Gear and pinion specifications; Lubrication; Gear and pinion lubrication; Rules for lubrication for the guidance of car-house employés; Armature and axle liners; Trolley wheels; Air-compressor maintenance; Air-compressor inspection; Time versus mileage basis car-house organization; Practical rules for the inspection of electrical equipment, for the guidance of car-house employés; Home-made tools and devices.

The committee reports a greatly increased interest in the work by the member companies, the data sheets having been filled out in a complete and painstaking manner. The thanks of the committee were extended to E. H. Anderson, of the General Electric Company, and J. L. Davis, of the Westinghouse Electric and Manufacturing Company, who rendered valuable assistance in the preparation of this year's report, and also that of last year.

The discussion was opened by E. W. Olds, who analyzed the various subdivisions and called attention to the number of recommendations which had really been put into practice by the member companies.

The committee recommended as one of the tests for carbon brushes a vibrating test using a rotating disc with a drop of one-eighth inch. One could hardly tell without trying it whether this test would be too severe. In his judgment this would seem to be the case. He was happy to say that there had been a considerable advance in the production of insulating material within recent years.

Concerning the gear and pinion specifications, it would seem that if the pinion steel was of the proper tensible strength, that the test would not show very much reduction of area. A dense and tough material must be secured. At the same time, the steel must have a high elastic limit. To-day there are very few companies using grease for lubrication, and even with old motors, oil is being very extensively employed.

Paul Winsor stated that his company had used about fifty impregnated coils with a good deal of success. With regard to babbitting, the company had held out against using patented babbitting, and had found its greatest success with the use of an expensive babbitting which ran high in tin. He had used a small trolley wheel, as light as could be got, but it had not been possible yet to convince his company that it could make any great saving by changing its procedure. He thought that the foremen's meetings were very important and helped materially in cutting down delays and improving the service. To-day the delays are one-half of what they were a year ago, and this improvement has been followed month by month throughout the year.

Mr. Adams endorsed Mr. Winsor's remarks, and said that he tried to go a little further, and in addition to decreasing troubles with the foremen, presented brief talks on interesting subjects. Representatives of the various companies had attended these meetings and talked to the men. Regarding the use of trolley wheels, he had found that the average life of a five-inch wheel was from 20,000 to 25,000 miles, as against 3,000 to 10,000 miles for four-inch wheels.

Mr. Doyle stated that in New York city service during the last year the company has secured about 3,000,000,000 miles of work with a certain type of carbon. This carbon had reduced the troubles on the Manhattan Elevated Railway eighty-five per cent, and had reduced the troubles in the subway about ninety-six per cent. The cost runs to about 17.3 cents per 1,000 car-miles, as compared with a former cost of forty-four cents.

E. Gindre, of Le Carbone Company, addressed the meeting on the matter of carbon brushes, and stated that there should be as many specifications for controlling carbon brushes as there are different grades taken as standards. He discussed the various tests. The vibrator tests he did not think corresponded closely enough to the conditions of practice. The shocks and vibrations to which traction brushes are normally subjected in actual service can not be compared with the exaggerated trial connected with the vibration test. The resistance test he had always found of value, as it answers more closely to actual practice. The abrasion test he considered would be a rational method when running the different brushes on soft material. The decrease in weight would be proportional to the abrasive coefficient. With regard to the subject of single and double widths of brushes, he thought the advantage of single-width brushes lay in a better distribution of the current, as they fitted the commutators more easily on account of their smaller section.

Mr. Brady, of the National Carbon Company, said the report was a step in the right direction. He thought, however, that most of the tests would be found impossible for most mechanics or men in the barns to make. Most of the tests were laboratory tests, which it was hard for those skilled in such work to make accurately. Unless extreme care were taken it was hard to bring the brush down to a true surface. The slip-ring test was a good test, but to his mind was more a matter of contact resistance than anything else—that is, a brush with a high-contact resistance will glow more quickly than a brush with a low-contact resistance. A brush with a high-contact resistance is a good brush to have in some cases, while one with a low-contact resistance is good in other cases. The manufacturing companies were glad to go into the matter of brush tests with anybody and make brushes for any specifications. It did not necessarily follow that if a brush would give 100,000 revolutions on a vibrator, and 300 amperes under test on a slip ring, that it would work satisfactorily on all motors.

Mr. Doyle suggested that the carbons be classified on the car-mileage basis. If their performance could be measured in this way it might prove a reasonable mark for the manufacturer to work to.

Taking up the matter of gears and pinions, Mr. Doyle said that his company had found that a special treatment of carbon steel increases its value as much as 100 per cent. It occurred to him that some suggestions might be made by the Standardization Committee with a view to designing some form of test which would indicate the wearing characteristics of different compositions of material which had been subjected to different courses of treatment.

Mr. Winsor said that the vibration test

would help a great deal. It would not fix a standard of how many vibrations a certain brush would make, but it would show that under certain conditions, if a certain character of carbon would make 20,000 vibrations or revolutions, that it would be able to live up to certain conditions.

E. E. F. Creighton presented a paper entitled "Lightning Protection for Electric Railways."

This described the new types of aluminum arresters which have been developed by the General Electric Company for street-railway lightning protection.

Mr. Anderson took up the discussion of the gear and pinion specifications given by the committee. He said that the values given in the report are within the range of carbon steels, applying particularly to the service where they would be required. It will not be wise to run tensile strength and elastic limit tests too high, because this makes the tools too brittle and they will not stand the shocks.

The discussion of Mr. Creighton's paper was then taken up, and in reply to the question whether there was any well-defined method of applying lightning arresters with reference to the number installed per mile, Mr. Creighton stated that a great deal depends upon the internal resistance of the arresters. The idea of installing five or six lightning arresters to the mile was probably due to the fact that the arresters in themselves had a considerable internal resistance. If a cloud discharges directly over a line, the more arresters installed per mile the greater freedom will there be from trouble from such discharges. The line arrester would have little effect in taking care of a discharge just over a car, and dependence would have to be placed largely upon an arrester on the car. The line arrester can take care only of the discharge in its near vicinity, and it helps out in the general protection by reducing the quantity of discharge that the arrester on the car has to take care of. It is rather an undecided question if there should be more than two arresters per mile. Mr. Creighton thought that if there were a good discharge path, two arresters per mile would be sufficient to relieve the ordinary strain.

The further consideration of the subject of lightning protection on cars, on motion, was referred to the Committee on Maintenance.

The report of the Committee on Maintenance and Inspection of Electrical Equipment was accepted, and the report as a whole referred to the incoming committee, which would have charge of these matters.

The meeting was then adjourned until Wednesday morning.

WEDNESDAY MORNING SESSION.

The Wednesday morning session of the Engineering association was called to order at 9.30 o'clock.

The report of the Committee on Standardization was presented by H. H. Adams.

This report stated that the standards adopted by the association as a result of the report in 1907 are being seriously considered by the various electric railway companies and rapidly adopted by others throughout the country. This applies particularly to axles, journal bearings, journal boxes, brake shoes, brake-shoe heads and keys, and standard section of flange and tread of wheels. The present report recommends that the standard height of couplers for interurban cars from the top of rail to the centre of the coupler should be thirty-one inches. This is the standard adopted for all steam railroad passenger cars. The committee recommends that the standard height of couplers for city cars from the top of rail to the centre of the coupler be twenty inches.

With regard to the type of coupler to be recommended as standard for city cars, the committee suggests that the subject be continued for consideration for at least another year, or until a coupler has been developed of sufficient merit to meet with general approval and suitable for adoption as a standard. In selecting a proper type or pattern of coupler for interurban cars, the committee has been handicapped from the fact that no form of automatic coupler or attachment has been developed in practical service by which interurban cars can be coupled together and can also be directly coupled to standard steam railroad cars. The committee recommends the adoption as standard for interurban railways of a coupler of a vertical plane type which will have the same contour lines of knuckle and guard arm as will automatically couple with standard steam railroad couplers. It is also recommended that the distance from the centre of the pocket pin to the pulling face of the coupler be fifty-four inches. This length will apply equally as well for cars in city service. Where a bumper arrangement will permit, the committee recommends that on city cars a pocket casting should be placed on the top of the bumper, the centre of the pocket to be thirty-five inches above the top of the rail, and the casting to be of ample strength and properly braced, so that, by means of a suitable bar, city cars can be coupled on the level with the automatic couplers of interurban cars. It would appear that for the present, at least, it would be advisable to maintain a link slot and coupling pin hole in the knuckle of the automatic couplers.

For standard height of platforms for interurban cars the committee recommends that from the top of rail to the top of platform floor the height be fifty-one inches, and that the height for city cars from the top of rail to the top of platform be thirty-one inches.

So much variance in practice is found in the different cities concerning the height of car steps that the committee merely suggests the following as recommended practice for interurban cars: Height from top of rail to top of tread of first step, seventeen inches; to top of tread of second step, twenty-nine inches; to top of tread of third step, forty inches; to top of platform floor, fifty-one inches. Similar recommendations are made for the heights of step on city cars as follows: To top of first step, seventeen inches; to top of second step, thirty-one inches; height of riser from top of vestibule floor to floor of city car, ten inches.

The committee recommends that the bumper arrangement on interurban cars be made as solid and substantial as the design of the equipment will permit, and if possible, some suitable arrangement provided which will prevent the bumpers of interurban cars from passing over the bumpers of the lower city cars.

The committee also recommends that where possible the top of bumper on city cars be reinforced with a bumper casting of suitable design which will engage the bumper of the interurban cars as well as provide a wider surface, thus preventing the bumpers from passing over and the cars from telescoping in case of collision between city and interurban cars.

The committee recommends that the standard height for bumpers on interurban cars from the top of rail to the top of bumper shall be fifty-one inches, and the height from the top of rail to bottom of bumper, forty-three inches. The standard height from the top of rail to the top of bumper on city cars shall be thirty-one inches, and the width of bumper for city cars shall be six inches.

In opening the discussion Mr. Adams said he believed that the question of the height of bumpers is one of the most important considerations presented in the report.

Mr. Doyle stated that in his lay-up yards an eight-car train, running at a speed of thirty-five miles an hour, collided with a string of empty cars. One of the cars that was laid up was equipped with a bumper plate made of a steel casting with a corrugated face. This casting prevented the front car of the moving train from telescoping the rear car of the stationary train, but the cars following the leading car climbed over each other and destroyed the ends. The corrugated bumper plate engaged the other car and prevented it climbing up at that point. The condition of the cars at the other points in the two trains was a valuable demonstration of the efficiency of the corrugated buffer plate.

Mr. Olds stated that the ordinary steam coupler was not sufficient to take care of the vertical movement which obtained where the roads changed their grade. As far as the height of platform was concerned, he thought that the committee's recommendation of thirty-five inches, which is steam railroad practice, is what should be adopted because of the many roads handling steam cars over their tracks.

In reply to a question Mr. Doyle explained that the corrugated buffer which he described was placed in the end of the sills, and as the cars come together the line of sills is maintained and the force of collision is dissipated by throwing the cars off sideways. Unless the casting is placed right on the ends of the sills the great force of a high-speed collision would break down an ordinary platform. The construction of the car should permit the interlocking of the sills by their ends; then it is impossible for the car to telescope. If, in the ordinary city car which has a platform tied up to the main sills, the interlocking device is provided, the device is valuable only at such low speeds as the strength of the platform will resist. He did not believe it would be possible to generate speed enough to destroy the alignment of long sills. The force tends to go sideways or up, and the superstructure would break at the point of attachment to the sills. In connection with having castings provided in the structure there should be some material between the casting and the end of the sills proper to offer a resistance similar to that employed in the couplers of freight cars. There should be a dampening spring or some other provision made to absorb the shock, because of the effect on the passengers of the sudden stopping of steel cars.

J. F. H. Wyse, of the Toronto Railway Commission, said that the subject of standardization is of especial interest in Toronto at the present time, as there is now before the Ontario Railway and Municipal Board an application to lower the steps of city cars. In Toronto a number of prominent physicians have come forward and stated that high steps on the cars in the city of Toronto were injurious if not dangerous. The height of step recommended, regarding which discussion has taken place, and to abolish which an application has been made to the Toronto commission, is practically the same as that which the committee suggests in the present report as standard. In view of this condition, therefore, it would seem to him that if postponing the adoption of the proposed standards and going further into the question resulted in securing a lower standard than seventeen inches for the first step on city cars, the public's best interests would be served, an immense amount of expense to the operating companies would be avoided, and a cause removed which promises to be a source of irritation between the municipal authorities and the railway companies.

The president read a communication on the subject of the height of car steps from Howard A. Kelley, a physician of Baltimore, Md., in which he entered a protest as a physician against the seventeen-inch standard, which he considered militated against the safety and comfort of women, little children and the aged.

H. W. Blake said that the New York State Street Railway Association had gone carefully into the matter of the height of car steps three or four years ago. The conclusion had been reached that there was thirty-one inches to be made up between the ground and the platform riser. If the first step is made lower, the second must be made higher. The first step one naturally takes with the right foot, and the hand rail is in position for assistance.

Mr. Adams stated that in New York the operating companies are limited in the width across sills, which is a vital point. Cars can not be built eight feet across the sill, and consequently, clearance between sills can not be obtained to enable the radiation of a truck with thirty-three-inch sills and keep the car floor low enough to give a lower step. The New York companies do have a step somewhat lower than recommended in the report, but he would point out that there are conditions which limit the height of these steps.

The report of the Committee on Power Generation was presented by G. H. Kelsay, chairman.

This report gave particular consideration to the practical operation of steam turbines, steam meters and flue-gas analyzers. The report states that the investigations of the committee have brought forcibly to its attention the apparently indifferent methods of operation practised in many power stations, and particularly in the boiler room. The committee believes that there is far too little attention given to economy in the boiler room, and that a careful and systematic use of apparatus available would result in a great saving. It is suggested that the work of the committee be continued and that further reports should be expected next year on the question of carbon-dioxide recorders in addition to an investigation into the use and merits of draft gauges, pyrometers and systems of damper control. It is also suggested that an investigation as to the merit of buying coal on a basis of analysis should receive attention by such a committee, together with an investigation as to the methods of making analytical tests of coal and the use of calorimeters.

The report stated that twenty out of twenty-seven replies received from companies indicated that the users considered a turbine equal to or preferable to the reciprocating engine on the score of reliability, while but five preferred reciprocating engines as to this point. For operation under varying steam pressure the replies are not so decidedly in favor of the turbine, there being five out of twenty-four replies favoring the reciprocating engine. Steam-driven auxiliary equipment is preferred under most circumstances, but especially so where the exhaust is needed to heat the feed-water. The users of steam meters seem to agree that they have found the instruments valuable for test, for measuring accurately small quantities of steam, and for getting approximate divisions of steam used for various processes. Some complain of the high cost of the meters and the small variety of uses to which a given meter can be applied.

The result of the work the committee has been able to do on flue-gas analyzers indicates that these instruments are of unquestionable value, and the records, when properly taken and interpreted, offer a means of detecting defects both in the construction and operation of boiler furnaces which might not otherwise be exposed.

Charles Hewitt, in opening the discussion on this report, said that it was his experience that in the case of turbine plants and steam-engine plants equally modern and equally well designed, there was very little difference in the steam economy. An exhaust-steam turbine with a well-designed reciprocating engine would show an economy much greater than any straight turbine plant that could be built.

Mr. Roberts said that he had been surprised at the excellent performance of the turbine under excessive overload conditions. There seemed to be almost no range of power within the possibility of the strength of the material of which the turbine is constructed that it will not work up to.

R. H. Ross said that with regard to the ability of the turbine to operate under overload, that certain types of steam turbine, particularly the impulse type, give an increased efficiency under overload. The best economy with such a turbine is obtained at the greatest load that can be carried. It is to the advantage of users of this type of turbine to put on it all the load which the generator can carry without overheating.

In taking up the discussion of flue-gas analyzers, Mr. Winsor pointed out that it was customary to weigh the coal and record the electrical output, but between these two there is almost nothing to work from. Methods of knowing how coal is being burned are needed, and it is necessary to know what the boiler and what the various other units entering into the generation of power are doing.

Mr. Hewitt stated that it was generally believed that the most satisfactory point from which to take out the gas for analysis was from the stack or near the stack. He was opposed to this conclusion. In a battery of five boilers, for instance, working on one stack, it is no indication whatever of any individual boiler's performance. As a general principle, the nearer the approach is made to the stack, the less indication of carbon dioxide is found. He has discovered that the only reliable indication which can be secured is by taking a sample of gas from about the middle of the combustion chamber. Various means of abstracting the gas have been tried, and he has finally settled down to the following scheme: A pipe is run into and completely across the combustion chamber. This pipe is perforated with holes, so that a very large sample all the way across the combustion chamber is secured. He has found that the banking of a boiler in one bank materially affects the gas in the flue and in some cases it has been found that the banking of one boiler affects the other, although the other boiler may not be banked.

It was voted to accept the report and refer the subject matter to the incoming committee.

The session was then declared adjourned.

The report of the Wednesday afternoon and the Thursday sessions will be presented in the next issue.

Claim Agents' Association.

THE first session of the Claim Agents' Association was called to order by the third vice-president, J. S. Harrison, at 3.45 P. M. Monday. The president's address was read by Charles B. Hardin, claim agent, United Railways Company of St. Louis.

The report of the executive committee showed that W. H. Weh, second vice-president, had resigned because of leaving the employ of the Cleveland Electric Railway Company to engage in other business.

The treasurer reported that the total expenses were $807.89, leaving a balance on hand of $1.37 on October 1.

The Tuesday morning session of the Claim Agents was called to order at 10 o'clock, with Vice-President Harrison in the chair.

The first paper taken up was entitled "The Organization of a Claim Department for a Small or Moderately Large Company, Including a School of Instruction as a Means of Preventing Accidents," by Francis J. Ryan, M. D., Syracuse Rapid Transit Railway Company, Syracuse, N. Y.

Dr. Ryan exhibited a set of record books and forms, and explained their use.

In discussing Dr. Ryan's paper, F. W. Johnson stated that with the Philadelphia Rapid Transit Company proper instruction had brought about a marked reduction in the number of accidents.

The second paper was entitled "The Claim and Its Disposition," by Peter C. Nickel, claim agent, New York City Railway Company.

The Tuesday afternoon session was called to order at 2.30 o'clock, and the paper entitled "Uniformity in Claim Department Records and Accounts" was read by John J. Reynolds, claim agent of the Boston Elevated Railway Company.

The paper was referred to the incoming executive committee for further consideration.

An address was made by James R. Pratt, claim agent of the United Railways and Electric Company, of Baltimore, who spoke upon the advantages he had received from joining the Alliance Against Accident Fraud.

The paper entitled "The Duties of Claim Agents and Other Officials of Quasi-Public Corporations to the Public" was presented by Eugene R. Roberts, claim attorney of the Knoxville Railway and Light Company.

At the session of the executive committee held on Tuesday evening the following nominations were presented: President, C. B. Hardin, claim agent, United Railways Company of St. Louis; first vice-president, E. C. Carpenter, claim agent, Indiana Union Traction Company; second vice-president, J. S. Harrison, claim agent, Jacksonville Electric Company; Dr. F. J. Ryan, Syracuse Rapid Transit Railway Company; secretary and treasurer, B. B. Davis, claim adjuster, Columbus Railway and Light Company.

The closing session of the Claim Agents' convention was held on Wednesday morning. President Goshorn presided and stated that the amendments to the constitution and by-laws proposed by the executive committee had been considered by the executive committee of the parent association, and it had been decided to refer them for action to the 1909 executive committee of the Claim Agents' association.

The question box was read and President Goshorn described the working of the index system in his office.

The report of the nominating committee presented at the executive session on Tuesday evening was unanimously adopted.

President-elect Hardin, after a brief address, appointed the executive committee a Committee on Employment and a Committee on Ways and Means, after which the Claim Agents' convention was adjourned.

Transportation and Traffic Association.

THE American Street and Interurban Railway Transportation and Traffic Association held its technical sessions on Monday afternoon, Tuesday morning, Wednesday afternoon and Thursday morning. The first session was called to order at 3 o'clock Monday afternoon by President C. Loomis Allen. The report of this session was presented in last week's issue of the ELECTRICAL REVIEW.

On Thursday morning the following officers were elected: President, C. Loomis Allen; first vice-president, R. T. Todd; second vice-president, G. L. Radcliffe; third vice-president, A. W. Warnock; executive committee, the officers, and G. W. Parker, H. C. Page, N. W. Bolen, H. A. Davis.

TUESDAY MORNING SESSION.

The Tuesday morning session was called to order at 9.30 o'clock.

The report of the Committee on Training of Employés was presented by J. W. Brown, chairman.

This report deals with a comparison of the past and present requirements of transportation employés. The methods of procedure of a number of companies are presented in categorical form, and the report makes the following conclusion: "The committee, after careful consideration of the various methods of discipline, and with knowledge gained through actual operation of the merit and demerit system, recommends it as being the best form of administering discipline on account of its taking notice of minor infractions of rules which otherwise would not be subjects of discipline, and also because of the fact that it makes possible commendation of good work on the part of the employés. It affords, as well, an accurate record of the employé's work in every particular."

The committee also recommends that this subject be given earnest consideration, to the end that the men operating the cars and trains may be selected with a proper view of their fitness as to intelligence, acuteness of senses, physical condition and proper aptness for the work.

In opening the discussion on this report, W. H. Collins stated that his company was securing very good results by making a careful selection of its motormen and conductors and starting to train them by putting them on cars with regular motormen, and afterward giving them an opportunity to become familiar with the mechanical equipment by a special training in the shops.

P. P. Crafts stated that the Iowa & Illinois Railway Company first selected the man for his general appearance and qualifications. He then was put through a medical examination, being given a very complete test for vision and hearing and other physical and mental qualifications. If he passed the surgeon's test he was put on a car with one certain motorman and one certain conductor. The company has one man who is especially fitted for breaking in men—that is, he has the knowledge and the moral power to make a man understand what he wants him to learn. Mr. Crafts believes that the indiscriminate breaking in of car-service employés with various motormen and conductors does not result as a general thing to the best advantage of the company. It is better to have one or two men in particular who are especially adapted to this kind of work. After the man has run for such a length of time as is required by the instructor, if he be a motorman he goes into the shop for a few days to learn the essential points of the equipment. The conductor is examined to a greater or less extent as to his knowledge of ticket forms and the handling of the public, etc. After that both classes of employé are put on the extra list. The company selects from the extra list, after the summer season is over, the employés best fitted for the winter list or to go into regular service.

E. E. Potter, of Seattle, said that conditions in his city were governed a good deal by its great distance from other centres. As a consequence, there is more or less of a floating population. The Seattle Electric Company does not, as a rule, employ men who have had previous experience on other roads. The company has found that it gets better results from men who seem to possess the necessary physical and mental qualifications, training these men in its instruction school. The company has an equipment of dummy apparatus, with which the applicant is taught the necessary rules concerning signals, the working of the air devices, and the starting and stopping of cars. He is put under carefully selected motormen and conductors. Only men who have exceptionally good records and who possess the natural qualifications of instructors are picked for this work. The new man's work is carefully observed for a period of six months, and if he does not conform to a certain standard he is taken off the car and placed with a number of other men on an experimental car run over the various lines. He acts as motorman or conductor and is put through another series of tests and his work observed. The company also makes use of daily bulletins, which are posted each day, commenting, in the colloquial phrases that the carmen use, upon the good or bad work which has been noticed on the various lines. A general meeting of the men is held at headquarters about once a month, and some one from the other departments gives them a brief, interesting talk. The men are interested and secure a knowledge of the various parts of the system, the mechanical part of the car and the power stations, and the different points that there are around not only the company's lines, but other lines in the same section.

The men are also given short talks by the claim attorneys and the various inspectors.

Dana Stevens, of the Cincinnati Traction Company, stated that where his company has city and interurban lines operating from the same centre, the practice is to promote conductors and motormen from the city service to the interurban service, the principal reason for this being that the city rates of pay are lower than the interurban rates, and that by the time a conductor or motorman has become a proficient city man, he has reached a point where he will probably want the higher rate of wages which is paid on the interurban lines; therefore, he is promoted to the interurban, on which the lowest rate of pay is as high as the highest rate on the city lines. He has the privilege of staying on a city line, but if he wants to go to an interurban he can, with the prospect of advancement for time service there. Men between the ages of forty and fifty years of age are selected, preferably men with families, regardless of whether they are city or country-bred. If the man gives any local references these are seen personally. Of course, if his references are away from the city, these are written to. If the applicant is accepted he is sent to an instruction school, which is equipped with the various appliances with which he should become familiar. He is then sent to one of the different divisions, reporting to the superintendent, and is put on a car to be broken in. He works directly under an instructor until he is endorsed as competent to operate a car over the line in question. At the present time it is possible to make a very good selection of men, and in no case is a man known to be under twenty-one years of age or over forty-five selected.

R. S. Goff, of the Boston & Northern Street Railway Company, stated that in operating in ninety-five cities and towns some 930 miles of road, almost every condition is met. The employment of men is put directly up to the division superintendents, of which there are sixteen. As far as employing men who have been in other branches of public service is concerned, there is a rule that they shall not be employed except under the O. K. of the vice-president's office. The application is forwarded by the superintendent to the inspection department at Boston, the division superintendent taking care of everything local. The men are placed in service and broken in for varying lengths of time. The older men in the employ are selected for inspection service, and if it appears that a beginner does not get along properly with one instructor, he may be changed to another. In each division there are a few men who are selected for their competence as instructors. He did not agree with the other speakers with respect to the men having had city service making the best men for interurban service. He thought that it was the general opinion of the superintendents that the men on interurban service are far better if they are brought up in that class of service than if they are trained as city men.

C. E. Learned, of the Boston Elevated Railway Company, said that their procedure was very much the same as that described by the gentleman from Seattle. Instead of taking the extra man off a car and showing his deficiencies to the other men on the road, he is quietly instructed by a special instructor. The instructors receive ten cents a day extra for their service the year round, whether they break in a man or not.

J. E. Duffy, of the Syracuse Rapid Transit Railway Company, stated that one of his companies operates three systems: one a purely city system, one an interurban operating for thirty miles between two cities, and the other a city and interurban. When the interurban line was started—an electrified steam road of the West Shore Railroad between Syracuse and Utica—the question of providing men for this service came up. The management decided to take the old men from the two city lines and train them for interurban service. The selection was left to the superintendent of the two ctiy companies. The men were entirely unfamiliar with high-speed equipment and block signals. They were first placed in the shops when the cars were being assembled, and were paid the regular rates of wages while they were receiving instruction. There were forty-two men in the first instruction classes, and it cost the company approximately $7,800 to instruct the men necessary to man the cars. The experience of the company was entirely satisfactory in the matter of promoting the men from the city service to the interurban service, and he believed that the management was quite satisfied with the expenditure of the money.

E. F. Peck, of Schenectady, pointed out the importance of having the men subjected to a written examination. When an accident happens the men very often profess great ignorance, and the local papers take advantage of this fact to noise about a cry that the men are unfamiliar with the rules.

Mr. Duffy said that his company had felt the necessity which Mr. Peck pointed out, and that the Syracuse company took 450 of its employes and paid them for the time that was consumed when making out a written examination. This examination was placed with their record, and all men hired since that time are compelled first to pass an oral examination, which the instructor verifies in writing, and then a written examination, which the applicant signs.

The Hon. W. Caryl Ely addressed the meeting, and called attention to the fact that the present very efficient condition of the organization was an evidence of the fact that the American association is doing a useful work and a lot of it. He thought that there would be a tremendous amount of good obtained by the members of the Transportation and Traffic association from the meetings, and that the emoluments for work will constantly become greater as men become more efficient. It seemed to him that there never was a time when the opportunities were so great as they are now. He called particular attention to the fine series of pictures illustrating the Inland Empire System. Thirty years ago there were no buildings where the Shoshone Flyer now runs, and to-day in the state of Washington there are less than a million people. In spite of this in thirty years there has been the most extraordinary development.

The paper entitled "The Carrying of United States Mail on Electric Railways—Its Advantages and Disadvantages, and the Compensation Therefor," was presented by C. H. Hile, assistant vice-president of the Boston Elevated Railway Company.

After a brief discussion of this paper by J. T. Choate, the convention was adjourned until Wednesday morning.

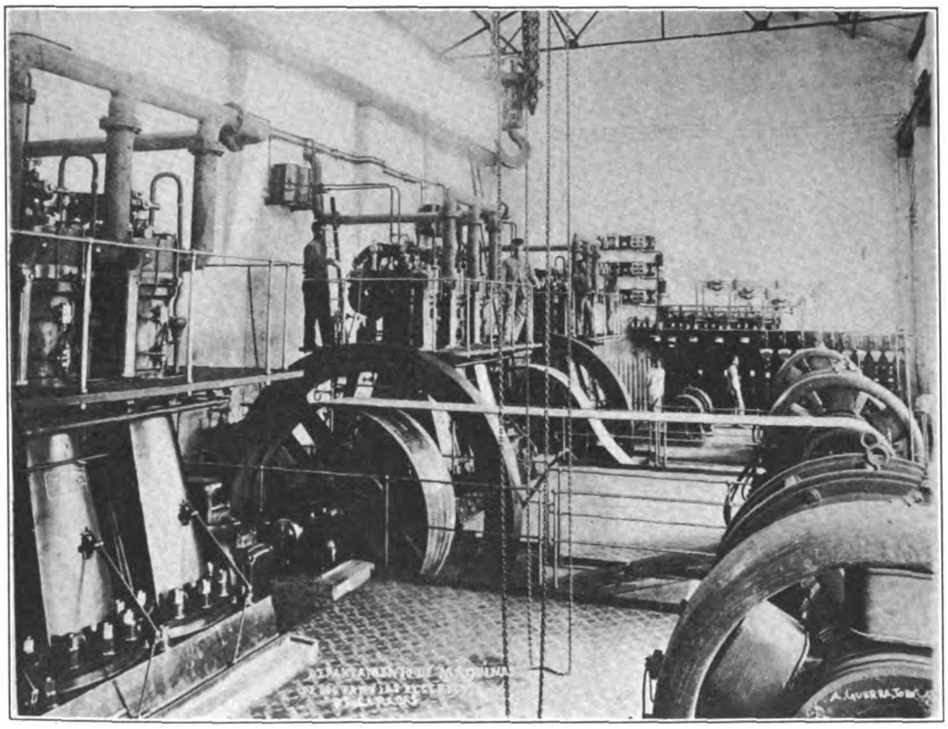
The report of the concluding sessions will be presented next week.

THE ELECTRIFICATION OF THE CARACAS (VENEZUELA) TRAMWAYS.

MODERNIZING ONE OF THE OLD SOUTH AMERICAN CAPITALS.

Caracas, the capital of Venezuela, South America, is the ninth in size of the twenty capitals of America. Caracas was founded by Diego de Lazada in 1564, some sixty years after the settlement of La Guaira, only ten miles away on the coast. The history of the town has been the general history of the Spanish Main. Within twenty years of its foundation the city was raided by Amyas Preston and again later in 1595 by Drake. From 1810 to 1872 there were almost constantly at least two, and sometimes more, opposing armies in the field. In 1872 Guzman Blanco came, took the presidential chair, and with him arrived a comparatively golden age for Venezuela. In 1888 the dictator, who was living in Paris, was formally deposed, and from that date revolution succeeded revolution. The reigning president, Cipriano Castro, won the supremacy in 1899, and has since held his own in spite of efforts, both internal and external, to dislodge him.

Caracas, as has been already stated, is a town of red and white roofs, in squares. It is, in fact, built, as far as the configuration of the ground permits, on the American chess-board system.



Caracas Tramways. Engine Room.

Previous to the year 1905 there were two small horse companies in operation, the Bolivar, running east and west from the station of the Central Railway to that of the La Guaira and German lines. The other was the Caracas Tramway Company, which, starting from the Plaza Bolivar, radiated out to the different quarters of the city. In 1905 the two companies were combined under the presidency of Dr. Zuloaga, a leading member of Caraquenian society, and the directorship of Edgar A. Wallis and Albert Cherry, two of the most prominent members of the British community. A concession was obtained from the municipal authority with a view to the electrification of the whole system, and E. H. Ludford, formerly manager of the Bolivar company was appointed general manager of the whole. Mr. Wallis then went to London, where he speedily interested English capitalists in the scheme, on which J. G. White & Company, Limited, drew up a full report. Their recommendations were accepted and a contract was drawn up, whereby J. G. White & Company, Limited, undertook to supply a complete equipment, including track, office buildings, car-shed, power-house and plant and cables. Work was started in the spring of 1907 and completed by February, 1908.

The routes selected, with a total length of ten miles, were practically those of the old companies. These naturally converged into the Plaza Bolivar, the centre political and social of the city, in which and around or near which all the ministerial and government buildings are situated. The principal line is that from east to west, uniting the Central Railway with the La Guaira stations. On the north side are three routes. Of these the Pastora runs to the northwest through a fashionable district; the Avenida Norte to the Hospital Vargas, past the Panteon where are the ashes of the heroes of the independence, Bolivar and Sucre, and a monument to Miranda; while the third, the San José, parallel to this, but further to the east, runs through a working-class district to the northern boundary. On the southern side are three routes, one to the southeast to the Ponte de Hierro, where the track crosses the Guaira River and connects with a light tramway to a suburb, three miles out; a second to the due south; a third to the southwest. The last divides into two, of which one crosses the La Guaira and the other, the Palo Grande, connects with the German line at a station of that line. Besides tapping a large and populous quarter of Caracas, the Palo Grande line forms the connecting link of a chain of railways of uniform gauge stretching some 180 miles from Pto. Cabello, an important growing port to the west of La Guaira, passing through Valencia, the city second in size and importance in the north of Venezuela, and traversing Caracas, travels toward the south by the Central Railway. By the route also the Caracas meat supply is introduced into the city, the abattoir being situated a short distance from the Palo Grande Station. The maximum gradient is four per cent.

The rails are in thirty-foot lengths and weigh eighty-seven pounds to the yard, and were supplied by the United States Steel Products Export Company. They are of a pattern made especially to suit South American requirements. The tie-bars are of the Bayliss, Jones & Bayliss type. The rail are of the continuous pattern. The rails are of the continuous stringer, sixteen centimetres deep by forty-seven centimetres broad, and are anchored every fifteen feet. The paving is of four kinds—cobbles, setts, macadam and concrete. The special work was manufactured by the Hadfield Steel Foundry Company, Limited, of Sheffield. All points are automatic and of the best toughened cast steel with manganese tongues. They are ten feet six inches in length and have a centre radius of 100 feet. The mates are of solid Era manganese steel, and the rails are bonded with 0000 Brown & Sharpe concealed bonds, supplied by the United States Steel Products Export Company. The fact that no general drainage system is in use in Caracas, and that the drains in existence are principally private property and close to the surface, caused considerable hindrance to the otherwise rapid progress of the work.

The bulk of the overhead construction consists of side poles with cross bracket arms. The junctions are formed with 7/12 galvanized steel span wire, with a breaking strain of 4,000 pounds per square inch, supplied by W. F. Dennis & Company. Only tubular poles are employed, of which 450 are of the Grand National type, their dimensions being seven and five-eighths inches diameter, bottom section, six and five-eighths inches in centre and five and nine-sixteenths inches top section, and thirty feet in length. The rest of the poles are thirty-one feet in length and are of British standard pattern. All were supplied by Messrs. Stewarts & Lloyds. The bracket-arm tubes are two and three-eighths inches diameter. The feeder boxes, supplied by Estler Brothers, are three in number, being fitted with 250-ampere quick-break switches; the section boxes, fourteen, with 100-ampere quick-break switches. The trolley wire is of the 00 Brown & Sharpe grooved type.

The feeder cables, some four miles in length, are all aerial, and are suspended from cross-arms on the poles above the brackets. They are all of pure aluminum with a size of 0.33 and 0.25 square inch, and have a conductivity sixty per cent of that of copper wire, with a conductivity of ninety-nine per cent of Matthiessen's standard of pure copper. They were supplied by the British Aluminum Company and covered by the Silvertown India Rubber & Gutta Percha Company, with triple-braided weatherproof insulation and compounding over all.

The power-house, office buildings and car-shed are all built on one site on the north of the Avenida Este. The plot is rectangular and with a frontage of 53,870 metres and a depth of 43,520 metres. They are all of brick with steel girders and roofwork obtained from Brown, Duncan & Company, of Bootle. The roof coverings of the power-house and car-shed are of galvanized iron, but the office buildings and manager's dwelling are tiled. The doors and window frames are of cedar.

The car-shed is situated at the back. Its dimensions are thirty-five metres by 12.34 metres, and its walls are six metres in height. It contains five tracks, two of which have a pit and are supported on iron columns. The floor and pit are concreted. The rails in the entrance and car-shed are the American Society of Civil Engineers seventy-pound tee rail, and the paving at the car-shed entrance is cobble.

The frontage is taken up with the office buildings and the power-house, over which is the manager's dwelling. The office buildings are all on the ground floor and cover an area of thirteen metres by eleven metres. It is subdivided into manager's, clerks' and accountants' rooms, and men's waiting room, and is provided with lavatory fittings by Doulton & Company. The first story has been arranged to serve as a residence for the manager of the company, who can thus exercise the unusual close supervision requisite in training an inexperienced staff. The roof over the shops was also adapted to serve as a roof garden, providing a cool and pleasant place of retreat in the tropical evenings. The rest of the road frontage is taken up with the engine room, with a length of forty-four metres and a depth of eleven metres and a height of ten metres, while behind the engine room is the battery room, with a floor area of nineteen metres by seven metres, and the machine, carpenters' and other needful shops, the whole making one compact and self-contained system.

There are two aspects from which the power-house may be regarded, either as a substation for a high-tension current or again as an independent producer. As a substation it is employed to transform from 4,500 to 500 volts. The high-tension alternating-current is obtained from the electrical company of Caracas. This company has two stations, at Encantado and Los Naranjos, about sixteen kilometres from the capital. There are four generators at each station and more machinery is now being introduced. The motive force is the water of the Guaira River, which has a fall of thirty-eight and one-half metres and 154 metres at Encantado and Los Naranjos, respectively. During the day the power is supplied by the electrical company.

In the evenings, however, when the town is lighted electrically, and also during stoppages which may occur occasionally, the power is produced in the power-house itself. This is effected by three Diesel engines of 240 brake-horse-power each, running at 180 revolutions per minute. The Diesel engines were selected on account of the high price of coal. They have, moreover, an additional advantage in that no delay need occur in starting them, an advantage which is obvious in the case of a sudden interruption of the high-tension transmission. The engines are belted to three motor-generators. On the induction-motor side these are designed for 5,000 volts, three-phase with fifty cycles, while on the direct-current side they yield an output of 150 kilowatts at 550 volts at a speed of 500 revolutions per minute. The station is also furnished with a battery of 260 Tudor cells, with a

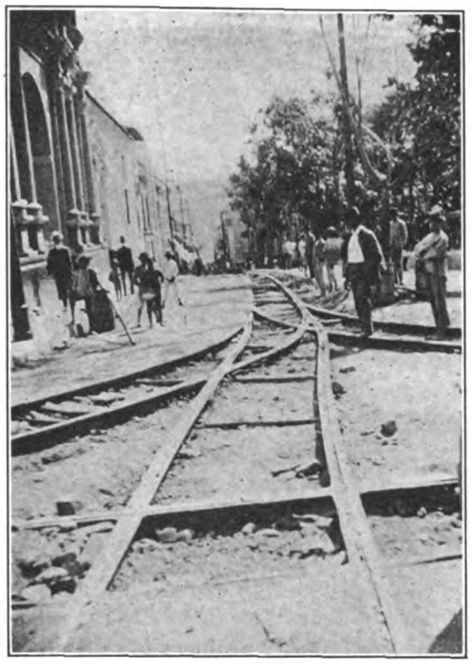
Caracas Tramways. Exterior View of Offices and Manager's House with Engine Room Adjoining.

capacity of 520 amperes for one hour and 252 amperes for three hours, the maximum charging current being 252 amperes. The Lancashire Dynamo and Motor Company has supplied one of its automatic reversible boosters. The regulation with the battery and booster is such as to keep the load on one or two generators operating in parallel (*i. e.*, 150 kilowatts or 300 kilowatts at 550 volts) constant within eight per cent over or under the normal load of 272 or 544 amperes, provided the maximum load does not exceed 100 per cent of the normal load of the set or sets running. In case of 150 per cent overload, the variation does not exceed ten per cent and in the case of 200 per cent overload the variation does not exceed twelve per cent.

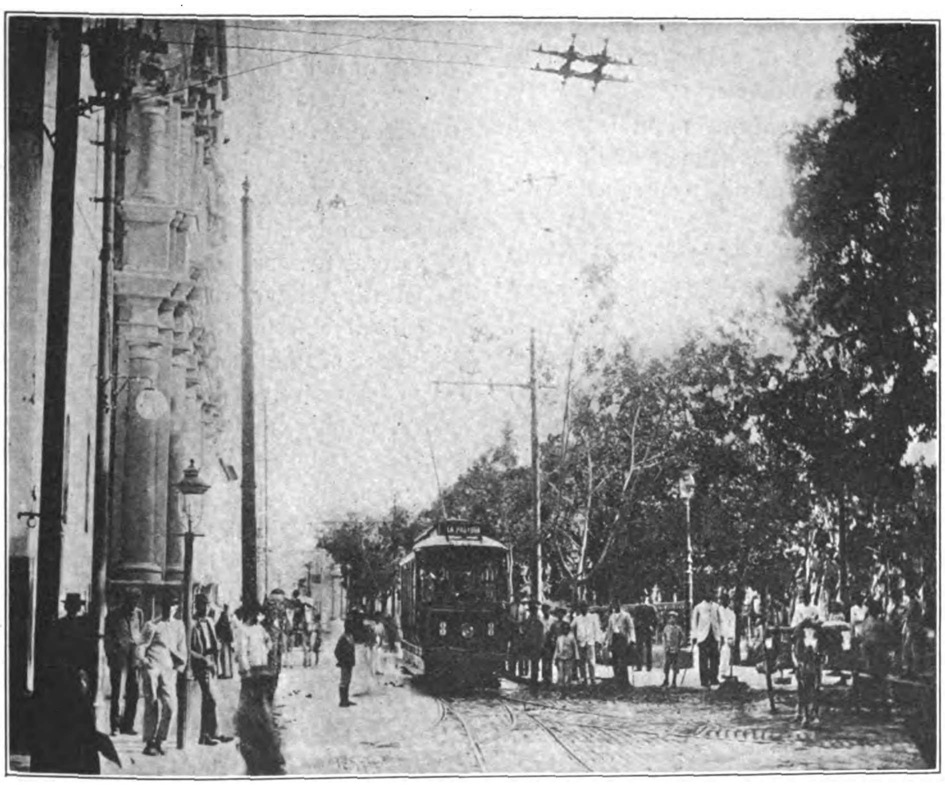
The switchboard consists of ten panels, *viz.*, one high-tension incoming feeder panel three-phase, 5,000 volts between wires. Three induction-motor panels, one battery and booster panel, three direct-current generator panels and two feeder panels, all fitted with the necessary instruments. The board and motor generators were supplied by the General Electric Company, of New York.

The cars, thirty in number, each with a seating capacity of thirty-two, are of the open single-deck type. The car bodies were supplied by Miles, Voss & Company, Limited, of Birkenhead.

The body framing and flooring are of teak and the roof of aluminum. The seats are of the garden-seat pattern, four being reversible and four stationary. They extend transversely the whole width of the car. Storm curtains are provided at the open sides. There are destination indicators and also lifeguards of the Hudson and Bowring type at each end of the car. The trucks are all of the Brill pattern and were manufactured by the United Electric Car Company, Limited.



Caracas Tramways. Special Work, Under Construction.



Caracas Tramways. Construction at the Cathedral Corner of Plaza Bolivar, Central Square of the City.

The electrical equipment of each car is composed of double-motor GE-58, four-turn, thirty-seven-horse-power for 500 volts. It includes also two B-18 controllers with one set of handles, magnetic blowout circuit-breaker, etc. With a view also to the sharp street corners and heavy gradients, each car has in addition to the mechanical brake one Westinghouse magnetic track brake.

From the commencement of the work by J. G. White & Company, Limited, under the supervision of J. G. Rose, in March, 1907, to its completion in February, 1908, the ordinary horse-drawn tramway traffic was in full operation. The traffic and construction were so arranged that during the whole period of conversion little, if any, diminution, took place in the receipts of the tramway company.

Meeting of the American Society of Mechanical Engineers.

The November meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West Thirty-ninth street, on Tuesday evening, November 10. Franklin Phillips, president of the Hewes & Phillips Iron Works, Newark, N. J., will make an address on "The High-Powered Rifle and Its Ammunition—Instruments of Precision," illustrated by lantern slides.

Mr. Phillips is an expert marksman, and in 1903 won the position as first alternate on the international rifle team to England. He was for many years chairman of the committee on rifle and pistol practice in the National Guard of New Jersey, and is now ordnance officer of the Second Infantry of that state.

Tests of rifles and ammunition at Sea Girt, N. J., by men connected with the New Jersey National Guard have led to marked improvement in arms and ammunition and to an entire change in the powder used by the Government, thereby greatly increasing the accuracy of the shot. The improvement has been extended to large guns, and instead of two per cent hits which were made at Santiago, eighty per cent is now the average in some ships.

Mr. Phillips has actively participated in this work, and as he is primarily a mechanical engineer, as well as a marksman, he will explain to his audience the practical bearing of his investigations upon the construction of arms and the elements entering into ammunition.

THE INTRINSIC BRIGHTNESS OF LIGHTING SOURCES.[1]

BY J. E. WOODWELL.

The importance of intrinsic brightness as a factor in practical illumination has been long appreciated and strongly emphasized. At no time has this factor been more essential from the standpoint of hygiene of the eye than the present. The opportunities for violation of the laws of hygiene have not only been enlarged but the penalties of such abuses have been greatly augmented, with the general introduction of the more recently developed lighting sources of high intrinsic brightness, such as the metallic filament incandescent lamps, flaming arc lamps and high-pressure gas lamps. In too many of the recent installations the most dazzling gas and electric lamps are ruthlessly placed in such positions that the eye can not escape the glare. Moreover, the distressing brightness of the source is often intensified by the improper use of concentrating reflectors.

Briefly, any brilliant source of light in the field of view, however small, causes a contraction of the pupil of the eye and reduces the effect of illumination received from other parts of the visible field. A contraction of the pupil also takes place even if the bright spot is viewed only occasionally. Furthermore, the continuous or occasional presence of a bright light source in the field of view impairs, temporarily at least, the sensitiveness of the eye itself, thus again reducing the effectiveness of illumination. Moreover, the contraction of the iris in the presence of bright light sources soon reaches the limit of its protective faculty, beyond which it responds feebly to an increase in brightness. The control of the pupillary aperture appears to be designed to strengthen the vision under comparatively weak illumination, rather than to protect against excessive intensity or brightness.

Recent researches of André Broca and F. Laporte[2] indicate that the pupillary contraction caused by bright light sources within the peripheral vision reduces visibility in proportion to the decrease in working illumination and produces the greatest eye fatigue in comparatively weak illumination. The exhaustion and injurious effect was greatly reduced on the other hand under an illumination of from 1.86 to 3.72 foot-candles, which was shown by tests to be favorable for work, taking into consideration the physiological properties of the eye and the mean limits of its accommodation.

The intrinsic brightness of the luminous source rather than the distance of the source from the eye was shown to be the principal cause for pupillary contraction. This same careful investigation also made it evident that the different light sources may be classed—with reference to their action in producing pupillary contraction and residual images—in the order of their respective intrinsic brightness.

The researches referred to above as well as other previous investigations do not indicate that the protective faculty of the eye is susceptible to the energy effect or to light rays of different color.

Ultra-violet rays have been regarded by some authorities as harmful, but it has been shown that these rays in the light from various forms of incandescent illuminants of high intrinsic brightness are with few exceptions, much less than in direct or even reflected sunlight. Other invisible radiation of much more harmful character may accompany not only the newer light sources of high incandescence but those of lower temperature as well.

The more important hygienic effects of light sources of high intrinsic brilliancy within the field of vision may then be summarized as follows:

1. Contraction of the pupil is caused, thereby reducing the amount of light entering the eye and the consequent visibility.

2. The sensibility of the visual organs is temporarily impaired by residual images and retinal fatigue.

3. The effects of (1) and (2) are also produced by the occasional view of bright sources or by subjecting the eye to sudden fluctuations of light.

4. Intrinsic brightness rather than the distance of the source from the eye is the principal cause for pupillary contraction.

5. The harmful effects are greatest in proportion to the decrease in the working illumination and are considerably reduced under an illumination exceeding two foot-candles.

6. The different luminous sources may be classed with reference to producing pupillary contraction and after images in the same order as their respective intensities.

In applying the knowledge of the laws of hygiene of the eye to the design of artificial illumination, the best criterion of the proper values of intrinsic brightness of the light source, as well as of other essential factors, is daylight.

The intrinsic brightness of nearly all of the artificial light sources being so much higher than that of natural daylight is the principal cause of eye-strain and wear and tear on the visual organs. Even the most successful efforts to secure diffusion in artificial illumination by the so-called indirect method can not be compared with the diffusion of daylight. From this point of view diffusion is the most important single quality of daylight. Diffusion may be obtained in artificial illumination by enlarging the area or surface of the light source, by shading the source with diffusing globes or screens, or by concealing the source and utilizing the diffuse reflection of the surfaces which receive the direct light.

The intrinsic brightness of a light source is the candle-power or intensity of the source divided by the area of the luminous surface. The intrinsic brightness of a small surface is the candle-power perpendicular to the surface divided by the area of the surface. Intrinsic brightness is stated, therefore, in candle-power per square inch, or in hefners per square centimetre when metre units are employed.

Measurements taken by Basquin show a mean annual brightness for zenith sky in Chicago of 500 candles per square foot, or about 3.47 candles per square inch, with a range from 200 to 1,100 candles per square foot according to the month and other conditions. Making due allowance for the decrease in brightness near the horizon for natural reasons, and the reduction of the effective sky area by buildings and other local objects, the virtual intrinsic brightness of the sky in relation to the flux of light received through an ordinary vertical window, under average conditions probably rarely exceeds one-fourth of the above figure.

Measurements of the daylight illumination received in rooms at various distances from a window fitted with a ground-glass screen indicate also that the vertical brightness of the flux of light from the sky, direct sunlight excluded, though varying widely under different conditions, is not often more than one candle-power per square inch. Even such a comparatively low degree of brightness exposed to view affords discomfort to the eye. Shades and screens are depended upon to modify all but the most moderate natural brilliancy so that with a satisfactory interior illumination the virtual intrinsic bright-

[1] Abstract of a paper presented to the Illuminating Engineering Society, Philadelphia, Pa., October 5-6.

[2] Étude des principales sources de lumière au point de vue de l'hygiène de l'oeil. MM. André Broca et F. Laporte. *Bulletin* of the Société Internationale des Électriciens, vol. viii (2d series), No. 76.

ness of the flux of daylight through windows may be as low as 0.1 or even 0.01 candle-power per square inch.

Even an abnormally high illumination of ten foot-candles on a white diffusing surface, such as white blotting paper, gives an intrinsic brightness of the surface very little more than 0.005 candle-power per square inch, neglecting absorption which would reduce the apparent brightness to 0.004 candle-power or less.

Compared with such figures the intrinsic brightness of all of the naked artificial luminous sources is enormously high, while the values secured in actual practice by the use of shades and diffuse reflecting surfaces are generally more than ten times as great.

A number of authorities regard four or five candle-power per square inch safe and admissible and one or two candle-power good practice. While the use of even the lower of these values in artificial illuminations is questioned, it would result in a most pronounced improvement from the hygienic standpoint and alleviate one of the principal causes of eye-strain and fatigue.

Acid-frosted or sand-blasted incandescent carbon or metallized-filament lamps as commonly used in exposed positions without reflectors have an intrinsic surface brightness of from 0.75 to 1.0 candle-power per square inch. When in the field of vision, however, such frosted lamps frequently produce a most distressing and harmful result, and reduce the value of the effective illumination.

In consideration of the foregoing data, as well as from actual experience in the design of illumination, it is the opinion of the writer that from 0.2 to 0.1 candle-power per square inch is none too low for the safest and best practice where artificial sources must necessarily be placed in the constant or even occasional field of vision. The use of such a factor is necessarily dependent upon the local conditions and especially upon the intensity of general illumination of the objects viewed and the corresponding pupillary aperture, as noted by Broca and Laporte.

In the presence of a highly illuminated field of view the iris diaphragm of the eye is "stopped" down almost to a minimum, and the direct effect of any light sources within the field of vision is correspondingly lessened. These conditions occur in practice where a room or space is almost uniformly illuminated by exposed lighting sources of high brilliancy and there are neither dark surfaces, sharp contrasts nor shadows which would require the eye to work with a larger pupillary aperture. Such conditions, while tending to reduce the deleterious effect of brilliant light sources, are not the most favorable for best vision. Working in such an environment it is not strange that a comparatively high intensity of illumination in foot-candles is frequently demanded and the eye appears insatiable. From the standpoint of efficiency, therefore, as well as of hygiene, the conditions must favor a pupillary aperture which is sufficiently large to work the eye at its maximum sensibility. To accomplish this result the intensity of illumination should not only be moderate, in general from 1.5 to four foot-candles, but the intrinsic brightness of the sources should be reduced to 0.2 or 0.1 candle-power per square inch; or else the sources must be completely excluded from the field of vision.

With a weak illumination, however, requiring the eye to work at or near the limit of opening of the pupillary aperture the eye is extraordinarily sensitive to the direct light from sources of even moderate intrinsic brightness, and under such circumstances the actual apparent surface brightness of the source can not be kept too low for safety. This point is illustrated by the distressing effect of frosted and shaded lamps, and sometimes of candles, in the field of vision under the conditions of a weak general illumination frequently found in theatres, churches and auditoriums.

It is possible that the effects of overstimulation by means of varying intrinsic brightness has some such relation to the pupillary aperture through the range of accommodation of the eye as that of the ability of the eye to note a constant fractional difference in luminosity through a wide range of intensities of illumination, according to the law of Fechner.

The distance of the luminous source from the eye within the limits ordinarily found in interior illumination does not appear to be material, except in its relation to the position of the source and its inclusion or exclusion of the field of vision.

The preceding discussion has been confined to the direct effects and modification of the intrinsic brightness of luminous source, but it is evident that the same conditions will apply equally well to the reduction of the intrinsic brightness of all illuminated surfaces which become secondary sources of illuminations. Even with indirect illumination the ratio of brightness of the reflecting surfaces to that of the illuminated field may be excessive.

The foregoing data will have their principal application, however, in the design of globes and shades which are commonly employed to reduce the intrinsic brightness of exposed lighting sources. In arriving at the resultant intrinsic brightness it is necessary to refer to the spherical candle-power of the source and to make allowance for the absorption by the glass which may vary between from fifteen to twenty-five per cent for alabaster to sixty per cent or more for opal or porcelain glass. The absorption by ground glass will vary according to the process employed in roughing or sand blasting, but it will generally be between twenty and forty per cent. The thickness as well as the quality of the glass will also have a marked influence upon the absorption. Moreover, the distribution of the light from this source will be modified by surrounding the lamp with an inclosing globe. The most perfect diffusion will be received by a ground opal glass, but at a sacrifice of from forty to sixty per cent of the total light. The more transparent glasses, on the other hand, do not sufficiently diffuse the light from the source. In any event, however, it is important that the size of the diffusing globe or shade should be proportioned to the candle-power of the source, so that the reduction of intrinsic brightness will be approximately uniform. Fixture designs employing exposed frosted lamps together with other lamps in large inclosing globes of comparatively low intrinsic brilliancy are especially objectionable.

Belgian Electrical Industry.

Consul-General Ethelbert Watts announces that in the Brussels district of Belgium there are several underground tramway lines worked by two different companies. The companies employ their own staffs for their construction work.

The work of laying the underground telephone system is carried out on the contract plan.

A concession for an electric tramway has just been granted in Namur.

Projects are under way for electric lighting plants at Anderlecht, Etterbeek, Auvelais and Montaigu.

The Electric Club of Chicago.

The Electric Club of Chicago was addressed, at a meeting held on October 14, by W. J. Warder, Jr., of Roth Brothers & Company, on the subject of "Direct-Current Elevator Motors." On October 21 the club was addressed by W. T. Dean, of the General Electric Company, and next Wednesday the address will be made by Peter Junkersfeld, of the Commonwealth Edison Company.

Illuminating Engineering Society—II.

Report of the Second Day's Sessions of the Convention Held at Philadelphia, Pa., October 5 and 6.

(Concluded.)

TUESDAY MORNING SESSION.

THE first paper taken up Tuesday morning was entitled "Intensity of Natural Illumination Throughout the Day," by Leonard J. Lewinson. This dealt with the intensity of illumination produced by natural sources of light, such as the sun, moon and stars, modified by the earth's atmosphere. Experiments were undertaken to secure data under various atmospheric conditions at different periods during the day. To make a complete survey of the subject would involve years of effort. A problem which is open to discussion, and which is of much importance can be summed up in the question: Why does the human eye, which is satisfied with an illumination of two foot-candles produced at night by an artificial source, require at least twenty foot-candles of daylight for ordinary reading purposes? Two Sharp-Millar photometers equipped with miniature tungsten lamps were used. The experiments were conducted on the roof of the Electrical Testing Laboratories in New York city, where there was practically no obstruction to the light from the sky. Tables and curves were given, showing the variation of the intensity of natural illumination. Considering first the night illumination, it was noted that the sky light value approximates one-one-thousandth foot-candle when the moon is not visible. The rate of illumination during the hour preceding sunrise is enormous. When the observation was made, at 5.25 A. M., about seven minutes before sunrise, the illumination was 10,000 times that at 4.25 A. M. During the hour after sunrise the rate of increase is relatively small. When the sun first appears above the horizon the horizontal illumination is about equal to the normal. After the sun is well above the horizon the normal illumination increases more rapidly than the horizontal. During the later morning hours there is a steady increase of both horizontal and normal illumination. A correspondingly regular rate of decrease is noticed after noon and until 6 o'clock, when the falling off becomes more marked. A fair average figure for horizontal illumination produced by moonlight and sky light on an ordinarily clear night is about fourteen-thousandths foot-candle. The daylight illumination varies in intensity from 2,000 to 8,000 foot-candles between the hours of 8 A. M. and 4 P. M.

The discussion was opened by Carl Hering, who remarked that it seemed apparent that we should adapt our artificial illumination or night illumination to correspond with daylight to make the best use of our eyes. It might be of interest to know that the maximum illumination obtained—12,000 foot-candles—corresponds to the intrinsic brightness of the Welsbach mantle. He did not care to assume any responsibility for the data, but he pointed out that if the conversion factor of 452, by which the candles per square inch are multiplied, are reduced to foot candles, it would indicate that a piece of paper exposed to daylight is as bright as a Welsbach mantle. If the figures are correct this is the case.

J. E. Woodwell raised the question whether the two values indicated here—that is, the horizontal component and the normal component—were as important as the vertical component, as practically all of the light which enters modern structures comes in through vertical windows. In future work of this kind he would suggest that measurements be made of the vertical component of illumination, and that data be secured concerning the effect of the reflection of the exterior walls and buildings upon street lighting.

Emile G. Perrot said that he had made a number of observations concerning the relative efficiencies of daylight at various times of the year. The test described, being made in September, he thought did not give any real value from a practical standpoint in designing a building, for the information that is really required by the architect should cover the entire year, as the illuminating value of the sun changes all the year round. We must remember that the sun in winter is lower in the horizon than in summer, and consequently the penetration of the sunlight into a room in the vertical plane would be greater in winter than in summer. Again, the sun sets and rises in different positions at different times of the year, so that the position of a building may be right for one time of the year and wrong for another.

A communicated discussion of this paper by R. S. Hale called attention to the fact that it is evident that in street lighting the intensity of illumination in the morning daylight, say, an hour before sunrise, is higher than the same time in the evening daylight, say, an hour after sunset. For that reason he considered that municipal schedules for street lighting can be regulated to economize in the use of artificial light in the early morning hours. He also called attention to the physiological effect upon the retina of the eye of a person who has been working at night out in the open. The retina is more extended in the morning hours, so that it takes in more of the reflected light than it does at any other time.

In closing the discussion Mr. Lansingh stated, in answer to Mr. Woodwell, that there was considerable question with regard to the measurement of ordinary illumination. It was hard to decide which way to turn the photometer—whether away from the sun, or toward the sun, or at an angle. Measurements will probably have to be made in a great many planes, and the paper was simply an introduction to the subject. He would point out, however, that all measurements of illumination made during the day would be measurements of the sunlight plus the sky light.

The paper entitled "The Integrating Sphere in Industrial Photometry," by Dr. Clayton H. Sharp and Preston S. Millar, was read by Dr. Sharp. This paper described the integrating sphere, sometimes known as the Ulbricht sphere, which was first put into practical form in 1900. It consists, briefly, of a hollow sphere containing the source of light, and coated inside with a white diffusing paint. Into the side of the sphere is set a small window of diffusing glass, the brightness of which, when the direct rays are screened from it, measures the total luminous flux within the sphere. The theory of the integrating sphere is as follows: If a source of light having a uniform distribution of candle-power is suspended at the centre of a hollow sphere, the illumination at any point on the surface of the sphere is proportional to the mean spherical candle-power or to the total luminous flux of the source. If, however, the source be moved away from the centre, this relation no longer is true. If the interior of the sphere is coated with a white diffusely reflecting coating, obeying Lambert's law, the illumination at any point of the surface may be regarded as being made up of two component parts: first, that due to the light falling on it directly from source; and, second, that due to reflection from all other sources of the surface of the sphere. During the past two years experiments have been made with integrating spheres at the Electrical Testing Laboratories in New York, with uniformly favorable results. In using the integrating sphere reliance must be placed in the substitution method of photometry. The sphere may be used in conjunction with existing photometric apparatus. At the Electrical Testing Laboratories an eleven-inch sphere has been used with small lamps. A thirty-inch sphere is used with a simple Lummer-Brodhun photometer. An eighteen-inch sphere and an eighty-inch sphere are used with a convenient type of portable photometer.

The discussion was opened by Francis E. Cady, who asked whether any investigation had been made of the effect of the collection of dust or dirt on the inside of the sphere on the diffusing surface.

H. Thurston Owens asked if this type of photometer had been used for gas lamps, such as gas arcs.

Alfred A. Wohlauer asked whether the theory of the integrating sphere could be applied to the precalculation of the illumination due to reflection from walls or ceilings.

In closing the discussion, Dr. Sharp said that they had made no investigation with regard to the effect of dust, because the simplest thing to do was to take the dust off.

As to the measurement of large gas lamps, this would undoubtedly be entirely feasible.

With regard to the measurement of large reflecting surfaces, Dr. Sharp did not quite see the direct connection between the constants of the sphere and the constants of the rooms when measuring the light reflected from walls and ceilings.

The paper entitled "The Ives Colorimeter in Illuminating Engineering" was read by Dr. Herbert E. Ives. This paper described the Ives colorimeter, designed by Frederick E. Ives for the measurement of all colors in terms of three primary colors. By means of the colorimeter it is possible to describe a color accurately in terms of the red, green and blue components of a standard white light. For instance, in place of the indefinite term "pink," a color may be designated as red, sixty-two; green, thirty-one; blue, fifty. These figures mean that by mixing red, green and blue light in the proportions given, there is produced to the eye the sensation of pink. Two colors alike to the eye measure alike in the colorimeter. In this it differs from the spectrophotometer, which gives the intensity at every point in the spectrum, but only an approximate indication of how the eye will compare the color in question with another. A table was read showing the red, green and blue readings of various sources of illumination. From the observations made it would appear that the best light for matching colors is that of the Welsbach mantle, while that of the Cooper Hewitt lamp—an extremely selective source—exhibits wide deviations.

D. McFarlan Moore opened the discussion on this paper, and stated that in his opinion the light from the carbon-dioxide tube should be given the first place in its approximation to daylight. From the paper he would draw the conclusion that the mercury arc would be preferable to a carbon-dioxide tube over a ribbon counter in a drygoods store. This statement, he said, was misleading. As a substitute for natural light the carbon-dioxide tube was superior to all others. He quoted the results secured by a number of authorities, which would indicate that the spectrum of the carbon-dioxide tube, when passing an electric current, differed very slightly from daylight. Mr. Moore called attention to tests carried out by Professor Utzinger for the Siemens-Schuckert Company in Germany. The figures obtained in these tests differed very materially from those given in the paper. Professor Utzinger makes the statement that the carbon-dioxide tube does not differ from daylight more than three per cent on a cloudless day. Mr. Moore also took exception to the method which was used in effecting a comparison of the illumination of the tubes in the New York Post Office, upon which the data given in the paper were based.

Dr. E. P. Hyde explained the circumstances under which the tests were made. Every precaution was taken to secure an accurate reading, and he felt convinced that the figures given by Dr. Ives were not far from correct.

Frederick E. Ives stated that he had made the tests described in the paper, and that direct comparison was made with the light from an electric lamp. It seemed to him that the carbon-dioxide tube comes nearer to daylight than any of the other artificial illuminants used in these tests. His impression was gained perhaps because of the steadiness of the light and because it was rich in blue lines. He thought that it represented the color of a rather blue sky than average daylight.

E. L. Elliott stated that he had the greatest admiration for the work of Dr. Ives, and that it was reasonable to expect something very practical in the way of color measurements; but to put the carbon-dioxide tube as bluer than the mercury lamp introduced a discrepancy which it seemed to him was too large to be explained away. He did not know of any light sources which had been introduced for commercial use which were wider apart in their appearance, and an instrument that would confuse these things would not be of the most reliable character.

Dr. Hyde, in answer to Mr. Elliott, stated that during the time of the test three observers had stood in the room and had in perspective the carbon-dioxide tubes and the mercury-vapor tubes. The consensus of opinion was that, of the two sources, the carbon-dioxide tube was slightly bluer and the mercury-vapor tube slightly greener. The conclusion was that there was very little difference in the integral result—that is, in the apparent color, and it so happened that the data, when worked up, confirmed the observations made on the spot.

The paper entitled "Calculating and Comparing Lights from Various Sources" was read by Carl Hering. This paper was an attempt to clarify the apparent mistiness surrounding many of the calculations of light by giving the formulæ in such form that they can be directly used for numerical calculations, and to explain in plain terms some of the less usually understood, but often very useful, and perhaps not generally understood laws. It was also an attempt to show what the real physical meaning is of the various quantities involved, so that they may be used more intelligently. The paper proceeded to throw into the form of equations the fundamental relations existing between the various factors involved in the calculations, and also gave graphical demonstrations of the methods by which these relations were arrived at. Eliminating literal factors, the conclusions were represented directly by the physical name given to the terms involved in the equations.

Dr. Sharp discussed this paper at length from the point of view of its definitions, and called attention to the necessity for caution in accepting the dicta laid down.

Alfred A. Wohlauer discussed the paper with regard to its application for certain measurements wherein the data given were at variance with the practice generally observed.

In his paper Mr. Hering defined the flux of light as representing the quantity of light radiation, as that which is bought, sold and used—that is, the statement of the amount of flux alone, without any further specifications, is not sufficient for industrial purposes.

Both Dr. Sharp and Dr. Hyde believed that the proper way to define flux would be as it was naturally used in practice, in terms of the quantity of luminous energy flowing across a surface of unit area per second; in other words, make specific flux a point function. Dr. Hyde did not believe that the spherical candle is the common unit of flux, and that we could not consider the official unit as a lumen.

E. L. Elliott said that the fact that so many authorities hold opposing ideas concerning the common unit to be used in the measurement of light was a sufficient evidence of the chaotic state in which photometric measurements still are. He could see no discrepancy in taking the spherical candle-power as the practical unit of flux of light. He believed that this term was understood by ninety-nine where there would not be one found who would know what the word "lumen" meant. As far as the hefner was concerned, it had the virtue of being established from an official source. If we traced the official candle which we call official in this country to its source, he supposed we would ultimately land in the Reichsanstalt in Germany.

In closing the discussion on this paper Dr. Hering said that he was simply taking things as they were. He agreed that as long as we use certain expressions to convey certain meanings, we should accept one term to mean one thing. If certain formulæ were not acceptable, they, of course, could be omitted. As far as the Geneva Congress was concerned, it was a matter of record that it was the first body to define the lumen, the lux and other units.

TUESDAY AFTERNOON SESSION.

The first paper taken up on Tuesday afternoon was entitled "The Calculation of Illumination by the Flux of Light Method," by J. R. Cravath and V. R. Lansingh. This paper was presented by Mr. Lansingh.

This paper described certain methods employed by the authors in calculating the illumination of large interiors, and showed the practical application to the suggestions made by Dr. Clayton H. Sharp in his presidential address before the first annual convention of the society, at Boston, July 30, 1907.

P. S. Millar called attention to the desirability of collecting and tabulating data bearing upon the coefficient of utilization of light. The ratio between the flux of light applied in a given installation and the values of the light generated, is a valuable factor. If we can determine that ratio in such a manner as to apply it in practice to rooms of various sizes, with decorations of various characteristics, we can readily work out complete illumination schemes before the installation is made.

The next paper was entitled "Street Lighting with Gas in Europe," by E. N. Wrightington. This paper was presented by R. C. Ware.

This paper described the types of burners which are being utilized for lighting Continental European cities. The inverted lamp seems to have been pretty thoroughly tested on the other side, and has given good results. The efficiency for useful light obtained greatly exceeds that of the upright lamp. There are two reasons for this advantage: first, because the proportion of light below the horizontal is much greater than from an upright mantle, and because the construction of the inverted-mantle burner permits the use of reflectors which will collect the upright rays and turn them in a useful direction. Most of these lamps are equipped with a pilot flame, and the main lamp is ignited by means of a lever arm. The most striking feature of street lighting on the other side is unquestionably the use of high-pressure inverted gas lamps. These lamps are found in very large units, running as high as 3,600 mean lower hemispherical candle-power. Posts are placed near together, and the streets are almost as bright as if lighted by daylight. The light is well diffused, and the effect very soft and pleasing.

Walton Forstall, in opening the discussion on this paper, asked whether there was any special pressure used with the intensified lights. He believed that at the gas exhibition in Dublin last year the pressure was sixty inches.

Dr. Bell replied to this question, to the effect that the sixty-inch pressure is the highest pressure that is being used with compressed gas. Compressed gas started a few years ago at ten or twelve inches; then it went to sixteen, and then to twenty, thirty and forty, and it has now reached sixty inches, which is the exact pressure of the system in Berlin. The distribution is through steel tubes, which are put together with gaskets. The lights are supplied by a tube-pressure pumping station operating gas engines. In Berlin the system uses compressed gas, and that seems to be the more usual tendency, although some of the systems use compressed air, and one system in Paris actually feeds oxygen obtained from liquid air to the burner to intensify the light.

T. J. Little, Jr., stated that he had recently experimented with seventy-one inches with a special mantle, with good results. He believed that this will revolutionize the whole business as far as high-pressure lighting goes.

Dr. Bell stated that to remove a possible misapprehension, it should be known that in the pressure gas burners the pressure is maintained to inspirate a sufficient quantity of air to give an intensified flame. There is in no case such a pressure of sixty inches against the mantle.

The paper entitled "Design of the Illumination of the New York City Carnegie Libraries" was read by L. B. Marks.

In this paper the author discusses the characteristics which are involved in the illumination of a public library. The layout of the various divisions is indicated, and the method adopted in providing just that illumination best suited for the service involved. The features of the design include: freedom from glare, all the lamps being shaded; the intrinsic brightness of the lighting sources is kept down to one-tenth of a candle-power per square inch; the general illumination is one foot-candle on the horizontal working plane; the horizontal illumination on reading tables is five foot-candles; the vertical illumination on the book shelves ranges from one and one-half to four foot-candles; the horizontal illumination on the book shelves ranges from four to eight foot-candles; the ceiling pendents for general illumination are designed for efficient use of tungsten lamps; lights near windows are placed on the same circuit as far as possible; the lamps for general illumination are hung high, but low enough to avoid sharp contrasts on the ceiling.

N. W. Gifford stated that the author gave five foot-candles as the proper amount of illumination on a reading table. He asked whether this was enough or too much; if there was not a popular tendency to ask for more light than was necessary. He said that in Boston the matter had been investigated by a commission, considering the question of school lighting. He believed the figure established was 2.5 foot-candles.

Dr. Bell replied that he was also of the impression that the figure was 2.5, but there seemed to be some doubt in the minds of the physicians as to what was the best figure for school-room illumination.

In closing the discussion Mr. Marks said that there is considerable question as regards the amount of illumination on the reading table. After an investigation covering six months in a New York public library, studying the conditions, the conclusion was reached that 2.5 foot-candles, under average working conditions, was not nearly enough for the readers who frequented the libraries. This is so to a certain extent because of the books being printed in different languages. With some of these the type is exceedingly small. What has been attempted in the installation described in the paper has been to establish a happy mean. A book can be placed in such a position as to get ten foot-candles on any reading table in the library. On the other hand, if the book is held just outside of the edge of the table, it will receive only 2.5 foot-candles.

The paper entitled "Engineering Problems in Illumination," by Alfred A. Wohlauer, was read.

The object of this paper was to present a conception of the duties of the illuminating engineer; to point out and to develop problems which have been solved by him, and to give an idea of the elements and fundamentals an illuminating engineer has to master in order to be able to carry out his work, and then lay down a clear and convincing proof that illuminating engineering is an individual profession.

Albert J. Marshall, in discussing Mr. Wohlauer's paper, called attention to the necessity for giving due consideration to both the utilitarian and æsthetic values in illuminating engineering work.

F. J. McGuire also called attention to the necessity for an illuminating engineer to consider æsthetic values, and not to assume too much importance with regard to the matter of economy of current. He called attention to several instances where the architects had opposed the idea of introducing the services of an illuminating engineer.

Mr. Lansingh directed attention to the fact that prismatic glassware had been developed which would enable the illuminating engineer to secure certain definite results that might be applied to areas of widely differing characteristics.

E. L. Elliott called attention to the large discrepancy which must always take place between theoretical and actual values. In attempting to obtain uniform illumination, for instance, in a store, where it would undoubtedly be desirable, in some cases it would be found in practice that after the engineer had secured, as nearly as could be calculated, a uniform illumination, there would be considerable variance after the lighting had been installed.

The paper entitled "Intrinsic Brightness of Lighting Sources," by J. E. Woodwell, was presented. An abstract of this paper is given elsewhere in this issue.

The discussion on this paper was opened by D. McFarlan Moore, who congratulated the society on taking up the subject of intrinsic brilliancy. He thought that Mr. Woodwell's statement that the intrinsic brightness rather than the distance of the source from the eye is the cause of the contraction of the pupil of the eye, is illustrated in exterior lighting in a remarkable way. He also stated that the theoretical specifications indicated in the paper are only met by the vacuum tube. In this system of lighting the illumination can be regulated over a large degree of brilliancy, but it is generated at the intensity a which it is used.

The paper entitled "Some Experiments on Reflection from Ceiling, Walls and Floor," by V. R. Lansingh and T. W. Rolph, was read.

The tests described in this paper were undertaken to determine the values of the reflection of light from ceiling, walls and floor under average conditions of artificial lighting. The paper described the test room, the lamps and reflectors, the instruments, and the methods of test. The conclusion is reached from these tests that the floor has little value as a reflector. Comparing the values with one lamp and reflector with those with three lamps and reflectors, the effective angle with light ceiling and dark walls and floor is sixty-three degrees in the first case and fifty-six in the second case. The average angle of sixty degrees may be considered as good for the assumed conditions with small rooms.

The paper entitled "Architecture and Illumination," by Emile G. Perrot, was read by the author.

Mr. Perrot holds that the architect's means of expression is by the use of materials of construction which must be so molded and shaped as to give the appearance of solidity; that is, that the building is a concrete reality; that it is solid and substantial in addition to being a thing of beauty. This effect is produced largely by means of shades and shadows. It is here that light plays a most important part in the bringing out of the details which characterize the work of the master architect. The study of the play of light and shade on the exterior of a building requires the highest kind of training for the successful outcome of an architectural composition. With interior lighting a different condition exists; hence the design of details for the interior of a building should not possess the same characteristics as are found on the exterior of buildings. His idea as to the way in which the Illuminating Engineering Society could materially help the architects would be by the publication of tables embodying standards and giving data and formulæ for the lighting of all types of buildings with various illuminants. If buildings are to be properly lighted and made to embody the latest improvements, the architect should be kept in touch with all that is new and desirable for the purpose of effectively and economically lighting the building he designs, with the view of wedding architecture and illumination. He believed this result could better be accomplished through the society than by any other means.

Following the discussion on this paper President Bell thanked the Philadelphia committee for the successful work which had been put into the convention. The total membership registered was 242, and there were visiting the convention 158. It had been especially gratifying to him as presiding officer to see the way in which the members had actually attended the business meetings. Wherever the next convention might be held, the local bodies would have to work hard to maintain the pace set by Philadelphia.

The meeting then stood adjourned.

Convention of the National Society for the Promotion of Industrial Education.

The second annual convention of the National Society for the Promotion of Industrial Education will be held at Atlanta, Ga., November 19, 20 and 21. The headquarters will be at the Piedmont Hotel, where the annual banquet will be held on Thursday evening, November 19. The meetings of the convention will be held at the State Capitol, House of Representatives. The exhibition of work by pupils of the trade schools will be arranged in the corridors of the State Capitol surrounding the House of Representatives.

The Fixation of Atmospheric Nitrogen.

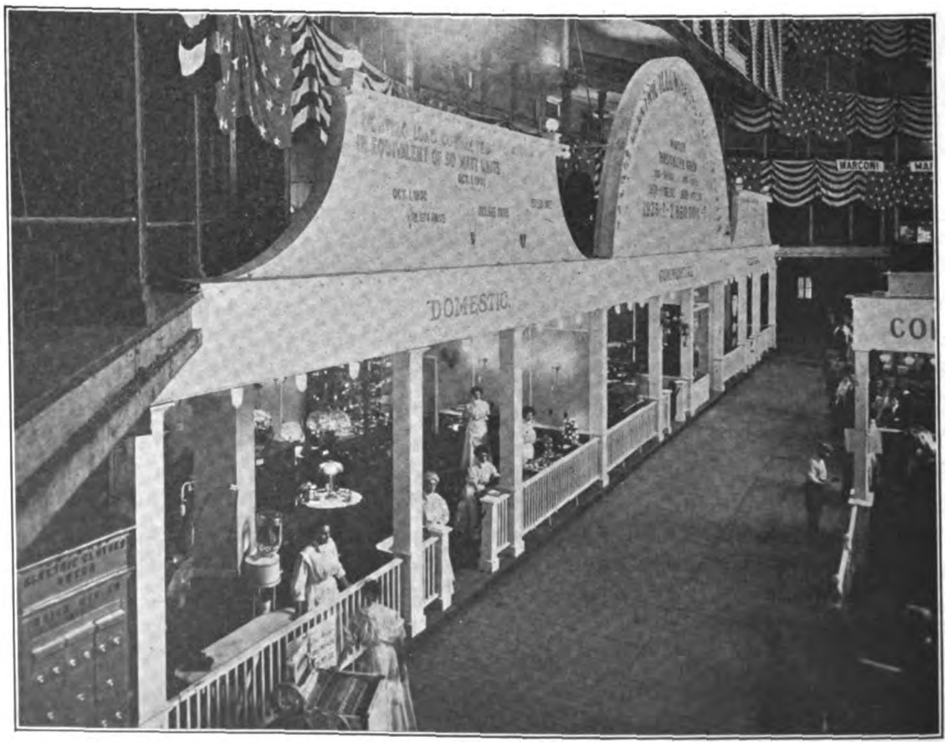
This subject was discussed at the recent International Congress of Applied Electricity, held at Marseilles, France. Mr. Blondin, vice-president of the section for Electrochemistry and Electrometallurgy, described the processes of Kowalski and Mocsicki and of Birkeland and Eyde. The latter process is characterized by the use of alternating-current arcs in the form of discs nearly two metres in diameter. The plant at Nottoden, in Norway, uses this process and consumes 36,000 kilowatts with an output of 500 kilogrammes of NO_3H per kilowatt per year. Mr. Blondin also described the Frank and Caro process used at Notre-Dame-de-Briancon for the manufacture of cyanamide of calcium. The fixation here is effected by the electric effluvium. The frequency used is fifty periods per second. It was stated that according to Birkeland the frequency is not of importance, as he had not obtained any improvement by increasing the periodicity. It would seem that the ionizing action has very little influence, perhaps one in 1,000. Reference was likewise made to the process of Professors Gorbow and Mitkievitch, of St. Petersburg, who employ a high-tension three-phase current with furnaces consuming a maximum of fourteen kilowatts for producing nitrous oxide. The results show a production of 480 kilogrammes per kilowatt-year. The process is not yet applied on an industrial scale. The Pawling process used at Innsbruck was next brought to the attention of the congress. It is based on the system of horn lightning arresters, furnaces of 500 to 700 kilowatts being used, and is characterized by the direct production of thirty-six to forty-degrees Beaumé nitric acid. Researches made by Professor Haber, of Karlsruhe, were also mentioned. He has found that the principle of increasing the output lies in improving the ionizing action of the arc. In order to do this a lowering of the temperature is indispensable, a high temperature being one of the great obstacles to the ionizing influence. Professor Haber has realized the necessary condition by slightly decreasing the pressure and utilizing electrodes of Nernst material. The ionizing action undoubtedly takes place, as a thermic calculation will indicate. The concentration of the oxide, which is five per cent in the Birkeland process, amounted to fourteen per cent in the Haber experiments.—*L'Industrie Electrique (Paris), September 25.*

Photographs of the New York Electrical Show.

The accompanying illustrations are interesting as showing the extent to which decorative features were carried and actual demonstration of material made at the New York Electrical Show, which was held at Madison Square Garden recently.

One of the most prominent features of the show was the huge "Brooklyn" sign, spanning the Fourth avenue end of the amphitheatre. The Brooklyn Edison exhibit presented a unique exemplification of the utility of electrical devices and was divided into representations of domestic, commercial and industrial applications. The façade overtopping the booth was made to illustrate the great growth of the Brooklyn Edison system during the last decade.

THE BROOKLYN EDISON SIGN AT THE NEW YORK ELECTRICAL SHOW.



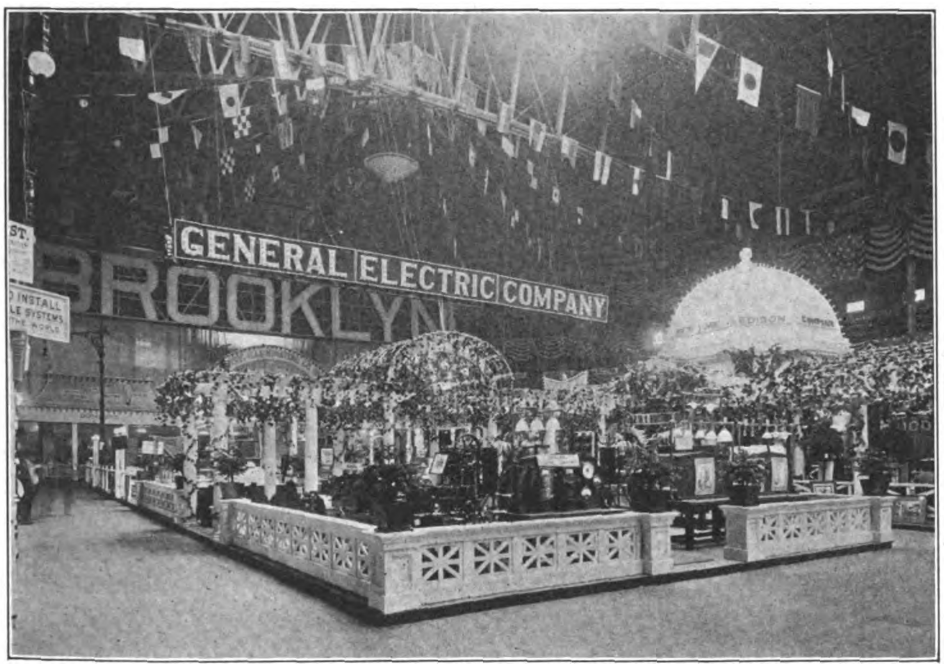
THE BROOKLYN EDISON EXHIBIT AT THE NEW YORK ELECTRICAL SHOW.

Other illustrations show the booth of the General Electric Company, which had one of the most artistic exhibits in the hall. Tungsten and tantalum lamps were the features of this exhibit as well as the principal objects of interest of the entire show. The large space occupied by the company was divided down the centre by a brick-floored pergola covered with vines and illuminated by forty, sixty and 100-watt tungsten lamps in Holophane reflectors. The effective beautiful green and white of the pergola in the brilliant rays of the tungsten lamps was further enhanced by miniature bulbs sparkling in the foliage. On one side of the pergola the company exhibited its complete line of electric heating devices, including the new electric toaster, a valuable adjunct to the electric chafing-dish, the new continuous heat of cigar lighter, and special kitchen outfits and ovens. At this end of the space a comparison was shown of the tungsten and carbon-lamp efficiency by means of the lamp-testing watt-indicators, and the new twenty-five-watt tungsten lamp was exhibited for the first time.

On the other side of the pergola tables were arranged with brass arches for showing the complete line of tungsten and tantalum lamps, and the new high-efficiency merging-prism Holophanes. A Deshler-McAllister photometer was arranged with a forty-watt tungsten lamp and a thirty-two-candle-power carbon lamp giving practically the same candle-power, and attached to two Thompson induction wattmeters with special rapidly-moving dial trains, so that the different rates of current consumption with equal candle-power were strikingly exhibited. This part of the booth was of particular interest to central station managers and supply dealers who appreciated the suggestion for a window display.

In the centre of the aisle was a direct comparison of one 250-watt tungsten lamp and thirteen sixteen-candle-power carbon lamps giving approximately the same candle-power, with a comparison of relative cost of current consumption per month. The two types of lamps were suspended from opposite ends of a balance arm, and on an arch above were three 250-watt tungstens in Holophane shades, which were exhibited as having approximately the same current consumption as the thirteen sixteen-candle-power carbon lamps below.

One of the most interesting features of the exhibit was a case of miniature tungsten lamps showing the innumerable forms in which it has been perfected by the General Electric Company. There were types suitable for use on automobiles, motor boats, table lamps, vest-pocket lights and practically all forms of low-volt and battery-service lamps were included in the many samples shown. The case was illuminated by fifteen-volt tungsten series sign lamps of four candle-power each.



The General Electric Company at the New York Electrical Show.

The General Electric Company also loaned the exhibition company a quantity of tungsten lamps for use in the chandeliers of the Madison Square Garden, this being the first time that the Garden has been so illuminated.

A 6,000-ampere direct-current wattmeter was the head of a line of instruments which extended to the new Type L portable lamp-testing watt indicator, which can be screwed into an ordinary socket and indicates the different watt consumptions of single incandescent lamps. Standard switchboard panels, generator panels, moving-picture machines, mercury arc rectifier panels, automatic compensator panels for alternating-current motors, and miscellaneous rheostats, circuit-breakers, contactors, etc., were displayed to advantage, as well as a small thirty-two-kilowatt Curtis steam-turbine generator set. Two new fifty-hour flaming arc lamps added to the blaze of illuminations surrounding the booth.

The representatives of the company included F. H. Gale, J. O. Case, W. J. Canning, T. Beran, C. E. Estabrook, A. D. Babsom, W. S. Brayton, F. C. Bates, A. D. Page, F. W. Willcox, G. C. Osborn, R. B. Parker, Henry Schroeder and W. C. Andrews, and a large number of visitors from the engineering and sales departments of the Schenectady works, among whom were seen M. P. Rice, C. W. Stone, W. S. Andrews, C. W. Bartlett, F. H. Vaughen, E. M. Hewlett, W. J. Newcomb and W. P. Brown.

The illuminating engineering department of the General Electric Company was represented by W. D'A. Ryan and G. H. Stickney, who used a pair of tungsten diffusers suspended in the pergola and the exhibit of tungsten lamps as texts for many instructive lectures on the new problems being solved in the lighting art.

Light and Power Plant for Twillingate, Newfoundland.

Boston capital has become interested in modernizing the city of Twillingate, Newfoundland, and as the initial and basic step will establish a plant for electric light and power. This will be the third such plant in Newfoundland, and basing opinion on the experience of those already in action, the enterprise is destined to be an exceedingly profitable one for those interested.

The city has a population of above 11,000, within a radius of four miles, and the plant will start with about 6,000 lights, including 500 street lights. The charter of the Twillingate company is direct from the government and covers the entire district, which embraces an area of about forty miles and contains a population of over 72,000.

The plant will consist of two 250-kilowatt steam turbines, it not being considered wise to depend upon the water power at hand. Based upon present contracts the Twillingate company shows a net profit the first year of seventeen per cent on its capital.

The plant is being installed under the supervision of Frederick S. Palmer, 103 Bedford street, Boston, Mass., who is president of the company and who has associated with him several Boston and Newfoundland financiers.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Electrification of the Melbourne Suburban System.

The Victorian Railway Commissioners, who are responsible for the management of the state railways of Australia, have, for some time past, been considering the advisability of applying electric traction to the Melbourne suburban lines, which form the most important part of the whole railway system. The number of suburban trains in Melbourne forms only 4.5 per cent of the total, while the suburban train mileage forms forty per cent of the total train mileage of the system. The suburban system has some 240 miles of track and 126 stations. For the year ended June 30, 1906, the suburban system had a train mileage of 2,772,669 miles, with 4,080,135 train-miles for the remaining system. The Melbourne suburban railway system is one of the most important in the world, and as the service given at the present time by steam locomotives is very good, the question of changing it requires careful consideration. Charles Merz, consulting engineer to the railway commissioners, has presented an exhaustive report, going into the whole question in great detail. Mr. Merz suggests that the possibility of increased schedule speed is the characteristic feature of electrical operation with a suburban service. To obtain this increased schedule speed, higher acceleration is required. The acceleration at present with steam operation in Melbourne is 0.36 mile per hour per second. By increasing the acceleration to 0.9 mile per hour per second, the time taken for an average run of 0.825 of a mile can be reduced from 147 seconds to 118 seconds. To do this with steam locomotives would not pay, whereas it is easy to obtain a considerably higher acceleration with electric traction. Mr. Merz recommends that normally electric trains should consist of an equal number of motor and trailer coaches. The trains would thus consist of two, four and six coaches, as may be required. For various reasons the three-phase system of operation is not recommended, and it practically comes down to a choice between single-phase system with overhead wires and direct-current system with a protected conductor rail. Further calculations show that the protected conductor-rail system at about 800 volts has many advantages over an unprotected third-rail system at a lower voltage. The adoption of the single-phase system for suburban service has in the past been influenced by the possibility of extending it in the future to long-distance branches. In the case of Melbourne the importance of the suburban traffic preponderates so much that this factor does not enter into account, for the main lines are such that is is doubtful if they will ever need electrifying. After working out in detail the cost of handling the Melbourne traffic with both systems, Mr. Merz finds that the additional cost of the train equipment with the single-phase system would practically balance the extra expenditure on the substations required in the case of the direct-current system. When the annual cost is considered it is found that under the Melbourne conditions the direct-current system shows a saving compared with the single-phase system, so that the latter can not be recommended on financial grounds. The generation and supplying of the necessary power will involve the production of 68,000,000 Board of Trade units per annum, a maximum load of 32,000 to 35,000 horse-power, and an annual expenditure of $500,000.—*Abstracted from Engineering (London), September 25.*

The Trackless Trolley System.

A deputation appointed last July by the Manchester Corporation Tramways Committee, of Manchester, England, to inspect the trackless trolley systems in operation in certain towns in Germany, has presented its report. Among other considerations, it is pointed out how the cost of operating tramways may be divided into running expenses, which remain approximately constant no matter how the total car mileage increases; and standing expenses, which decrease as the number of car-miles per mile of track increases. In illustration of this a table is worked out to show how such expenses increase per car-mile as the number of car-miles per mile of track increases. Taking extreme cases, it is seen that with a figure of $1,900 per mile of single track, with a half-minute service the standing expenses are 0.276 cent per car-mile only; whereas with half-hour service they reach the sum of 16.52 cents. Taking the receipts at twenty-two cents per car-mile, and the running expenses at seventeen cents—that is, the surplus receipts at five cents per car-mile—it would appear from the table that a nine-minute service is the economic limit. The report considers briefly the advantages of tramways for city traffic over mechanically propelled vehicles running independent of rails and independent of a central power station. It is pointed out that the work which a tramcar has to do varies considerably at different periods of the year. In winter, when the track is in bad condition, the tractive effort required reaches its highest point, but this may occur only for a few weeks. It is better and more economical to generate energy to provide for these peak loads in large quantities in a central power station than to provide each separate vehicle with an equipment for generating or for storing its own energy, which may only be called upon for its maximum output a few times a year, but which will have to be carried about by the cars all the year round. The only field for the motor bus is in towns or cities where tramways are not permitted or in suburban districts where the traffic is not sufficiently great to warrant the laying down of tramway rails; and in the latter districts it will have a competitor in the trackless trolley. For providing means of transit beyond the economic tramway limit the trackless trolley system claims consideration. The report describes the three trackless trolley systems inspected by the deputation in Germany. One connects the townships of Monnheim and Langenfeld, near Cologne, and was opened for traffic in 1904, and is two and one-half miles long. The overhead equipment is of the bracket-arm type, and there are two trolley wires. The passenger car is a single-deck vehicle equipped with a twenty-five-horse-power motor, with a front-axle drive by ordinary gear wheels. The car carries thirty passengers. Another line connects the townships of Neuenahr, Ahrweiler and Walsporzheim. This was opened in 1906, and is a little over three miles long. The cars weigh three tons two hundredweight, seating twenty persons. They are driven from the front axle by a twenty-horse-power motor. The front wheels are rubber-tired, and the back ones are steel-tired. The town of Mulhausen is equipped with the most up-to-date system of trackless trolley. The overhead equipment consists of four trolley lines—two positives and two negatives. This does away with the necessity, when cars are passing, for one of them pulling off the trolley, or eliminates special passing places. The cars weigh fifty hundredweight, and are equipped with one trolley boom, as against the two trolley booms with which the other systems are furnished. The deputation considers that the system, as seen by it in Germany, will require some modification to satisfactorily fulfil English conditions. In reviewing the financial aspect of the matter and making comparison with petrol omnibuses, it is remarked that trackless trolleys would be cheaper to operate than internal-combustion motors. As regards reliability, the report concludes that the commission would have more faith in cars equipped with tramcar motors satisfactorily fulfiling requirements, than in cars equipped with internal-combustion or steam engines as developed at this time. Aesthetic advantages are also pointed out. The corporation, it is understood, will present a bill to the next session of Parliament, asking for powers necessary for equipping and operating a trackless trolley system. In the meantime further observation will be made of the type of car and car equipment best suited to the English requirements.—*Abstracted from Electrical Engineering (London), October* 1.

The St. Clair Tunnel Electrification.

Increase in capacity was the primary object of the electrification of the St. Clair tunnel. Steam locomotives could scarcely clear the summit of the grade leading out of the tunnel with a 700-ton train. The single-phase electric locomotives with which this system is now equipped can take a 1,000-ton train up the two per cent grade at ten miles per hour. The locomotives have also solved the tunnel ventilation problem and removed a serious handicap to the passenger service. They have also made the service better in other respects. For instance, air brakes can now be used on freight trains in the tunnel. Under steam conditions the use of air brakes on freight trains was such a dangerous matter that hand brakes only were used, except on the locomotive. The use of air brakes meant that when a train broke in two on the grade in the tunnel, a portion of the train oscillated back and forth several times before it could be brought to rest with the hand brakes. The danger from the air brakes was due to the fact that the time required to recouple the train and release the brakes exceeded the time the steam locomotive could be kept in the tunnel with safety. The electrification has solved the problem of heavy service, heavy grades and bad ventilation. At Port Huron, the St. Clair River is very deep. The level portion of the tunnel is 100 feet below the level of the yards. The distance from the summit to summit is approximately two and one-quarter miles. Approximately a half mile at each approach is an open cut. The power station is situated on the Port Huron bank of the St. Clair River, at a point almost directly over the tunnel. The building is of concrete construction to the dynamo room floor. The walls above this point are lined with paving block and are corniced and coped with concrete. The roof is of cinder concrete. The walls are lined with enameled brick to the height of the switchboard. The remaining portion is lined with sand lime brick. The offices and switchboard room occupy the street front. The basement has plenty of head room and contains the condenser pump groups and stoker fan groups. The dynamo room floor is so recessed that the auxiliary apparatus in the basement is in view from the dynamo room floor. The boiler room floor is on the same level as the dynamo room basement floor. The power-station equipment is in duplicate, and there are two 1,250-kilowatt, three-phase, twenty-five-cycle, 3,000-volt turbo-generators. Either of these is capable of handling the maximum demand upon the station. The turbines have a large overload capacity, and the boilers have extra large steam drum capacity. The four boilers have a nominal rating of 400 horse-power each, and each boiler has three steam drums. Just outside the power station there is a vertical shaft which extends to the tunnel. A reinforced concrete duct chimney has been built in this shaft as a continuation of the power station duct lines. All the feeders pass from this chimney through holes in the tunnel shell into the tunnel. The locomotive feeders tap the trolley and rail at this point, which is the only distributing point for the entire trolley system. In addition to the locomotive feeders there are two feeders for the tunnel lights, two feeders for the Port Huron portal pump groups, two for the Sarnia portal pump groups, a three-phase power feeder and an arc-light feeder for the Port Huron yards, and similar feeders for the Sarnia yards. These cables are carried through the tunnel in ducts which are supported by reinforced concrete beams and secured to the lining of the tunnel shell. In the yards a single catenary trolley construction is used, while in the tunnel a modification of the catenary construction is employed. There are two parallel messenger cables and two parallel trolley wires. The messenger cables are supported on barrel-shaped insulators spaced at intervals of twelve feet. These messenger cables carry special double trolley hangers, which are also spaced at intervals of twelve feet, but located three feet from the middle of the messenger span. The tunnel is damp throughout a considerable portion of its length, but although the 3,300-volt bare wires are carried within three inches of the cast-iron shell, but two insulators have failed since the electric locomotives were put in operation. The tunnel division is protected by a block signal system which extends from summit to summit. The dispatcher's cabin is located at the Sarnia summit, and the other signal cabin at the Port Huron summit. Telegraph orders are used. In addition to the written order the conductor receives a staff when the train enters the block. The switches and signals are locked until this staff is placed in the instrument at the other end of the block.—*Abstracted from the Electric Journal (Pittsburg), October.*

The Kansas Gas, Water, Electric Light and Street Railway Association.

The eleventh annual meeting of the Kansas Gas, Water, Electric Light and Street Railway Association was held in Pittsburgh, Kas., October 8 and 9.

President C. L. Brown, of Abilene, called the meeting to order at 10 A. M., October 8.

The first order of business was the appointment of the following committees: Nominating Committee—R. C. Johnston, T. J. Huntington and W. E. Sweezey; Resolutions—B. F. Eyer, C. M. Lewis; Time and Place of Meeting—H. A. Almert, W. A. Scothorn; Auditing Committee—J. E. Taylor, W. F. O'Connor.

Officers for the coming year were elected as follows: President, W. A. Scothorn, Hutchinson; secretary and treasurer, James D. Nicholson, Newton.

Wichita was selected as the next place of meeting.

Twenty-one new members were elected and the meeting was the best ever held by the association in point of attendance, programme and entertainment. The theatre party, trolley ride and banquet were well attended and heartily appreciated.

INDUSTRIAL SECTION

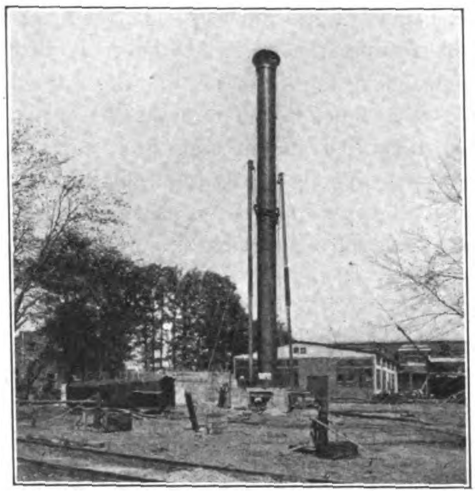
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Big Boiler Stack Erected at Ampere.

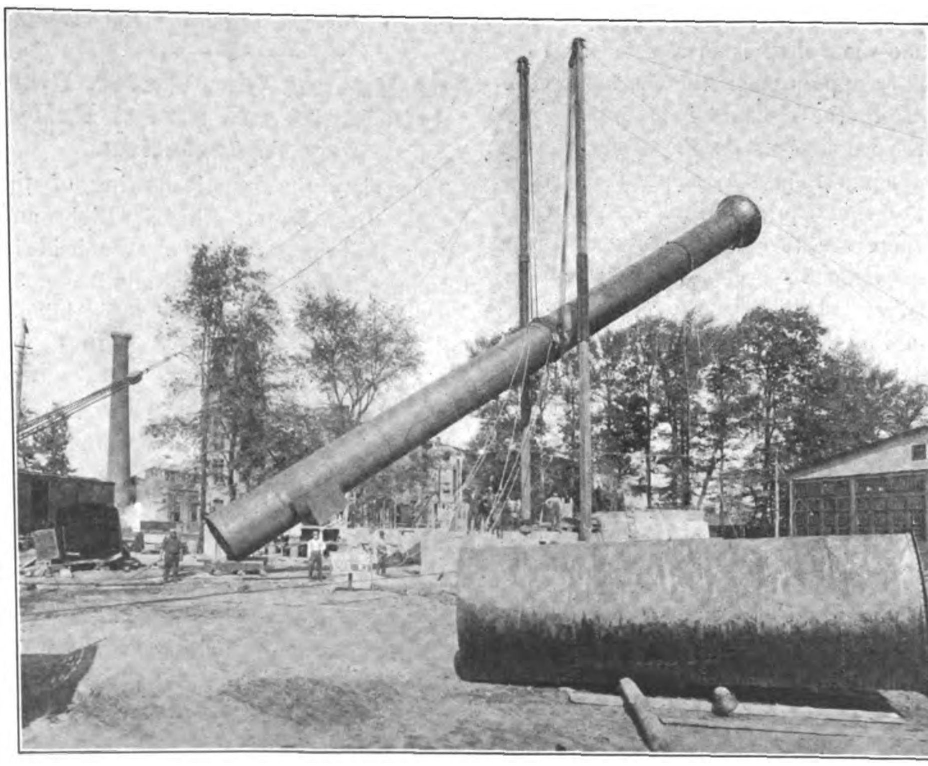
The improvements to the plant of the Crocker-Wheeler Company, of Ampere, N. J., manufacturer of electrical machinery, have reached the stage where work is being started on the new power-house, which when completed will have a capacity of 4,800 boiler horse-power. This entire capacity will not be installed at once. To furnish draft for the boilers temporarily, until the complete plant is installed, the company has erected a steel stack, seventy-two inches in diameter and 105 feet high, standing 125 feet in the air.

This stack will supply natural draft to 800-horse-power water-tube boilers (burning No. 2 buckwheat coal), with an ultimate capacity under artificial draft of 1,600 horse-power. The boilers are of the modern high-pressure water-tube type (steel castings) for generating steam at 200 pounds pressure. The furnaces of the boilers are each nine feet eight inches wide by ten feet deep. The breeching connection between the stack and the boilers is six feet wide, and increases in height as it reaches the stack to provide for future installation of boilers.

The breeching is built of the arched-top and bottom-plate construction to make it self-supporting. The weight of the stack and breeching is approximately eighteen to twenty tons and the stack was hoisted into position in one piece, which attests the progress of engineering construction, as this would have been impossible a few years ago. The present stack is to be used temporarily until the further development of the plant, at which time it is contemplated to erect permanent brick chimneys. For that reason the stack is located at present in position to provide for future development until the last boiler installation is made, and is erected on one of the future boiler-setting foundations. This foundation is built of concrete and that portion on which the base of the stack rests is reinforced with steel. The stack connection to the foundation is provided by means of a cast-iron sectional annular ring which is bolted to the foundation and also to the stack.



THE NEW STACK IN POSITION.



HOISTING THE NEW STACK INTO POSITION AT THE GROUNDS OF THE CROCKER-WHEELER COMPANY AT AMPERE, N. J.

The stack was designed and erected by the engineering-construction office of Walter Kidde, New York city. It was built by the Dover Boiler Works, of Dover, N. J.

New Type Circuit-Breaker.

Both fuses and circuit-breakers are recommended by the fire insurance underwriters for use with motors because in the smaller installations the circuit breakers are too expensive. For this reason fuses are often used, even though the work of replacing them when blown is excessive. Fuses are in many cases dangerous as well as expensive and troublesome to maintain. It is not an infrequent sight to find a blown-out fuse replaced by so heavy a wire that it could burn out only with a current which would severely damage the apparatus it is supposed to protect.

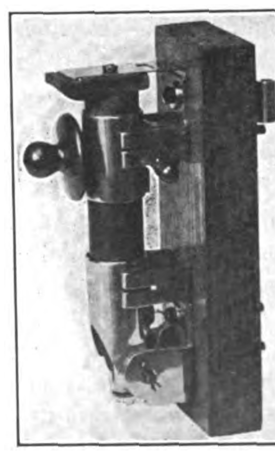


FIG. 1.—CIRCUIT-BREAKER CLOSED.

The general use of circuit-breakers has been limited because of the first cost of the installation. In order to provide a breaker which shall be able to compare in price with enclosed fuses, the Westinghouse Electric and Manufacturing Company has developed a small carbon break-circuit-breaker known as the Type F.

The illustrations show the compact and neat construction of the circuit-breaker, suggesting the appearance of a cartridge fuse. The tripping device is inside the movable arm; it may also be tripped by hand by the small insulating handle shown in Fig. 1. In addition, an auxiliary magnet coil may be attached to provide for tripping the switch from a distance, such as is required in connection with automatic limit switches on machine tools.

These circuit-breakers are made in four sizes for twelve and one-half, twenty-five, and fifty and seventy-five amperes. Each has an operating range of from eighty to one hundred and sixty per cent, that is, the tripping device may be set for any current within these percents of the rated capacity. Adjustment is made by a knurled nut at the lower end of the arm and may just be seen in Fig. 1. These breakers are made in single-pole types for direct current up to 250 volts and alternating current up to 440 volts, and are approved by the National Board of Fire Underwriters.

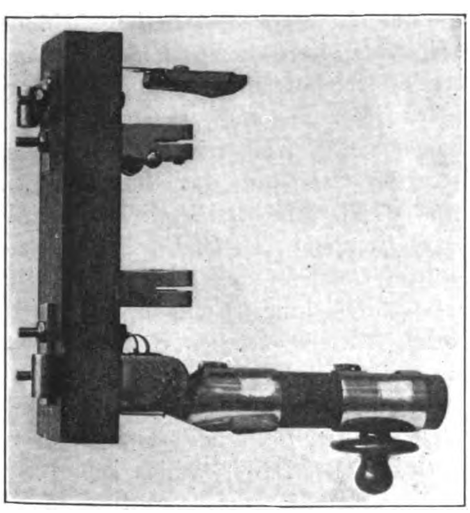


FIG. 2.—CIRCUIT-BREAKER CLOSED.

The standard circuit-breaker is mounted on a porcelain base, similar to the mounting of a fuse, with all the connections on the face of the porcelain to permit being placed directly on the wall. However, it is also supplied for switchboard and control tablet work where the connections are made on the back; two screws are provided for mounting under these conditions. The outfit as a whole takes up practically no more space than an enclosed fuse of the same capacity.

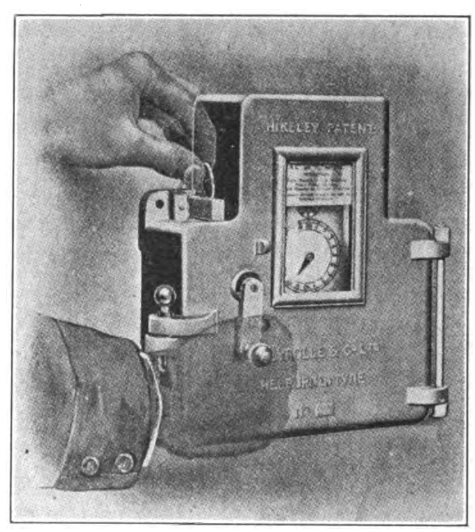
An English Prepayment Electricity Meter.

A method of charging in small installations, where the cost of an ordinary meter is not justified, is coming into use in some places, where the charge is based on the number of hours' use of current, irrespective of the number of lamps that are being fed. This system has met with considerable favor in some parts of Spain, says *Electrical Engineering*, London, and has lately been developed in England in a tentative manner on the mains of the large supply companies in the Northumberland and Durham areas.

It is therefore of interest to give a few details concerning the Hikeley patent meter, which has been especially designed to meet these requirements for installation up to about eight lamps. Briefly, the meter is supplied for use with alternating or direct currents, and is of the prepayment type. The circuit is closed automatically by putting one or more pennies in the slot, and the switches remain closed for a period depending on the number of coins inserted. The standard design is such that for every penny current can be used for five and one-half hours, but the calibration can be altered to suit any other rate.

The general appearance of the meter is shown in the illustration. It consists essentially of a clock with an electrically operated detent, beyond which there is no electrical metering gear about it. The clock operates a large toothed disc seen inside the instrument, tending continually to turn in one direction. If this motion goes on uninterruptedly it will, at the end of the travel, operate a trigger which, on being knocked away, allows the switch on the meter to open. The act of putting in a penny and moving a handle in accordance with the directions given, virtually "puts back the hands of the clock," and gives the tenant a further period before the trigger is operated. The motion is effected by first bringing the outside handle, which engages with a drum slotted to receive the penny, to the upward limit of its path. The penny, on being inserted, acts on a connecting piece between this drum and a toothed wheel, controlled by a spring and engaging with the large toothed disc. On bringing down the outside handle the large disc is thus turned through a position equal to one pennyworth, the penny is then dropped into a cash box, and the small toothed wheel is released from the drum. The position of the pointer on the front dial then shows the number of hours' running which the consumer has in hand before further payment becomes necessary. The slot in the drum is made large enough to allow a halfpenny to fall clear, so that if anyone attempts to defraud the electricity supply, the biter becomes bit.

As in slot machines of all descriptions damage is continually done by the insertion of bent pennies, the opening for the admission of coin just allows a straight full-sized penny to pass. The gauge has, however, a slight upward movement, so that, should a bent penny be inserted and stick, it can be lifted slightly and the penny prized from below. The cash box is sealed separately from the cover of the case, so the man who periodically winds up the clock can not collect the money without breaking the seal. With regard to winding, this in practice is found to be necessary about once a month, as the clock provided runs continuously for a fortnight, and the electrical detent prevents it from working when no current is passing.



THE HIKELEY PREPAYMENT WATTMETER.

The current passes through the winding of the electromagnet, which only allows the clock to run while current passes through it. A current equivalent to one eight-candle-power lamp is sufficient for it to operate the detent. The current then passes to one contact of a double switch, with entirely separate arms, through these two switch arms in series to the terminal block of the meter. It is purely in series on one limb of the lighting circuit, no shunt connection being used. The object of the double-arm switch is to prevent fraud. One obvious way to close the switch of the meter would be for the action of the handle, either upward or on its return journey, to bring the brush down into a contact, but this would allow a dishonest person to tie the handle in position without placing a penny in the slot. The way in which this is overcome is to have two separate bridge arms, one closed by the upward sweep of the handle, and the other by its return stroke. Moreover, unless the insertion of a penny has in the meantime caused the disc with the tripping device to be rotated, the trip will immediately operate on the downward stroke of the handle, and no current can be obtained. If there is no money "banked" in the machine in the form of hours to run, the back switch will not operate, but it should be noted that the handle of the meter can, if necessary, be used as a main switch, as the operation of the handle without the use of a penny will not move the pointer either backward or forward.

In the illustration it will be noted that the top portion of the window is occupied by a tablet giving instructions as to the working of the meter. The front of the case is hinged and padlocked; if it is swung back there will be seen a set of check dials covered from the consumer's observation by the instruction label, showing the total number of hours that the meter has been working. By comparing the hours run by the money in the cash box the collector can immediately detect theft of money. The electromagnetic detent which holds the balance in such a position that the clock will start again when the detent is withdrawn, can be reached for examination from the back of the meter, which, on being screwed to the meter board, is inaccessible to the consumer. The detent is of peculiar construction, consisting of a thin reed so arranged that, while it yields very easily to the pin on the balance wheel in one direction, it becomes rigid and detains the pin on the return stroke. The detent is withdrawn smoothly on the action of the electromagnet.

The whole design appears to be of strong and substantial construction, and the over-all dimensions of the device are about nine inches by eight and one-half inches, by five and one-half inches. A. Reyrolle & Company have developed Mr. Hikeley's patent, and the device has now been in successful use for about two years.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on November 17, for a large quantity of electrical material for delivery at various yards, under schedule No. 471.

Machine-Tool Controllers.

The self-contained drum-type machine-tool controller illustrated herewith is a recent addition to the line of electric-controlling devices designed for use with motor-operated machine tools.

It possesses the advantage of combining in one compact piece of apparatus the speed-regulating mechanism and the resistance.

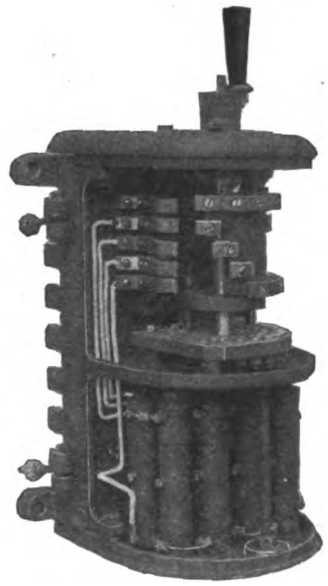


Fig. 1.—Front View of Machine-Tool Controller.

Fig. 1 is a front view of this new type of controller and shows the removable resistance units mounted in the lower half of the controller with insulated wires running from each unit to the metal "fingers" in the upper part of the device. These units constitute the armature resistance and are employed for starting duty only.

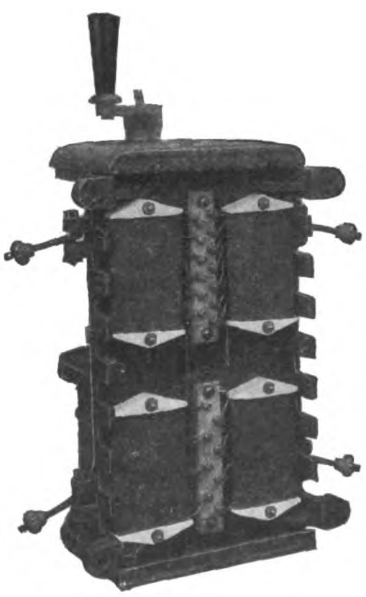


Fig. 2.—Rear View of Machine-Tool Controller.

Fig. 2 is a rear view of the same drum and shows another type of resistance unit —also removable—mounted on the back of the controller. The four units shown in this view constitute the field-regulating resistance and are divided into twenty steps, providing a range of speed variation of 2 to 1 or 3 to 1.

These controllers are made for both reversible and non-reversible motors ranging from one to seven and one-half horsepower, and are designed for use on either 100 or 220-volt direct-current circuits. They are made by the Cutler-Hammer Manufacturing Company, of Milwaukee.

Electrical Manufacturers at the Street Railway Conventions.

The annual exhibit of the American Street and Interurban Railway Manufacturers' Association, held in conjunction with the conventions, the proceedings of which are reported on other pages of this issue, covered the entire expanse of Young's Million-Dollar Pier, Atlantic City, N. J. At the annual meeting of the Manufacturers' Association, held on Wednesday afternoon, the following members of the executive committee were elected: For the one-year term: K. D. Hequembourg, Walker & Bennett Manufacturing Company; for the three-year term, J. R. Ellicott, Westinghouse Air Brake Company; C. C. Castle, Hildreth Varnish Company; J. H. McGraw, McGraw Publishing Company; W. K. Porter, Electric Service Supplies Company; Cornell S. Hawley, Consolidated Car Heating Company.

The *Electric Railway Journal* published a "Convention Daily," which kept everyone in touch with the proceedings of the various organizations, and formed a complete reference to the exhibits of the manufacturers.

There were nearly two hundred exhibitors of every appliance appertaining to electric railway service, outside of the track exhibits, adjacent to the pier. Among these may be mentioned:

LIST OF EXHIBITS.

The Allis-Chalmers Company, Milwaukee, Wis., showed an operating exhibit of air-brakes and parts, steam turbine parts, pictorial exhibit of other products. Represented by F. C. Randall, J. F. Dixon, H. W. Rowley, Harry Byrne, A. P. Peck, W. G. Clayton, J. T. Cunningham, St. John Chilton, J. B. Nicholson, S. H. Payne, J. M. C. Lucas, A. H. Whiteside, J. R. Jeffrey, J. H. Denton, W. A. Crawford, I. L. Dimm, W. S. Heger.

The American Steel & Wire Company, Chicago, Ill., exhibited bare and insulated wires and cables, rail bonds and rail bond tools, springs, wire rope and strand, woven wire fence, concrete reinforcement. Represented by F. Baackes, C. S. Knight, Jr., G.

A. Cragin, F. A. Keyes, C. R. Sturdevant, R. K. Sheppard, J. D. Sutherland, A. G. Greenberg, R. H. Pratt, B. H. Ryder, G. C. Kiefer, L. A. Dietrich, E. W. Vaughan, Chas. Larson, B. B. Ayers.

The Alfred and J. M. Anderson Manufacturing Company, Boston, Mass., showed its new remote-control oil switch, new brushholders for heavy railway service, third-rail insulators, Aetna railway insulators and Anderson line materials, new strain insulator of drop-forged steel. Represented by J. M. Anderson, Alfred Anderson, W. W. Hincher, G. C. Crane, Ernst Woltman.

The Blake Signal & Manufacturing Company, Boston, Mass., exhibited Blake despatcher's signals, Blake tube soldering flux, Blake wiring specialties. Represented by E. J. Burke, C. C. Blake.

The Buckeye Engine Company, Salem, Ohio, made its usual exhibit of photographs of steam and gas engines. Represented by C. H. Weeks, A. H. Riddell, James T. Castle.

The Chicago Pneumatic Tool Company, Chicago, Ill., showed a complete line of electric drills, hoists and grinders, spike-driving electric drill, air-compressor, air tools, vacuum cleaners. Represented by W. O. Duntley, Thomas Aldcorn, G. A. Barden, F. C. Severin, W. F. Heacock, Charles Booth, W. P. Pressinger, H. B. Griner, C. B. Coates, Howard Small.

The Consolidated Car Heating Company, Albany, N. Y., exhibited its well-known electric heaters and switches, trolley voltage signal bell system and crossing signal. Represented by Cornell S. Hawley, W. S. Hammond, J. Thomas Farmer, Jr., George H. Diack.

The Crouse-Hinds Company, Syracuse, N. Y., showed its arc headlights, incandescent headlights, mine headlights. Represented by H. B. Crouse, A. F. Hills, F. M. Hawkins, C. M. Crofoot, F. Buchanan, D. C. Gidley.

The D. & W. Fuse Company, Providence, R. I., exhibited enclosed fuses and cutouts of all types for 250, 600 and 2,500-volt circuits, service switch boxes, fuse boxes, cutout boxes for railway lighting and motor service, railway shoe fuse boxes, transformer and high-tension cutouts, and Deltabeston magnet wire. Represented by W. S. Sisson.

The Joseph Dixon Crucible Company, Jersey City, N. J., had on exhibition a special steel building and made a display of Dixon's Ticonderoga flake graphite oil, lubricants, silica graphite paint. Represented by DeWitt C. Smith, L. H. Snyder, J. A. Condit, John J. Tucker, Thos. Findlay.

Dossert & Company, Inc., New York, N. Y., exhibited solderless cable connectors. Represented by H. B. Logan, C. A. Flynn, D. J. Fitch.

The Electric Service Supplies Company, Philadelphia, Pa., exhibited its new "Pay-Within" car, "Protected" rail bonds, Keystone overhead line material, Garton-Daniels lightning arresters, automotoneers, Lyon sheet steel gear cases, Keystone air sander trap, Keystone pneumatic bell ringer, Keystone lamp guard, pneumatic door operating mechanism, compressed air door operating mechanism. Represented by C. J. Mayer, J. W. Porter, J. V. E. Titus, A. H. Englund, M. A. Berg, E. R. Mason, F. H. Jameson, H. G. Lewis, Edw. Hammett, H. R. Swartley, Jr., W. A. Armstrong, Jr., T. F. McKenna, F. A. Strail, R. P. H. Staub, F. C. Peck.

The Electric Storage Battery Company, Philadelphia, Pa., exhibited several styles of samples of the "Chloride" accumulator, diagrams of the new split-pole rotary converter, used for regulation of alternating-current loads, curves showing the regulation, and an average adjuster. Represented by Charles Blizzard, J. L. Woodbridge, G. H. Atkin, Albert Taylor, H. B. Gay, Edward L. Reynolds.

General Electric Company, Schenectady, N. Y., showed its type M automatic control for four seventy-five-horse-power motors, US-13 trolley base with twelve-foot trolley pole and Form 21 fork with wheel, trolley forks and wheels for various speeds, MR12 circuit-breaker, MS-8 switch, K-35, K-36, K-34 controllers with handles, fuse boxes, contactors, switchboard panel for Type M control, car light regulator, emergency straight air-brake equipment with compressor for motor car, emergency straight air-brake equipment for trailer car mounted on rack for operation, motorman's valves, emergency valve, governor, split, solid and forged rim gears, cast-steel center for gears, armature and field coils commutator segments, armature linings for GE-216 motor, Grade F pinion, section of field coil showing effect of vacuum compound treatment, 600 1200-volt railway motor, rail bonds, catenary and standard direct suspension line material, electrolytic car lighting arresters, Magnetite headlights, self-contained solenoid-operated circuit breaker arranged for 650-volt operation, alternating current and direct current, rotary converter panels. Represented by C. E. Sprague, C. C. Peirce, J. J. Mahoney, H. D. Hawks, W. J. Clark, R. E. Moore, E. H. Ginn, H. C. Marsh, W. J. Hanley, H. L. Monroe, G. D. Rosenthal, Gen. Irving Hale, J. R. Lovejoy, J. G. Barry, C. E. Barry, H. N. Ransom, W. B. Potter, F. E. Case, E. D. Priest, A. H. Armstrong, E. H. Anderson, G. H. Hill, A. V. Thompson, F. H. Gale, Mr. Corbin, Mr. Buell.

The General Storage Company, Boonton, N. J., exhibited storage battery plates, jars, tanks and accessories in various sizes, "Bijur" regulator and switchboard. Represented by Joseph Bijur, James Dixon, Edward Lyndon.

G. M. Gest, New York, N. Y., exhibited cable racks, conduit and photographs of typical installations.

The Gold Car Heating and Lighting Company, New York, N. Y., showed the Gold improved electric car heaters, junction boxes and parts. Represented by E. E. Gold, E. B. Wilson, J. M. Stayman, F. T. Kitchen, F. Cahill.

The Gould Storage Battery Company, New York, N. Y., exhibited various types of Gould cells, lead-lined tanks. Represented by H. N. Powers, C. H. Bradley, H. W. Brow.

The H. W. Johns-Manville Company, New York, N. Y., exhibited high-tension catenary overhead line material, asbestos wood, indurated fibre third-rail insulators, battery jars, low-tension overhead line material, arc deflectors, high-tension porcelain insulators, Noark enclosed fuses, molded mica sockets, friction tape, splicing compound, electric car heaters, asbestos pipe and boiler covering, asbestos roofing and packing. Represented by T. F. Manville, J. W. Perry, T. L. Barnes, S. G. Meek, E. E. Schmid, J. McSorley, C. N. Manfred, H. M. Voorhis, G. A. Saylor, H. M. Frantz, R. R. Braggins, W. W. Power, C. W. Schultz, E. B. Hatch, W. H. Kempton.

The Lord Electric Company, New York, N. Y., exhibited Earll trolley retrievers and catchers, Thomas laminated soldered rail bonds, Shaw lightning arresters, Cosper controlators, Garton choke coils, Garton "Multi-Vapo-Gap" lightning arrester, cell and block type, Garton "Hydro Ground," Leco ground plates, points, cap and couplings, Leco car seat heat deflectors. Represented by F. Lord, E. Kirkham, W. R. Garton, E. A. Robertson, Ray P. Lee, C. A. Davis, W. P. Cosper.

The Massachusetts Chemical Company, Walpole, Mass., exhibited samples of Armalac, Enamelac, M. C. paint, insulating tapes, splicing compounds, Walpole insulating board, field coil cushions, motor bushings, switch board matting car steps, corrugated matting. Represented by L. O. Duclos, A. E. Duclos, F. J. Gleason, E. W. Furbush.

The Elmer P. Morris Company, New York, N. Y., exhibited line material, car trimmings and general repair parts. Represented by Elmer P. Morris, Dwight E. Morris, Fred W. Roth, H. S. Tonks.

The National Carbon Company, Cleveland, Ohio, exhibited a vibrating machine for testing carbon brushes. Represented by N. C. Cotabish, F. D. Kathe, O. T. Weaver, W. B. Brady, A. E. Carrier, A. C. Henry.

The Ohio Brass Company, Mansfield, Ohio, exhibited trolley hangers and ears, rail bonds, third-rail insulators, catenary materials, high-tension porcelain insulators, Tomlinson car couplers, Universal sander valves and traps, Collin steam pressure regulating valves. Represented by C. K. King, A. L. Wilkinson, G. A. Mead, E. F. Wickwire, A. L. Price, C. H. Tomlinson, N. M. Garland, R. M. Campbell, Nathan Shute, W. H. Bloss, F. E. Johnson, E. C. Brown, J. E. Slimp.

The Rail Joint Company, New York City, exhibited samples of rail joints. Represented by B. M. Barr, D. J. Evans, C. A. Cool, G. W. Smith.

The Speer Carbon Company, St. Marys, Pa., exhibited carbon brushes for motors and generators, circuit-breaker carbons. Represented by J. S. Speer, G. P. Fryling.

The Standard Paint Company, New York City, established a comfortable reception room. Represented by J. G. Satterthwait, Paul J. McCarley, Charles E. Smith.

The Standard Underground Cable Company, Pittsburg, Pa., exhibited cables, wires, junction boxes, cable terminals. Represented by H. P. Kimball, T. E. Hughes, C. W. Davis.

The Standard Varnish Company, New York, N. Y., exhibited samples of insulating specialties. Represented by L. Robinson, H. Chilcote, A. Steinberg, E. A. Holland.

The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., exhibited magneto despatching telephones, central energy despatching telephones and kindred equipments. Telegraph signals manufactured by Telegraph Signal Company, Rochester, N. Y. Represented by J. O. Oliver, H. W. Lucia, E. O. Munson, H. C. Slemin.

The Wagner Electric Manufacturing Company, St. Louis, Mo., exhibited single-phase and polyphase motors, switchboard and portable instruments. Represented by W. Robbins, E. W. Goldschmidt, John Mustard, Brooks Faxton.

The Western Electric Company, Chicago, Ill., exhibited overhead material, pole brackets, armature and field coils, commutators, arc lamps, safety strain insulators, high-tension and third-rail insulators, Kalamazoo trolley wheels, headlights, Deltabeston coils and wire. Represented by A. E. Meixell, H. M. Post, F. Killion, M. A. Oberlander, R. Roth, F. C. Jaeger, R. H. Harper.

The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., exhibited standard direct current forty-horse-power motors, direct current fifty-horse-power interpole motor, 150-horse-power motor, unit switch system of control for use on direct-current and alternating-current railways, single-phase motors. Represented by J. A. Brett, W. N. Conwell, C. S. Cook, Thomas Cooper, C. H. Davis, H. P. Davis, T. W. Ewing, G. B. Griffin, W. M. McFarland, L. N. Reed, C. W. Register, H. C. Stier, C. B. Humphrey, J. C. McQuiston.

The Westinghouse Machine Company, East Pittsburg, Pa. Represented by E. H. Sniffin, L. L. Brinsmade, L. C. Bullington, H. H. Van Blarcom, J. H. Wagenhorst, R. E. Adreon, G. M. Bates.

The Westinghouse Traction Brake Company, Pittsburg, Pa., had an operating exhibit of equipments suitable for single motor car, two car trains consisting of motor and trailer, and three to five car trains; sectional motor-driven compressor; sectional brake cylinder with slack adjuster. Represented by A. L. Humphrey, J. R. Ellicott, C. R. Ellicott, E. L. Adreon, S. D. Hutchins, P. H. Donovan, Robert Burgess, A. Johnson, C. P. Cass, C. W. Townsend, E. A. Craig, F. M. Nellis, F. V. Green, C. J. Olmstead, A. Johnson, W. V. Turner, J. F. Miller and W. S. Bartholomew.

Current Electrical News

DOMESTIC AND EXPORT.

VIRGINIA WATER-POWER DEVELOPMENT—The Talley's Falls Improvement Company, M. R. Lewis engineer-in-charge, is planning the development of the water power of Talley's Falls, on Dan River, five miles from Scottsburg, Va. From 10,000 to 12,000 horse-power will be available for transmission to manufacturing plants in Virginia and North Carolina, including copper-mining properties in the Virginia-Carolina copper belt. Reports state that $1,000,000 will be the cost of the dam, electric plant and transmission lines.

$1,000,000 BONDS ISSUED BY MILWAUKEE ELECTRIC RAILWAY AND LIGHT COMPANY—Spencer Trask & Company and N. W. Harris & Company, of New York, have purchased jointly $1,000,000 Milwaukee Electric Railway and Light Company refunding four and one-half per cent bonds, due 1931. These bonds are being issued by the company to refund a like amount of Milwaukee City Railway fives, due December 1, 1908. The refunding four and one-half per cent bonds are being offered to investors at ninety-five and interest.

TO HAUL ORE BY ELECTRICITY—An effort is being made by the Arizona Mercantile, Transportation and Smelter Company, of Leavenworth, Kan., to obtain a concession from the Mexican Government for the construction of a standard-gauge electric railroad from some point on the Southern Pacific Railroad in Arizona, probably Maricopa, to the Gulf of California at St. George's Bay, cutting the distance from Central Arizona points to deep water a distance of 160 miles. It is proposed by means of this road to haul ore from the mines to deep water.

DES MOINES ELECTRIC COMPANY TO ENLARGE PLANT—Plans for the extension of its plant involving the expenditure of $1,000,000 have been announced by General Manager Paul B. Sawyer, of the Des Moines Edison Light Company, Des Moines, Iowa, hereafter to be known as the Des Moines Electric Company. This announcement comes as a culmination of recent changes in the incorporation of that concern, as announced recently. While the authorized capital stock of the new company is $5,000,000, the stock actually issued is exactly the amount of the Des Moines Edison Light Company stock outstanding, or $1,125,000. The remaining stock not issued is to provide in part the funds for the future growth of the company. The bonds issued at this time are of such amount as is needed to take up the outstanding indebtedness of the old Des Moines Edison Light Company, $730,000, and to pay in addition for improvements already in progress and contemplated for the year 1908.

NEW MONTANA POWER PLANT TO SUPPLY POWER TO MINES—Between $2,500,000 and $3,000,000 is to be expended in the construction of a new power line from Thompson, Mont., to the Murray district. This project has been in the hands of Senator Donlan, of Missoula, Mont., for some time and arrangements for financing has been completed. Construction work will soon be commenced. The plant will furnish power to the northside mines. From Thompson to Murray the line will be approximately thirty-one miles in length, the right of way having all been secured. Engineers estimate that even in the driest seasons no less than 29,000 horsepower will be generated, 18,000 above Thompson Falls and 11,000 below. The right of way runs west to Mullan and Wallace. One branch goes to Burke and another down Pritchard Gulch to Pritchard Creek will furnish power to Paragon, Chicago-London, Jewell-Jewell, Black Horse, Bear Top, Golden Chest, Terrible Edith, Pilot and many other properties.

NEW HAVEN TRACTION DEAL—According to a statement made by Vice-President E. G. Buckland, the New York, New Haven & Hartford Railroad is planning a $22,000,000 deal in Rhode Island. The New Haven plans to secure control of the United Traction and Electric Company, which has $8,000,000 capital stock and $9,000,000 of five per cent bonds. Included in the deal is the purchase of $5,000,000 four per cent bonds of the Rhode Island Suburban Railway Company. The United Traction and Electric Company owns all the lines in Providence and Pawtucket and their suburbs. Under the present arrangement the New Haven road has only the right to operate these lines. For this privilege it pays five per cent on the United company's capital stock, or $400,000 a year rental. In keeping with its policy the New Haven road wishes to acquire ownership of these lines. The New Haven plan is to give five per cent guaranteed bonds of the New Haven company and to exchange the bonds on a similar basis.

CHICAGO CITY RAILWAY TO BUY ELECTRICITY FROM COMMONWEALTH EDISON COMPANY—A contract by which the Chicago City Railway Company will abandon its power-producing stations and for the next ten years purchase all of its electric power from the Commonwealth Edison Company is ready for approval by the board of supervising engineers. The supervising engineers have already expressed themselves in favor of the contract, but it will be published and distributed before being approved. The contract will be the largest ever made in Chicago for electricity. At the beginning of the term, according to Samuel Insull, president of the Commonwealth Edison Company, it will cost the railway $800,000 or $900,000 annually, and at the end between $1,300,000 and $1,400,000 each year. At the present the street-car company secures slightly less than three-fourths of its motive power from the same company under a less favorable five-year contract. The street-car company will retain its transforming stations.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY TAKES WESTERN ELECTRIC STOCK—The American Telephone and Telegraph Company has arranged to pay for approximately 30,000 shares of Western Electric Company stock, purchased last January, with its four per cent convertible bonds. The transaction involved an exchange of nearly $7,000,000 of the bonds for the shares of the Western Electric Company. The exchange was made through the Merchants' Loan and Trust Company of Chicago. The terms of the offer made by the American Telephone Company to purchase all or any part of the Western Electric Company's stock not then owned by the former corporation were $250 in bonds or $225 in cash for each share, par value $100, of the latter concern's stock. Nearly $3,000,000 of the stock was deposited and this has been paid for in bonds where the amount of stock deposited included more than four shares. The American Telephone and Telegraph Company now controls approximately $12,000,000 of the Western Electric Company's $15,000,000 capital stock.

PHILADELPHIA RAPID TRANSIT LOAN—All interests of the Union Traction Company, of Philadelphia, Pa., which is leased to the Philadelphia Rapid Transit Company, have agreed upon a plan by which a board of directors satisfactory to all is to be elected at a special meeting of stockholders to be held on October 29, and the $5,000,000 loan of the Rapid Transit company is assured. To take the place of the directors who resigned because they held similar positions on the Rapid Transit company's board of directors, the following stockholders have been selected: William P. Datz, Jacob Disston, G. H. Chestnut, Henry Fernberger and E. M. Story. They will take the places to be vacated by the resignations of P. A. B. Widener, George D. Widener, John B. Parsons, George H. Earle, Jr., and William H. Shelmerdine. Jeremiah J. Sullivan's resignation will not be accepted, it has been mutually agreed, and he will be elected vice-president of the reorganized board. Robert A. Balfour, admitted to be the largest shareholder, is slated for the presidency to succeed Mr. Parsons. It has not been decided whether a secretary will be elected to succeed Charles O. Kruger, second vice-president and general manager of the Rapid Transit Company, but this will probably be done. The Balfour committee has sent out letters to stockholders asking for proxies for the directors named and urging each shareholder to vote for the plan by which the Rapid Transit company can pledge securities owned by the Union Traction Company for the proposed $5,000,000 bond issue.

ELECTRIC LIGHTING.

WOONSOCKET, R. I.—The Woonsocket Electric Machine and Power Company has been granted a right of way by the selectmen for its poles and wires.

MALVERN, IOWA—The Malvern Light, Power and Heating Company has begun preparations for stringing nine miles of wire from here to Tabor to carry current for lighting that town.

UNION, MO.—At a special election W. W. McCurdy was granted an electric light franchise by a vote of 111 to 1. The plant is to be in operation by April 6, 1909, when the Tibbe franchise expires.

AUBURN, N. Y.—The contract for building the new plant for the Auburn Light, Heat and Power Company, to occupy the present site of the old building in North street, has been awarded to Charles S. Keim.

SAN BERNARDINO, CAL.—The county supervisors have sold a franchise for many miles of electric power and lighting lines in the eastern section of the valley to the Home Gas and Electric Company, of Redlands.

SAFFORD, ARIZ.—M. E. Webster, formerly local manager of the Consolidated Telephone, Telegraph and Electric Company, is considering a proposition to give Safford and Thatcher an electric lighting and power system.

TAUNTON, MASS.—At a meeting of the county commissioners it was voted to advertise for a loan of $100,000 for the Fall River & Somerset Bridge. Walter H. Law was instructed to draw plans for the electric plant to operate the bridge.

WILLIAMSON, N. Y.—The town board has entered into a contract with the Sodus Electric Light Company to light the streets of this village with seventy incandescent lights of sixteen candle-power each for five years at a cost of $1,000 a year.

GOUVERNEUR, N. Y.—Alexander B. Clark and C. P. McAllaster, of Oxbow, are interested in a scheme to procure power for electric lighting purposes from Bullhead Lake, about two miles from that village. An engineer has surveyed the route.

HEBER, ARK.—An effort is now being made to establish an electric light plant. A corporation will be organized for the purpose of establishing and operating such a plant under the franchise granted W. H. Horton by the city council several months ago.

PURCELLVILLE, VA.—W. Warrington Evans, of Evans & Evans, Washington, D. C., has puchased the Purcellville Canning Factory building at $6,000, which he will equip as an electrical plant and furnish Purcellville, Round Hill, Hamilton and Bluemont with electricity.

NEW HAVEN, CT.—Plans are being perfected for the supplying of the whole of Yale University, including the dormitories, with electric light and power, derived probably from a new central plant. Estimates of the cost of the work, made some time ago, fix the expense at about $60,000.

WASHBURN, WIS.—The city has returned to the Washburn Electric Light and Power Company the lighting plant which was purchased last November. The city has run the plant for almost a year and found it a losing proposition. The lighting company will resume the conduct of the plant.

LEWISBURG, TENN.—A company, recently organized here, known as the Lewisburg Light and Power Company, has purchased the city electric light plant and will assume charge at once. It will greatly improve the system and service, and will establish, in connection, an ice factory and cold-storage plant.

EDMONDS, WASH.—A $20,000 electric light plant is to be built here by local capital. The first unit, with a capacity of 1,500 lights, will be in operation in sixty days. The Edmonds Electric Light and Power Company has been organized for this purpose, backed by C. Malmo, of Seattle; W. R. Ammon, of Prosser, and A. G. Pike, of Edmonds.

LOCKPORT, N. Y.—A new board of directors was elected at the annual meeting of the Niagara, Lockport & Ontario Power Company as follows: H. H. Westinghouse, George C. Smith, Paul T. Brady and Charles A. Terry, of New York city; William M. Clement and William H. Gratwick, of Buffalo, and H. D. Uptegraff, of Pittsburg, Pa.

NEW YORK, N. Y.—Plans have been filed for a one-story electric light station to be built on Blackwell's Island to supply light to the island institutions under the supervision of the commissioner of charities. It is to have a frontage of thirty-one feet and a depth of fifty-six feet and will be built of Greenwich green stone set in broken bond. It is to cost $5,000, according to the estimate of Raymond F. Almirall, architect for the city.

NATCHEZ, MISS.—Lynn H. Dinkens, the purchaser of the Southern Light and Traction Company local plants, comprising the electric light and gas plants, and six miles of electric street railway, sold by order of the court on account of a writ of ouster, the company having been declared a trust, has transferred the entire holdings to the Louisiana Railway Company. The consideration is said to be $5,000 cash, $40,650 stock, and the assumption of a $335,000 mortgage. The new company is domiciled in New Orleans.

WASHINGTON, D. C.—The Navy Department is planning several important improvements and changes in the navy yards at Boston and Portsmouth. At Boston it is proposed to install new electric generating machinery, which will materially increase the capacity of the power plant. This improvement will cost probably $50,000. This improvement will be in addition to the installation of generating machinery and boilers, which is going on at Boston under contract. Bids for the contemplated work will be advertised for in a short time.

LOUISVILLE, KY.—The so-called Fetter electric lighting franchise, carrying with it the privilege to sell electric light in the heart of the city, has been sold at public auction to George G. Fetter, the only bidder, for $5,515. This ordinance was sold six weeks ago to Hardy Burton for $45,515. Mr. Burton failed to pay his money over in the stated time, claiming that the title to the franchise was not perfect. The board of works decided that the Court of Appeals had definitely decided the franchise valid. The board, therefore, forfeited the $2,000 put up by Mr. Burton.

PENDLETON, ORE.—An electric light company has been organized to furnish light for Hermiston, Echo and Umatilla. Work has been started on two power ditches west of Hermiston. The drainage of water from the government and two private reclamation projects will be utilized to develop 500 horse-power. The water will be turned back into the river so as not to interfere with other projects. J. T. Hinkle, a member of the company, says two plants will be in operation before next summer. Other members of the firm are: O. D. Teal, H. G. and Ross Newport.

TOWER CITY, PA.—The Sterling Electric Light Company is pushing work on its plant located at Williamstown. The brick building, which is 150 feet by 60 feet, is almost completed. The boiler and machinery are being placed and the company hopes to begin operations by January 1. The plant is owner principally by Tower City capitalists. It was located at Williamstown, as the town is central, having the towns of Lykens and Wiconisco on one side, with Tower City, Reinerton, Orwin and Reiner City on the east. The company expects to operate its plant during the day.

NAPA, CAL.—The supervisors of Napa County have advertised for bids for a franchise to conduct a farmers' power line from Napa into Lake County, through the Napa Valley. The bids will be opened on November 11. E. D. N. Lehe, of Woodland, is promoting the system and will bid for the franchise. He proposes to supply power not only for electric lights but for pumping water, churning, and even milking cows. The system has been tried elsewhere in this state and has proven practicable and economical for farms and rural communities. Yountville, Oakville and Rutherford are among the towns above Napa which will be reached by the new system.

SYRACUSE, N. Y.—The stockholders of the Syracuse Lighting Company at their annual meeting elected the following directors: Stephen Peabody, New York; Henry Sullivan, New York; Walton Clark, Philadelphia; Lewis Little, George S. Philler, Philadelphia; W. S. Douthirt, Philadelphia; John J. Cummins, Syracuse; Hendrick S. Holden, Syracuse, and Lewis L. Walters, Syracuse. At a subsequent meeting of the directors these officers were elected; President, John J. Cummins; vice-president, Walton Clark; vice-president, J. C. Delong; secretary, W. F. Douthirt; treasurer, Lewis Lillie. President Cummins stated that only routine business was transacted.

ELECTRIC RAILWAYS.

GRAND FORKS, N. D.—The newly organized street railway company of Grand Forks has let the contract for the laying of steel to P. R. McDonnell, of Duluth.

PHELPS, N. Y.—The Phelps board of trustees at its meeting has voted to extend the franchise of the proposed Geneva, Phelps & Newark Electric Railroad another year.

SUFFERN, N. Y.—The board of trustees of Suffern has granted a franchise to the Rockland Railroad Company. This is the New Jersey corporation that proposes to build a road from Paterson to Suffern.

BOSTON, MASS.—The railroad commission has approved of an issue of $150,000 twenty-year five per cent bonds by the Norfolk & Bristol Street Railway for retiring indebtedness in construction of railway.

ELGIN, ILL.—The Elgin, Woodstock & Lake Geneva Railroad has awarded the contract for the surveying and grading of the roadbed to George H. Painter & Company, Chicago contractors. Work will begin immediately.

LONG BRANCH, N. J.—The Atlantic Coast Electric Railway Company, which operates a trolley line between Pleasure Bay and Asbury Park has been granted a twenty-year franchise to run a line between Pleasure Bay and Monmouth Beach.

LEBANON, PA.—A meeting of those interested in the projected street railway which is to extend from Campbelltown to Bismarck, Cornwall and Schaefferstown was held in Lebanon when a temporary organization was effected and steps taken toward the selection of permanent officers.

BAKERSFIELD, CAL.—Captain Cross, of Los Angeles, has issued orders to resume the survey at the Tejon ranch, in this county for the Los Angeles-San Francisco electric short line. The survey already is made from Los Angeles to Tejon ranch and the right of way through the forest reserve has been granted.

HATTIESBURG, MISS.—Officials of the Hattiesburg Traction Company, which controls the street railway franchise in Hattiesburg, announce that they have perfected arrangements for the financing of the enterprise, involving the placing of $250,000 bonds, and work on the plant will commence December 1.

ATLANTIC CITY, N. J.—In bankruptcy for more than a year, the Atlantic City and Suburban Traction Company, operating a line from the Boardwalk here to Absecon and Somers Point, and one time designated to afford an entrance to the resort for a $20,000,000 electric line from Philadelphia, will be sold under the hammer on October 31.

TERRE HAUTE, IND.—Providing for the protection of stockholders and creditors of the Terre Haute & Merom Traction Company, men interested in the enterprise have organized a new corporation with a capital stock of $50,000. Plans for the reorganization of the company were approved and it was decided to go ahead with the construction of the line from Terre Haute to Merom.

SEATTLE, WASH.—A franchise over twelve miles of the county road to Bothell has been granted by the board of county commissioners to the Seattle, Snohomish & Everett Railroad. The road is to be built within five years. The officers of the company are: President, Clyde C. Chittenden; vice-president, J. R. McLaughlin; secretary, treasurer and general manager, C. W. Kimball. The capital stock is $300,000.

SULLIVAN, ILL.—President Starbuck, of the Decatur, Sullivan & Mattoon Interurban, has returned from New York where he went to secure the funds for building this road, which will extend from Decatur to Mattoon. The route has been surveyed, and the right of way and franchises secured. The proposed route will cover forty-two miles. It is expected it will cost $1,000,000 to build and equip the road.

CAIRO, ILL.—A charter for the Cairo & East St. Louis Railway Company has been filed. The charter provides for the building of an interurban railway between Cairo and East St. Louis. The principal office is to be located in Cairo and the capital stock is named as $100,000 with William P. McKinley, L. E. Fisher, George M. Mattis, W. H. Carnahan and George W. Burton as the incorporators and first board of directors.

ST. PAUL, MINN.—The Twin City Rapid Transit Company announces that it will be ready to connect its St. Paul & Minneapolis lines with Fort Snelling as soon as the new bridge over the Mississippi is completed. This work is scheduled to end about March. The new line, which touches Minnehaha Falls, Fort Snelling and one of the most beautiful stretches of the upper Mississippi, will be featured as the scenic route between the Twin Cities.

GALESBURG, ILL.—The new Galesburg, Aledo and Northwestern interurban line will be built in three sections from Galesburg to Alexis or to Rock Island or to Muscatine, according to plans outlined by the promoters at a meeting held in Galesburg. It is proposed to raise $300,000 and build the first section of the line to Alexis. When this stretch is completed and the line is in operation it is proposed to increase the capital stock and take up the construction of the second section of the road.

SHELBYVILLE, ILL.—Engineer A. M. Fisher, Attorney R. T. Eddy, of this city, and John C. Bitzer, of Tower Hill, are engaged in securing right of way between Shelbyville and Pana for the proposed interurban line of the Mattoon, Shelbyville, Pana & Hillsboro Traction Company, and are meeting with success. Mr. Fisher is authority for the statement that G. Cooper, an Indianapolis traction magnate, has secured the pledge of European capitalists to build the road at once, providing the right of way is secured.

ALBANY, N. Y.—The Public Service Commission, Second District, has authorized the Buffalo, Lockport & Rochester Railway Company to issue $200,000 bonds for the acquisition of cars. The cars are to be purchased by the Buffalo, Lockport & Rochester Rolling Stock Company, which will execute a $200,000 mortgage to secure the bonds. The Rolling Stock Company then proposes to sell the cars to the Buffalo, Lockport & Rochester Railway Company upon its agreement to pay ten equal payments of $20,000 each with five per cent interest.

SEATTLE, WASH.—The transfer of the Seattle & Everett Interurban Street Railway system from Fred E. Sander and associates to the Stone & Webster interests, of Boston, is to be followed by the construction of a complete across-the-state electric interurban system. The southern terminus will be Portland, Ore., and the line will reach Vancouver, British Columbia, on the north. A contract is also to be awarded in the near future to build that section of the road between Tacoma and Olympia. The route from the state capital to the Grays Harbor country has been surveyed and the surveyors are now working south from Aberdeen to Portland.

SYRACUSE, N. Y.—Buffalo and Rochester were connected by trolley for the first time on October 2, and with the opening of regular traffic over the new Buffalo, Lockport & Rochester electric lines in a few weeks it will be possible to go from this city to Buffalo by trolley, by way of the Auburn & Syracuse, Rochester, Syracuse & Eastern and the new road. Upon the completion of the proposed extension of the Rochester & Eastern from Port Byron to this city, a trip with but one change, at Rochester, will be possible between the two cities. At the offices of the Beebe syndicate it is stated that the work of extension from Port Byron here will be begun early in the spring. It will require twenty-five miles of double-tracking and will cost $1,250,000, estimated. The Beebe interests are at present directing all efforts toward the completion of the Fulton & Oswego extension of the Lake Shore & Northern road.

DATES AHEAD.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Association of Car-Lighting Engineers. First annual meeting, Chicago, Ill., November 18.

National Society for the Promotion of Industrial Education. Annual meeting, Atlanta, Ga., November 19-21.

International Independent Telephone Association. Annual convention, Chicago, Ill., December 1-3.

American Society of Mechanical Engineers. Annual meeting, New York city, December 1-4.

American Roentgen Ray Society. Annual meeting, New York city, December 28-30.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

American Association for the Advancement of Science. Annual meeting, Baltimore, Md., January, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

PERSONAL MENTION.

GENERAL C. EDWARD MURRAY, treasurer of the Crescent Insulated Wire and Cable Company, visited Chicago recently, calling upon his agents, the Metropolitan Electrical Supply Company.

MR. SHELLMAN B. BROWN, general manager of the Maryland Electric Railways Company (Baltimore & Annapolis Short Line), has resigned, after fifteen years' service as superintendent or general manager of the company.

MR. M. McINTYRE, of Detroit, Mich., has been made operating superintendent of the San Francisco, Vallejo & Napa Valley Railway Company, Napa, Cal.. L. J. Perry, formerly general manager, will continue with the company as its business manager.

MR. E. M. HEDLEY, general superintendent of the Hudson Companies, will sever his connection with the McAdoo Tunnels on November 1. It is believed that he will become associated with the Interborough Rapid Transit Company, of New York City.

MR. ALBERT R. EASTMAN has been appointed general passenger agent of the Utica & Mohawk Valley Railway Company, the Oneida Railway Company and Syracuse Rapid Transit Railway Company. Mr. Eastman has for some time been the express agent of these roads and will continue in this capacity.

MR. B. A. BEHREND, for nearly ten years chief engineer of the Bullock Electric Manufacturing Company and for five years chief engineer of the electrical department of the Allis-Chalmers Company, the designer of the Bullock and Allis-Chalmers electrical machinery, has severed his connection with the Allis-Chalmers interests.

MR. BYRON CLINGERMAN, superintendent of the People's Light, Heat and Power Company, Springfield, Ohio, which has been consolidated with the Home Lighting, Power and Heating Company, also of Springfield, has resigned, and is succeeded by John Cook, superintendent of the Home Company, who will have charge of both plants.

MR. F. H. BETHELL, vice-president of the Bell Telephone Company of Pennsylvania and the Chesapeake & Potomac Telephone Company, who has been seriously ill for the past two months from typhoid fever, has left his summer home at Blue Ridge Summit, Pa., for Atlantic City, N. J. Mr. Bethell will, on or about November 1, leave for an extended European trip.

MR. H. P. JAMES, formerly electrical engineer of the Bryant Electric Company, now occupies the position of sales manager for the new line of push-button specialties recently placed on the market by the Cutler-Hammer Manufacturing Company of Milwaukee. Mr. James is a graduate of the Massachusetts Institute of Technology, where he received degrees in both electrical and mechanical engineering. Previous to his connection with the Bryant Electric Company, he was electrical inspector and engineer for the Associated Factory Mutual Fire Insurance Companies. In his present position with the Cutler-Hammer Manufacturing Company he will have opportunity to turn to practical account the result of his past experience in the inspection, testing and manufacture of electric lighting supplies.

OBITUARY NOTES.

MR. JONAS MEYERS, who was recently appointed superintendent of the Conshohocken Electric Light and Power Company, Conshohocken, Pa., was killed by a fall on October 16. Mr. Meyers was forty-three years of age.

DR. FREDERICK A. C. PERRINE, widely known as an authority on electrical subjects, died at his home on West Seventh street, Plainfield, N. J., October 20, following an illness of several months with Bright's disease. He was born at Freehold, N. J., in 1862 and was graduated from Princeton University, receiving the degree of Bachelor of Science. After devoting a short time to practical engineering he accepted the professorship of electrical engineering in Leland Stanford, Jr., University, which position he resigned to become president of the Stanley Electric Company at Pittsfield, Mass., doing some of the pioneer work in long-distance transmission. For the past few years he had been a consulting engineer, with offices in New York. Dr. Perrine was identified with several electrical organizations and was one of the most prominent members of the American Institute of Electrical Engineers, and he was the author of several technical works. He is survived by his wife, two daughters, Margaret and Anne Perrine, and one son, John. The funeral services were held at his late home on Thursday and the burial was at Freehold.

ELECTRICAL SECURITIES.

What it appeared at first would affect the American market very seriously, in the shape of an embroilment of the foreign powers, has lessened its appearance of disastrous consequence, and there are now assurances that for a time at least there will be no clash in the Balkan situation. The removal of the impending possibility of the dumping of American stocks by foreign holders and the strong condition of the banks here have been factors which have buoyed up the market, and with the end of the week prices began to creep upward, halting though the movement was in fact. When it is recalled that business is still far from normal, it comes as a surprise and should call for general gratification to note that railroads report that the gross earnings for the first week in October were only 3.9 per cent less than for the corresponding week in 1907.

Dividends have been declared upon the following electrical securities: Twin City Rapid Transit Company; regular quarterly dividend of 1¼ per cent on the common stock, payable November 14 to stockholders of record October 24. Milwaukee Railway and Light Company; regular quarterly dividend of 1½ per cent on the preferred stock, payable on October 31. United Electric Company; regular semi-annual dividend of 3½ per cent on the preferred stock, payable November 2. West Penn Railways Company; regular quarterly dividend of 1¼ per cent, payable November 2 to stock of record October 24. Michigan Telephone Company; regular quarterly dividends of 1½ per cent on the preferred stock and 1 per cent on the common stock, the preferred dividend payable February 1, 1909, and the common dividend payable December 1. Havana Electric Railway Company; regular quarterly dividend of $1.50 on the preferred stock, payable November 14 to stock of record October 24. Georgia Railway and Electric Company; regular quarterly dividend of 1¼ per cent on the preferred stock. American District Telegraph Company of New Jersey; regular quarterly dividend of 1 per cent.

ELECTRICAL SECURITIES FOR THE WEEK ENDED OCTOBER 17.

New York:	*Closing.*
Allis-Chalmers common	11⅝
Allis-Chalmers preferred	34¾
Brooklyn Rapid Transit	48½
Consolidated Gas	145
General Electric	143½
Interborough-Metropolitan common	10½
Interborough-Metropolitan preferred	31
Kings County Electric	125
Mackay Companies (Postal Telegraph and Cables) common	73¾
Mackay Companies (Postal Telegraph and Cables) preferred	67½
Manhattan Elevated	135
Metropolitan Street Railway	24
New York & New Jersey Telephone	114
Western Union	59½
Westinghouse Manufacturing Company	81¼

At the annual meeting of the Western Union Telegraph Company Paul Morton and Robert M. Gallaway were elected directors to succeed Morris K. Jesup and John D. Layng. The other directors were re-elected.

Boston:	*Closing.*
American Telephone and Telegraph	127
Edison Electric Illuminating	—
Massachusetts Electric	50½
New England Telephone	121½
Western Telephone and Telegraph preferred	75

Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	36
Electric Storage Battery preferred	36
Philadelphia Electric	10⅞
Philadelphia Rapid Transit	22
United Gas Improvement	87½

Chicago:	*Closing.*
Chicago Telephone	124
Commonwealth Edison	108½
Metropolitan Elevated preferred	40
National Carbon common	69
National Carbon preferred	110

TELEPHONE AND TELEGRAPH.

BOUND BROOK, N. J.—The council has granted a thirty-year franchise to the New York & New Jersey Telephone Company.

SALT LAKE CITY, UTAH—The management of the Utah Independent Telephone Company has accepted the new franchise ordinance passed by the council.

MONTGOMERY, ALA.—At a conference of leading officials of the Southern Bell Telephone Company, held in this city, plans were made for the extension of telephone lines into rural sections.

CROOKSTON, MINN.—The Tri-State Telegraph and Telephone Company has asked the city council of Crookston to grant it a franchise to use the streets and alleys and public places of the city for long-distance and toll service.

KNOXVILLE, TENN.—The East Tennessee Telephone Company on October 1 closed a deal connecting the East Tennessee wires with the Trotter exchanges, giving Trotter direct connection with all parts of the United States by long-distance telephone.

CARLISLE, PA.—The Bloserville Telephone Company has entered into an agreement with the American Union lines at Newville for a term of five years. The officers of the Bloserville Telephone Company are: President, George Barrick; secretary, William Calaman; treasurer, George Robert Fry.

CAMERON, S. C.—The Cameron Telephone Company has been organized with James M. Moss as president and Harvey L. Taylor as secretary and treasurer. All of the capital stock has been subscribed. An order has been placed for the equipment with the Western Electric Company. The following comprise the board of directors: James M. Moss, H. L. Taylor, F. I. Culler, J. J. Gee.

VERMILION, S. D.—The Northwestern Telephone Company has taken over the independent telephone line from Yankton to Elk Point, and from Elk Point out by way of Canton. It has also obtained a ninety-nine-year lease giving it connection with the local independent exchange at Yankton, and now controls all toll service out of Yankton.

HATTIESBURG, MISS.—The Home Telephone Company, of Hattiesburg, is negotiating for the construction of a long-distance line from this city to Seminary, with a view to ultimate extension on to Collins and then to Jackson, Miss. Later a line will be built south to Gulfport, thus giving the independent system control of the Gulf and Ship Island territory. Local systems at points along the line will be absorbed by the larger corporation.

BUTTE, MONT.—The Rocky Mountain Bell Telephone Company has started the construction of several new toll lines west from Butte to Deer Lodge and also to Anaconda. These new lines will furnish additional toll facilities for Anaconda, Deer Lodge, Missoula and the Coeur d'Alenes and Spokane. The construction of additional circuits east to Whitehall and Bozeman will also be started as soon as the necessary construction material is assembled.

NEW HAVEN, CT.—The returns of the Southern New England Telephone Company for the nine months since January 1, 1908, show that the additions to the stations in this state number 3,700. There is now a total of 64,000 stations in the state, the city of New Haven leading with a total of more than 10,000. The total number of exchanges in Connecticut is fifty-four. Since January two new telephone buildings have been opened, one in Danbury and one in Middletown, each with a common battery service.

DES MOINES, IOWA—The Farmers & Merchants' Telephone Company, of Marshalltown, with a capital stock of $250,000, has been granted a charter by the secretary of state. The company is made up of the officers and stockholders of the mutual telephone companies of central Iowa and the plan is to incorporate into one company the lines in Calhoun, Dallas, Hamilton, Story, Greene and other central Iowa counties. The stock issue will be 2,000 shares of preferred stock at $50 a share par value, and 3,000 shares of common stock at $50 a share par value. The new company will include the Mutual exchange in Des Moines, Clyde E. Brenton, of Dallas county, president of the Des Moines concern, being one of the officers of the merger. The organization of the new company means also that the working agreements which have been carried on between the different mutual concerns will be annulled and a new agreement entered into to connect the city and the central section of the state with other portions of Iowa.

NEW INCORPORATIONS.

SACRAMENTO, CAL.—Live Oak & Encinal Light and Power Company. $20,000.

LOS ANGELES, CAL.—Home Gas and Electric Company, Newport Beach. $50,000.

AUSTIN, TEX.—Howe Telephone Company, of Grayson County. $2,500. Incorporators: C. A. Shock, S. D. Donohue, R. S. Daugherty.

PETALUMA, CAL.—Mount Jackson Water and Power Company. $20,000. Incorporators: Thomas C. Mellersh, G. P. Hall and Thomas Mellersh.

TRENTON, N. J.—Middlesex Telephone Company, Monmouth Junction. $10,000. Incorporators: Clarence S. Grover, D. C. Mershon and Andrew Ely.

PORTLAND, ME.—Cairo Railway and Light Company, Portland. To manufacture and sell gas and electricity. $1,000,000. President, G. F. Duncan; treasurer and clerk, Edward Woodman, both of Portland.

MONTPELIER, VT.—Groton Telephone Company. $10,000. Organized for the purpose of maintaining telephone lines in the towns of Groton, Bradford, Topsham, Barnet, Corinth, Newbury, Peacham and Ryegate.

STOCKTON, CAL.—San Joaquin Valley Electric Railway Company, Modesto. $1,000,000. Incorporators: Morris L. Brackett, H. E. Teter, John G. Weir, E. T. Zook and G. E. Weaver. To build and maintain an electric railroad from Stockton to Modesto, a distance of thirty-five miles.

OMAHA, NEB.—Omaha & Southeastern Railway Company. To operate between Omaha and Lincoln. $100,000. Incorporators: Ellery S. McNaul, Dever Sholes, Charles L. Dundey, Nicholas D. Doune, L. Howard Brumbaugh, I. G. Ladd, F. H. Rile, G. E. Moffat and Stephen St. John Malven.

NEW MANUFACTURING COMPANIES.

HARRISBURG, PA.—The Fairmount Electric and Manufacturing Company has been incorporated with a capital of $50,000, with Chester S. Leonard, of Philadelphia, as president.

BOSTON, MASS.—The Moving Sign Company has been incorporated to do an electrical sign business. The capital stock is $50,000, and the officers are: C. B. Battey, president; T. S. McGowne, treasurer, Boston.

ALBANY, N. Y.—The Phone-Hear-Plain Company, of New York, has been incorporated with a capital of $100,000. The directors are Berthold Levi, Henry Raphael and Doun Wood, all of New York city.

CHICAGO, ILL.—The Delta-Star Electric Company has been incorporated with a capital of $1,500 to manufacture and deal in electrical goods and appliances. The incorporators are: Garret V. Weart, James G. Weart and James A. Obermiller.

INDUSTRIAL ITEMS.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has published an attractive bulletin, No. 5910-8, devoted to electrical equipment for mines.

THE OHIO BRASS COMPANY, Mansfield, Ohio, in the October issue of its bulletin, devotes considerable space to special information on car equipments.

THE NEBRASKA ELECTRIC COMPANY, Lincoln, Neb., announces that the personnel of the company has undergone a change and will hereafter be officered as follows: President, Paul W. Horbach; vice-president and treasurer, Albert G. Munro; secretary, Carl C. Wilson.

THE STUART-HOWLAND COMPANY has leased the adjoining buildings, Nos. 1, 2 and 3 Winthrop square and 12 to 36 Otis street, and has moved its Boston store and office to that address. This gives the company greatly increased space and as there is about 13,000 feet on each floor, with over 325 feet of street frontage, it is unusually light and admirably suitable for the purpose, and the large floor areas will enable it to handle goods with greater economy. Large expense has been gone to in fitting up for each department and the facilities, it is assured, are now unsurpassed. The company has recently acquired several valuable agencies, has largely increased its stock and reports business recently considerably in advance of last year.

THE PITTSBURGH TRANSFORMER COMPANY, Pittsburg, Pa., announces that Judge Archbold, sitting in the United States Circuit Court for the Western District of Pennsylvania, at Scranton, on October 2, handed down a decision holding in effect that infringement was not shown and denying the complainant's motion for preliminary injunction in the suit of the Westinghouse Electric and Manufacturing Company for infringement of the so-called "Stanley Patent No. 469,809," against the Pittsburgh Transformer Company.

THE MASSACHUSETTS CHEMICAL COMPANY announces that it has moved its New York office from 237 Broadway to the Hudson Terminal Building, 30 Church street. A. G. Cozzens is sales agent, as formerly. At the new address the well-known line of electrical tapes, insulating fabrics and compounds and molded rubber goods will be carried to fill emergency orders. The former telephone number, 3440 Cortlandt, is retained. The offices are on the third floor, just at the bridge connecting the two halves of the building.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., in bulletin No. 4621, illustrates and describes its luminous arc lamp for multiple circuits. The Form 2 lamp is intended principally for use in foundries, machine shops, freight houses, etc., where a large unit is desired, and combines high efficiency with low maintenance cost. The lamp is made for 110 and 220-volt direct-current circuits, the 110-volt being suitable for any line voltage from 100 to 125 and the 220-volt lamp for voltages from 200 to 250. The company has also designed a multiple luminous lamp for use on direct-current power circuits and also for use as a headlight on interurban cars and mining locomotives. The bulletin illustrates and fully describes all of these lamps.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing circulars descriptive of its flexible steel conduit and conductors. It is claimed that this conduit is absolutely flexible and can be installed at much less expense than can a rigid pipe system. The circular also contains illustrations of the Armour stripping tools and their application. Copies will be mailed to those interested. The company is also distributing circulars describing "Galvaduct" interior conduit, calling attention to the various structural details. Complete data are also given on the diameter, threads per inch, weights and prices. By means of a chart a graphic representation is given of the comparative sizes of double-braided wires and "Galvaduct" conduit. Copies of this circular will be mailed upon request.

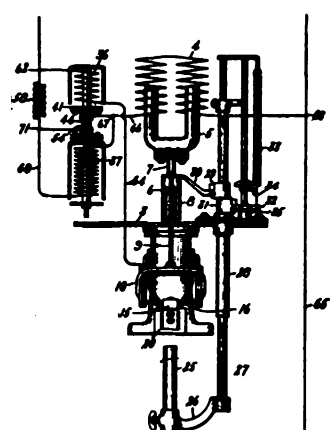
Record of Electrical Patents.

Week of October 23.

900,693. CIRCUIT-BREAKER. Charles C. Badeau, Schenectady, N. Y., assignor to General Electric Company. Filed September 16, 1901. Interoperating toggles are connected in tandem to multiply the force exerted on the movable contact.

900,699. CIRCUIT-CONTROLLER. Alexander Bevan, Providence, R. I. Filed September 16, 1907. Means are provided for absorbing the excess momentum of the circuit-closing lever.

900,708. HIGH-TENSION CIRCUIT-BREAKER. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. Filed February 19, 1903. Connected plates of magnetic material are disposed on opposite sides of the contacts.



900,718.—Arc Lamp.

900,718. ARC LAMP. Richard Fleming and Cromwell A. B. Halvorson, Jr., Lynn, Mass., assignors to General Electric Company. Filed May 1, 1905. The movable armature enters the series coil, and the electrode is actuated by differential coils.

900,719. ADJUSTABLE SUPPORT FOR VAPOR LAMPS. Stanwood E. Flitchner, Englewood, N. J., assignor to Cooper Hewitt Electric Company, New York, N. Y. Original application filed July 28, 1904. A combination of a tilting frame and vapor electric lamp.

900,732. ELECTRICALLY HEATED CURLING IRON. Harry Hertzberg and Maurice J. Wohl, New York, N. Y., assignors to Economy Electric Company, Brooklyn, N. Y. Filed April 18, 1907. One of a pair of co-operating members is tubular and contains a resistance therein.

900,733. ELECTRIC LIGHTING. Peter C. Hewitt, New York, N. Y., assignor, by mesne assignments, to Cooper Hewitt Electric Company, New York. Filed April 5, 1900. A combination of tubes, one of which yields a light containing rays which the light from the other tube is deficient in.

900,743. RELAY. Isidor Kitsee, Philadelphia, Pa. Filed October 19, 1907. Means are provided to bring the relaying contacts together independent of the incoming impulses.

900,745. SYSTEM OF ELECTRICAL DISTRIBUTION. Osias O. Kruh, Schenectady, N. Y., assignor to General Electric Company. Filed September 15, 1905. A plurality of rectifiers is engaged in combination with a plurality of energy-storing devices in series across the alternating-current leads.

900,771. ARMATURE FOR UNIPOLAR MACHINES. Jakob E. Noeggerath, Schenectady, N. Y., assignor to General Electric Company. Filed April 25, 1907. The armature has two sets of collector rings and armature conductors between said sets of rings.

900,773. ELECTRIC PLUG RECEPTACLE. George L. Patterson, New York, N. Y., assignor to Alice C. Patterson, New York, N. Y. Filed October 8, 1907. The receptacle has a horizontally hinged closure.

900,777. PREPAYMENT METER. William H. Pratt, Lynn, Mass., assignor to General Electric Company. Filed April 10, 1905. The movable coin chute is held in one position when empty and in another when one or more coins are contained therein.

900,780. DYNAMOELECTRIC MACHINE. Henry G. Reist, Schenectady, N. Y., assignor to General Electric Company. Filed June 20, 1904. In combination with the field poles and windings thereon there is a support for the winding of each pole comprising a portion encircling the pole.

900,781. DYNAMOELECTRIC MACHINE. Henry G. Reist, Schenectady, N. Y., assignor to General Electric Company. Filed March 1, 1905. The collector rings are provided with a cylindrical external contact surface and with a cylindrical internal contact surface.

900,786. TWO-BUTTON SWITCH. Frank W. Sanford, Schenectady, N. Y., assignor to General Electric Company. Filed October 2, 1905. An escape plate is rigidly connected with the contact blade.

900,793. ARC LAMP. George E. Stevens, Lynn, Mass., assignor to General Electric Company. Filed September 27, 1906. The frame is composed of a backbone made of a rod bent into the form of a yoke, having depending legs.

900,830. APPARATUS FOR NEUTRALIZING STATIC ELECTRICITY. William H. Chapman, Portland, Me. Filed January 23, 1908. An electrically charged insulated conductor with small radiating surfaces is secured within a hollow conductor which is connected to earth.

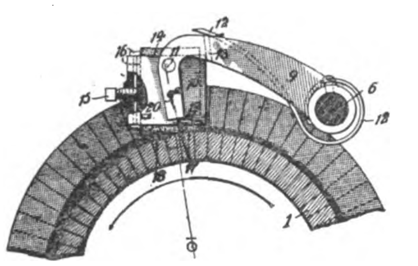
900,854. MEANS FOR LOCKING ELECTRIC SOCKETS TO FIXTURES. Harvey Hubbell, Bridgeport, Ct. Filed March 16, 1907. A coupling device is permanently connected to the socket shell.

900,884. AUTOMATICALLY ADJUSTABLE BRUSH-HOLDER. Walter J. Richards, Milwaukee, Wis., assignor to Allis-Chalmers Company. Filed September 10, 1900. A pivoted brush-holder is arranged with two separate contacting surfaces. The brush is automatically adjustable according to the direction of rotation.

900,898. ELECTRIC ACCUMULATOR. Molière C. Thiellet and Marius J. Denard, Lyon, France. Filed April 3, 1907. An electrode comprising, in combination with the oxide of lead, gelatine gelatinized in aqueous bichromate of potash, and asbestos fibre emulsified in sulphuric acid and silicate of soda.

900,909. ELECTRIC GLOW LAMP, ETC. Fritz Blau and Hermann Remané, Berlin, Germany, assignors to Deutsche Gasglühlicht Aktiengesellschaft (Auergesellschaft), Berlin, Germany. Filed April 25, 1906. A deposit of a metal is provided in the bulb before exhausting the bulb.

900,926. ELECTROLYTIC APPARATUS FOR PURIFYING LIQUIDS. John T. Harris, New York, N. Y. Continuation of application filed June 20, 1903. A magnetized anode of a material which will yield a coagulant, a cathode, and means for separating the impurities from the treated liquid.



900,884.—Automatically Adjustable Brush-Holder.

900,929. PILE PROTECTOR. William Howe, Seattle, Wash. Filed January 28, 1907. An electrode is slidably mounted on the pile and means provided whereby the electrode may be substantially insulated from the surrounding water when submerged.

900,961. PRODUCTION OF MAGNESIUM BY ELECTROLYSIS. George O. Seward and Franz von Kügelgen, Holcombs Rock, Va., assignors to Virginia Laboratory Company, New York, N. Y. Filed October 10, 1905. Magnesium fluoride and calcium chloride are fused together with flux of an alkali fluoride. The bath is rendered anhydrous and then electrolyzed to produce magnesium.

900,962. PRODUCTION OF BARIUM AND BARIUM ALLOYS. George O. Seward and Franz von Kügelgen, Holcombs Rock, Va., assignors to Virginia Laboratory Company, New York, N. Y. Filed March 28, 1906. Fused barium chloride is electrolyzed with the addition of a barium salt of a lower melting point.

900,977. DYNAMOELECTRIC MACHINE. Bernard A. Behrend, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed March 26, 1906. The stationary laminated core has circumferential ventilating passageways, and cooling air currents are forced through a hollow frame surrounding said core.

901,013. GALVANOMETER. Louie E. Knott, Boston, Mass., assignor to L. E. Knott Apparatus Company, Boston, Mass. Filed November 24, 1906. A vertically arranged magnet is permanently connected to the base, and a backing plate is detachably secured to the magnet.

901,027. SAFETY GUARD FOR TROLLEY WHEELS. Frank J. Nolan, Buffalo, N. Y., assignor to the Automatic Trolley Guard Company, Buffalo, N. Y. Filed September 13, 1907. Means are provided for supporting the trolley wire in the opening intervening between the two wings of the trolley guard.

901,033. ELECTRIC BELL. George L. Patterson, New York, N. Y., assignor to Alice C. Patterson, New York, N. Y. Filed September 28, 1907. A self-contained wall bell.

901,050. ELECTRIC CLOCK. Charles H. White, Sparrows Point, Md. Filed April 24, 1907. The minute arbor is provided with a tight ratchet wheel and a rocker which is loose on the arbor, having an extended weighted arm and carrying a pawl which engages with the teeth of the ratchet wheel, together with a shank, bearing and armature.

901,108. MUFFLER FOR TELEPHONE TRANSMITTERS. George Kracker, Philadelphia, Pa. Filed December 28, 1907. Sound-deadening material is placed in the mouthpiece and casing.

901,122. SYSTEM OF ELECTRICALLY CONTROLLED SIGNALS FOR RAILWAYS. Jean Paul and Théophile Ducousso, Paris, France. Filed April 13, 1907. Two similar parts are pivotally mounted in a transparent casing and actuated by an energized electromagnet.

901,171. ELECTRIC BURGLAR ALARM. Simon B. Hess, New York, N. Y. Filed May 27, 1907. Multiple alarm signal systems are in shunt with each other.

901,189. MOTOR-CONTROLLING APPARATUS. Michael C. Regan, U. S. Army. Filed February 4, 1908. A step-by-step resistance-inserting mechanism.

901,207. LIGHTNING ARRESTER. Jacob B. Struble, Wilkinsburg, Pa. Filed December 10, 1906. A lightning arrester having in combination means for forming a spark-gap, and means for dampening an arc.

901,212. TELEPHONE HOOK SWITCH. Henry Tideman, Menominee, Mich. Filed July 6, 1907. Locking means are provided for the adjusting screw.

901,213. TELEPHONE HOOK SWITCH. Henry Tideman, Menominee, Mich. Filed July 6, 1907. The tension spring is supported and retained by the locknut.

901,214. TELEPHONE HOOK SWITCH. Henry Tideman, Menominee, Mich. Filed July 6, 1907. The tension spring is adapted to engage and actuate the hook lever.

901,215. TELEPHONE RINGER. Henry Tideman, Menominee, Mich. Filed July 6, 1907. The cores of the electromagnets are drilled and threaded internally at the armature end.

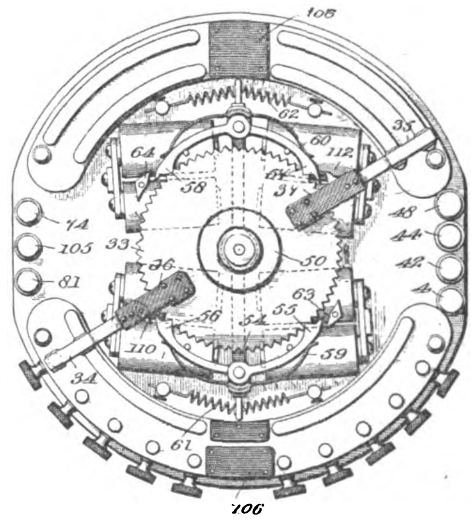
901,216. TELEPHONE RINGER. Henry Tideman, Menominee, Mich. Filed July 6, 1907. The cores and helices of the ringer are mounted within the magnet frame.

901,250. CAB SIGNAL SYSTEM. Daniel J. McCarthy, Wilkinsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed May 19, 1908. An indicator is carried by the vehicle and arranged to have a circuit induced therein by current flowing in the track circuit.

901,261. SAFETY FUSE. Frank D. Reynolds and Joseph Sachs, Hartford, Ct., assignors to the Sachs Company, Hartford, Ct. Filed April 17, 1906. The fuse strip has a rupture portion and adjacent portions of substantially the same cross-section as, and of greater heat-radiating surface than, the said rupture portion.

901,269. TELEPHONE RINGER. Henry Tideman, Menominee, Mich. Filed July 6, 1907. The helices and armature are mounted entirely within the U-shaped permanent magnet.

901,280. ELECTROPLATING APPARATUS. John T. Daniels, Newark, N. J., assignor of one-half to the Hanson & Van Winkle Company, Newark, N. J. Filed May 11, 1908. A permeable container is suspended in the stationary tank, and is rotatable on an axis at an angle to the level of the surface of the solution.



901,189.—Motor-Controlling Apparatus.

901,294. APPARATUS FOR ELECTRIC LIGHTING. Peter C. Hewitt, New York, N. Y., assignor, by mesne assignments, to Cooper Hewitt Electric Company, New York. Original application filed April 5, 1900. An incandescent lamp is connected in series with a U-shaped fibre tube.

901,299. METHOD OF PRODUCING ELECTRIC COILS AND CONDUCTORS THEREFOR. Isidor Kitsee, Philadelphia, Pa. Original application filed February 11, 1907. Means are provided for slitting a sheet of conducting material to divide the same into a plurality of strips, and then insulating the strips to adapt same as independent windings.

901,306. SYSTEM OF ELECTRIC DISTRIBUTION. Percy H. Thomas, Pittsburg, Pa., assignor to Cooper Hewitt Electric Company, New York. Filed January 21, 1903. Means are provided for effecting a continuous flow of current in a given direction through a series of vapor rectifiers.

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Changes for advertisements should be in this office by *Friday noon* for the following week's issue.
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CONTENTS

PUBLISHER'S ANNOUNCEMENT.

The Electrical Review has purchased the *Western Electrician*, of Chicago, and the first issue of the consolidation of these two journals, the Electrical Review and Western Electrician, will be published from Chicago on November 7, 1908.

The Electrical Review was founded by George Worthington in February, 1882, and is the pioneer American electrical weekly. Since its inception consistent effort has been made to promote the development of the electrical industry, and the journal has grown and prospered, until to-day it stands thoroughly entrenched as a technical publication worthy of the interest of discriminating and thoughtful men.

The trend of events to-day is toward the establishment of absolute equities between all the people, and the publisher of a technical journal must lead in the effort to deliver to the purchaser the highest return possible for value received. It is thus with the purpose of better serving its great family of subscribers and advertisers, due to the enlarged opportunities of centralization of effort and the inevitable extension of the industry, that the Electrical Review moves its publication office to Chicago and joins forces with its western contemporary.

There will be no change in the personnel, the present editorial and business organizations of both journals being continued and merged; and the present offices in New York city, supported by a strong editorial and business staff, will be maintained.

ELECTRICAL MACHINERY AND COTTON MANUFACTURERS.

The reciprocity of commerce was admirably illustrated the other day by Dr. E. W. Rice, Jr., vice-president of the General Electric Company, in his sententious address welcoming the National Association of Cotton Manufacturers to the works at Schenectady, when he said that the members of that association had been patrons of the company to the amount of $1,000,000 during the last year, and that the company had purchased cotton cloths and yarns to the same amount during this period.

This also illustrates how both parties can profit at a bargain. It is evident that the electric company sold its goods at a profit and, on the other hand, by the use of electric plant the cotton manufacturers have prospered in the application of a method of lighting which keeps the operatives in better condition, and also makes better goods by the facility of accurate discernment of colors, and the detection of the inevitable imperfections in weaving.

Since the general installation of electricity in textile mills the old-time preference for summer-made goods over those woven in winter, whose shorter days meant artificial lighting, has vanished from the market.

The electrical transmission of power in mill yards is an economic improvement over the use of horses for the purpose. The motor for storehouse elevators has been another element which showed in the insurance rates when the use of a portable steam boiler and engine for the purpose so amplified the premiums that the expensive use of manual labor for hand hoists was indeed the cheaper.

The electric transmission of power is producing the radical change in cotton manufacturing, which has mechanically remained unaltered for nearly a generation. Cotton manufacturing is essentially an engineering problem on account of the relatively low cost of raw material to that of the manufactured product.

Like the proverbial barrel made to fit the bung-hole, the salient problem in cotton manufacturing always has been the transmission of power from the prime mover to the machines. With the progress of the water-wheels, successively of the undershot, breast, overshot and finally the turbines, with their closed trunks in place of the open trench, the positions and dimensions of the mills have been as continuously modified.

The steam engine made other changes, but with all of these the belt tower for power transmission has continued in its costly construction, expensive maintenance and large fire hazard.

Like the doctor in "La Malade Imaginâre," the introduction of electric transmission "has changed all this," and there are quiet intimations of further radical changes in electrical transmission which will force the most astounding changes in the spinning of cotton. The market has no mercy for an old mill, and the iconoclasm of new inventions in converting old machinery into junk is as inexorable as an earthquake.

These are answers to the natural question why the cotton manufacturers should interrupt the natural flow of sessions at their meeting at Saratoga Springs, from a consideration of standard specifications for staple gray goods; what is a plain weave; textile tests in Europe; cones and fliers; colors and dyeing apparatus; textile fabrics and their consumers, and other topics of like ilk, to visit an establishment for the production of electrical apparatus, and the result is that the economic principles of their New England thrift did not permit them to lose the opportunity.

This consideration of electrical questions is no new venture of the Cotton Manufacturers' association. More than twenty-five years ago it began to have papers on electric lighting in mills, and it has continued to have papers on these applications of electricity to this day, keeping to the forefront in giving a fair hearing to those who had anything to offer on the subject which would furnish a contribution toward better results or cheaper processes, and the twain have generally gone hand in hand.

The practical scope of electrical applications is illustrated by the position which this branch of their uses has occupied at these meetings, and this is only one of the many industries where these changes are progressing to the material benefit of all manufacturing interests.

THE RELATION OF ELECTRICAL ENGINEERING TO THE OTHER BRANCHES OF THE PROFESSION.

Electrical engineering, in its various forms, comes into contact with more phases of human activity than does any other branch of the engineering profession, and, indeed, it is called upon oftener by the several other branches to help solve some troublesome problem than is any other division. There is, of course, a reason for this which must depend upon some fundamental principle of electrical engineering and which distinguishes it, in some degree at least, from the other branches and which it will be interesting to elucidate.

This principle should be apparent if we divest any electrical application of all the non-essentials, of all those things which could not be replaced by something else without transferring the application to another branch of engineering. If, in doing so, we find some one feature of these applications which is common to all, it is probable that this feature is one that is largely responsible for the success of the system. When, moreover, we find that this feature is the one which has led to the substitution of the electrical system for various others in different lines of work we are justified in assigning to it the greater part of the credit for the success of all such applications. Is there any fundamental principle in electrical engineering of which this can be said?

Examination of our electric lighting systems shows us a number of new devices, each of which is undoubtedly to some degree responsible for the success of the systems. But do we find any device here which could not be discarded? The dynamo seems to be one, but should another method of producing electrical energy be found, which would be as cheap as the dynamo, the lighting system would still be electrical; and have we not been looking for such a device in the so-called carbon-consuming cell?

Turning to the other end of the lighting system we find no new principle. Light is produced by bringing a body to incandescence through the production of heat. This is the only way we have yet developed; and we have to-day a goodly variety of electric lamps, any one of which could be discarded and its place filled by another. All apparatus coming between the dynamo and the lamp could likewise be discarded, if necessary, except the wires over which the current is transmitted; yet even here we might substitute portable storage batteries by means of which the daily supply of electricity might be delivered in wagons. Since, therefore, no single element of the system can be considered absolutely indispensable, the feature we are seeking must be a resultant of the combination. Now the combination is merely a means of transferring energy from one point to another; in the common phrascology, a means of transmitting and distributing power. In fact, the entire electric lighting system is nothing more than a means for transferring the heat units of the coal to the incandescent element of the lamp.

Do we find the same condition in the electric railway? Obviously the dynamo is no more essential here than it is in electric lighting—very necessary to-day but by no means certain to be a part of the system of the future. The electric motor is indispensable, but does it not merely constitute one step in the more important problem of transferring power from a distant point to the car axles? And is not this transmission of power from a central point to the cars the real explanation of the success of the electric railway? Other systems of accomplishing the same end have been replaced by the electric system merely because the latter has shown itself better in this respect than they.

In the field of general power distribution the same is true, and this system is replacing the local power plant because of the ease and economy with which electrical energy can be distributed from a central point. In the hydroelectric systems it is very evident that the success depends upon this feature. The utilization of water power is not new, but it is only since the development of electrical transmission that we have had a means of transferring the power of the water to a distant point where it can be utilized. The larger water powers represent far more power than a single manufacturing establishment placed on the power site can utilize; moreover, the expense of developing these powers is often greater than the amount of power needed by the factory will warrant. Hence such resources will only be developed when their power can be distributed to a large number of establishments. Electrical transmission offers the only successful means we have of doing this.

Consider a case where this fundamental principle of transmission is less apparent. The telephone seems at first an exception, yet is it not the exception which proves the rule; that is to say, does not a more careful examination of the principles of telephony show that this is only a very special case of electrical transmission and distribution? The power involved is exceedingly small in any single operation, but that does not affect the principle, nor does the fact that this power is not wanted for itself; indeed, we hardly realize that power is being transmitted. But neither do we want the electric power for itself in any of the applications of electricity. What we are after are the results of the transmission of the power: in the one case, light; in another, mechanical power, and in the third a transmission of speech. And what is true of the telephone is true of all electric signaling systems. They are nothing more than special cases of the transmission of electrical energy. We are justified, therefore, in saying that the one common and essential feature of all electrical systems is the transmission of power. The distance of transmission may be a hundred miles or only a few feet, but the principle is the same.

If, then, the principal object of the work of the electrical engineer is the transmission of power, it is clear that he must be a specialist in this work. And to be entirely successful he must specialize on all phases of the problem. Some engineers must devote themselves to the development of the best apparatus for producing and controlling electrical power in the various forms found best adapted to the manifold uses to which this power is put. Others must study the problem of transmitting this power in the most economical and reliable manner. And others, again, must give us the best devices for utilizing the electric power where delivered for producing the desired end. But all may be classed together as specialist in the production and control of power.

If we accept this classification of the electrical engineer as one who deals in the production and distribution of power, the reason for his close association with so many phases of activity is clear. In nearly all of our work power is required and the electrical engineer offers the easiest and most convenient way of obtaining this. Hence he is called in. And the relation of this branch of engineering to the others is also plain. The mechanical engineer produces machines, the electrical engineer furnishes him with the power needed for the production and operation of his machines. The civil engineer builds railroads and various structures and the electrical engineer furnishes him with the power needed in the building and utilization of these structures. He also furnishes the mining engineer with the power the latter needs in his business of producing ores and minerals. And the same relation holds with respect to the other less distinctly recognized divisions of engineering. In fact, we may fairly say that the electrical engineer has appropriated to himself the production of power, just as the other branches have each occupied a different field. This is his domain and here he should rule supreme.

ELECTRIC TUNNELING.

The use of a tiny gas flame or a platinum point heated to incandescence by a circuit has long been used to engrave glass by the decrepitation of small pieces, and this property may be used to a more practicable extent and on a larger scale in rock cutting in tunnels and mining.

A series of electric arcs on a turret at the heading is proposed for the purpose.

The first attempt to pierce Hoosac Mountain in northwestern Massachusetts was by means of a gigantic turret carrying numerous chisels, the invention of General Herman Haupt, but, after boring a hundred feet or so, the machine was abandoned and the 4.71 miles of tunnel made by drilling and blasting.

It was a long time before this tunnel was lighted by electricity, as there was not at the time any insulated wire in the market which would resist the dampness of the tunnel.

THE TEXTILE MILL POWER PLANT.[1]

LEWIS SANDERS, M. E.

The function of a textile mill being the production of goods, its power plant is naturally of secondary importance; also its construction and operation involve a line of management and specialized knowledge that is entirely foreign to the main business of the mill. The power plant, however, is a very serious factor in the profit-earning capacity of the mill, for if every loom and spinning frame is not driven continuously at its maximum economic speed the productive capacity must fall off; there may be a loss of one to five per cent in capacity from this cause; also the cost of power may be excessive.

The power plant has gradually increased in complexity until it has become a distinct branch of engineering beyond the scope of the mill architect proper. Very few mills are developing their power at as low a cost as they should, although they may contain the most economical types of engines and boilers, because these have not been assembled into the most efficient working unit. The power plant has not been sufficiently considered as a working whole, attention having been confined too much to the individual units comprising it. The modern power plant engineer is the product of the electric power industry, where the economical production of power is the life blood of the business, and the shortage of experts in this line may be judged by the number of central stations whose power plants are anything but models, although this matter is of vital importance to them. The introduction of the electric drive now permits the development of the mill and the power plant along the lines suited to each without having the limitations of the one interfere with the other.

The operating management of the mill has to supervise all the processes of manufacture, and on the efficiency of this depends the success of the mill. There is thus on the same management the complex and unrelated business of running a power plant, the result of which can seriously affect the profits of the mill. The management can not give this last sufficient attention without danger of entailing much greater losses in the mill through loss of production. A decrease of mill efficiency of one per cent would offset a power plant economy of twenty per cent. The power plant problem must be met without loading any more burdens on the shoulders of the mill management. Manufacturers specialize in most things except in the production of power. Until recently they had to go into the power business whether they would or not; it will be to the profit of those manufacturers who evolve a proper method of divorcing the power business from the textile industry.

In some cases the problem can be best met by purchasing power, but the central station managers are very much at fault in this matter, as they are rarely willing to make equitable rates. They are running a lighting business first and a power business second. In a few years we will find power the main business and light a by-product. Where power can not be purchased I suggest the formation of what would be practically a separate power plant company from which the mill would take its power and steam exactly as it would from a central station. The larger mills could carry this out independently while the smaller ones could have such an organization in common, the fact that they were competitors being no more bar to this than it would be to their taking power from the same water power company.

In considering the replacement of an existing plant by a more economical one, the economies should be sufficient to pay all fixed charges on the new investment and a satisfactory profit besides, or the change will not be justified.

In considering the change of an existing mill from belt to electric drive it will be found that the saving in power will rarely justify the change, but if the opportunity be taken to completely remodel the power plant the results will frequently justify the investment. Also the possible increase in mill output, due to bringing all machines up to maximum speed, will very often justify the change independently of any power plant economies. In making improvements in a mill it is important that they form part of a comprehensive scheme and not be made in a disconnected manner.

My firm made a test of a large mill of which a small portion was electric driven and the rest belt driven. We found losses of $26,000 that could have been avoided:

Loss due to excessive price paid for coal	$14,000
Loss due to excessive air used in combustion	2,573
Loss due leaky dampers on economizers	1,595
Loss due use of smoke consumers	1,710
Loss due leak in feed-water heater	1,110
Loss due steam wasted by turbine	5,500
Total	$26,488

Aside from the price paid for coal this plant was being run up to the average of good mill practice and in some respects better. The losses found might have existed in the most modern plant if not detected by a most rigid system of records.

The unit costs of operation for the three power plants of this mill, figured on the basis of perfect operation, are:

COMPARATIVE UNIT COSTS OF OPERATION.

(Pocahontas coal, at $4 per ton.)

COST OF COAL, AS BURNED, INCLUDING ALL LABOR.

A plant	$4.50 per ton
B plant	4.72 "
C plant	4.55 "

COST PER 1,000 POUNDS OF STEAM GENERATED.

A plant	20.00 cents
B plant	22.60 "
C plant	23.20 "

COST PER 1,000 POUNDS OF STEAM AVAILABLE FOR POWER, MANUFACTURING AND HEATING.

A plant	25.9 cents
B plant	25.2 "
C plant	25.85 "

COST PER 1,000 INDICATED HORSE-POWER HOURS FOR POWER.

A plant	$2.30
B plant	4.40
C plant	4.27

The differences in costs are, therefore, due entirely to the design of the plants and are a true measure of their relative value. It is interesting to note that the plant that generates steam at the least cost is not the one that supplies it to the mill at the lowest cost.

Steam distribution per week, present plant, is:—

	Pounds.	Per Cent.
Auxiliaries, stokers, etc	1,733,500	14.7
Engines	4,775,100	40.4
Manufacturing purposes	4,426,000	37.5
Heating (mean) for year	875,000	7.4
Total	11,819,600	

Exhaust from one engine used for heating water, part of which is used for manufacturing purposes.

POWER DISTRIBUTION PER WEEK.

No. Hours Run.	Kilowatts per Hour.	Kilowatts per Week.
6	2,430	14,550
55	2,200	110,000
6	200	1,200
67.5	344	22,400
Total kilowatt-hours per week		147,950

NOTE.—The output of the A and B engines has been reduced to equivalent kilowatts.

ANNUAL OPERATING EXPENSE, PRESENT PLANT.

Coal, 27,200 tons, at $4 per ton	$108,800
Labor, power plants	21,723
Labor, filter plants and arc machines	1,130
Removing ashes	953
Total	$132,506

On account of the subdivision of the power plants and the large quantities of live steam used in this mill we found that a new plant could be designed that would show sufficient economies to justify scrapping the present one. The new plant recommended consists of three Curtis vertical turbo-generators of 750 kilowatts capacity each, with special provisions for extracting steam at forty-five pounds for centring and carbonizing, and at five pounds for dye kettles, scouring, heating, etc.; the boilers to be three 1,000-horse-

[1] Paper read before the National Association of Cotton Manufacturers, Saratoga Springs, N. Y., September 29-30. Abridged.

power water-tube boilers, hand-fired with combined forced and induced draft, so as to give the greatest adaptability to various grades of coal.

The size of the unit adopted for turbines and boilers is as large as possible consistent with having the units of such size that if one breaks down the remainder can carry the extra load on overload capacity. The size of unit must also be selected with reference to the load at various times, so that those in operation shall carry as nearly as possible full load, in order to secure maximum economy.

Those more used to belt-driven mills where large engines are correct practice, because provision can not be made for breakdowns, or the load concentrated on one unit, have contended that two 1,500-kilowatt units would be more economical in this case. Not only would these entail a larger investment, but they would be actually more expensive to operate than the smaller units, owing to their poorer load-factor.

As for the effect of substituting steam at five pounds pressure for live steam in the dye kettles, etc., it should be borne in mind that after having done work in the turbine down to this pressure, it still has about 90 per cent of its original heat left, although it has given up nearly 50 per cent of its available energy. To keep up the capacity of the dye kettles, therefore requires only ten per cent greater weight of exhaust steam than of live steam, and large enough pipes to take care of the greater volume at this low pressure.

The new plant consisting of three boilers and three turbines and auxiliary apparatus, will do the work now done by three power plants containing 23 boilers, 4 engines, 1 turbine and the auxiliary apparatus in triplicate. It will require 15 men for its operation as against 33 with the present plant.

STEAM AND POWER DEMANDS, NEW PLANT.

Hours per Week.	Kilowatts per Hour.	Pounds Steam at 45 Pounds.	Pounds Steam at 5 Pounds.	Steam Turbines	Fed to Boiler.	Total Pounds per Week.
6	2,430	9,000	61,500	102,800	108,200	649,000
55	2,200	9,000	61,500	98,200	103,400	5,570,000
6	200	9,000	61,500	80,250	84,400	506,500
15	344	.....	29,000	34,200	36,000	539,000
52.5	344	.....	9,000	14,600	15,400	807,000
33.5	....	.....	9,000	......	10,520	342,000
Total						8,413,500

UNIT COSTS OF NEW PLANT, WITH SOFT COAL, AT $4 PER TON, HAND-FIRED.

Cost per ton of coal burned	$4.42
Cost per 1,000 pounds generated	19.7 cents
Cost per 1,000 pounds steam available to mill.	20.8 "
Cost per 1,000 indicated horse-power	$1.98

ANNUAL COST OF NEW PLANT, USING SOFT COAL, HAND-FIRED, AT $4 PER TON.

18,740 tons of coal	$75,000
Labor	10,250
Removing ashes	610
Total	$85,860

Using the same grade of coal in each case the present plant costs $132,000 per year to operate while the new one will cost only $85,000 a year, or a saving in operating expenses of some $47,000.

A mill load is practically uniform, which is very favorable to economical operation and should permit power to be generated at a lower cost than a central station of the same size, except where the station has built up a heavy day load. But how many mills are able to show any such results? In order to reach high economy a proper system of records is necessary; those kept by most plants are useless. The power plant records to be of value must completely account for everything, practically continuous test data; what is more they must be promptly worked up and acted upon. If they are simply filed for future reference they are a useless expense and had better be omitted.

A separate power plant organization, such as I have advocated, should maintain an experimental station at the most convenient mill, a school of instruction should also be maintained for firemen and engineers. All men should be promoted according to their records, which should always be open to their inspection. Mr. Jurgensen, chief engineer of the Hotel St. Regis, has very successfully organized and conducted such a school for several years, resulting in a higher grade of men and a decrease in operating expenses. Very few mills are aware of what they might save as they do not know the extent of the losses.

My conclusions are that in textile mill power plants we should give more attention to the need of a higher grade of engineering skill and a more careful study of the local conditions in the design of the power plant.

Careful attention to the fact that what is wanted is the power plant that will deliver steam and power to the mill at the least cost and that it is not always the plant showing the highest evaporation or the lowest steam consumption that does this.

The selection of a size of unit, where other conditions do not outweigh it, that will permit one to be thrown out of service and allow the extra load to be carried on the overload capacity of the remaining apparatus.

Not to make improvements to existing mills until a comprehensive plan has been worked out, and then to make all changes in accordance with this.

The advisability of divorcing, where practicable, the power business from the textile industry.

The need of a system of power-plant records that will detect all defects and falling off in efficiency of machinery or men, coupled with a management that will at once remedy them.

Lake Superior Power Company Reorganization.

Announcement is made by the Lake Superior Power Company first mortgage bondholders' committee, which recently advised bondholders to deposit, that considerably more than a majority of the bonds have been deposited, and that an additional number has been pledged. The bonds continue to be freely deposited, many who were awaiting the deposit of a majority now lending their aid to the plan of reorganization.

The committee controls the situation and is said to be engaged in the preparation of a plan of reorganization which will give substantial value to the bonds deposited. The time for deposit has been limited to November 30, 1908. The Commercial Trust Company of Philadelphia and the Guaranty Trust Company of New York are depositaries.

Electrical Engineer and Draftsman for Federal Service.

The United States Civil Service Commission announces an examination on November 23, 24 and 25 to secure eligibles from which to make certification to fill a vacancy in the position of electrical engineer and draftsman in the office of the supervising architect, Treasury Department, Washington, D. C., at $1,200 per annum, and vacancies requiring similar qualifications as they may occur. Applicants should apply at once to the United States Civil Service Commission, Washington, D. C., for application form 1312.

Civil Service Examination for New York State and County Service.

The New York State Civil Service Commission will hold an examination on November 21 to secure eligibles from which to make certification to fill a vacancy in the position of engineering draftsman, Public Service Commission, First District, at a salary ranging from $1,200 to $1,800 per annum. The last day for filing applications for this examination is November 14. Full information and application form can be secured from Charles S. Fowler, chief examiner, Albany, N. Y.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

PORTLAND ELECTRIC COMPANY.

The Portland (Me.) Electric Company's income account for the year ended August 31, 1908, is as follows: Gross, $304,951; expenses, $124,871; net, $180,080; charges, $106,277; surplus, $73,803, which compares with a surplus of $44,191 for the preceding year.

CUMBERLAND TELEPHONE AND TELEGRAPH COMPANY.

The report of the Cumberland Telephone and Telegraph Company for the month of September and nine months ended September 30 is as follows: September gross, $508,130; expenses, $288,719; September net, $219,411; charges and taxes, $43,766; September surplus, $175,645, which compares with $157,042 for September, 1907. Nine months' gross, $4,554,713; expenses, $2,642,036; nine months' net, $1,912,667; charges and taxes, $341,847; nine months' surplus, $1,570,830, as against $1,295,813 for the previous fiscal year.

EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.

The twenty-third annual report of the Edison Electric Illuminating Company of Boston, for the year ended June 30, 1908, shows as follows: Gross, $4,229,239; expenses, $2,261,344; net, $1,967,895; miscellaneous profits, $38,441; total net, $2,006,336; taxes, $397,584; balance, $1,608,751; interest, $54,988; dividends, $1,390,796; surplus, $162,967, as compared with $85,602 for the year 1907.

President Charles L. Edgar says: "The increase in connected load during the past year has been as great as during the preceding year, which was, up to that time, by far the largest in the history of the company. Taking into consideration the business depression, which has existed during the greater part of the year, this result is extremely satisfactory.

"As will be remembered, the price was reduced in June, 1906, from eighteen cents to fifteen cents, resulting in a very large increase in business. A further reduction from fifteen cents to twelve cents went into effect on July 1, 1908. It is confidently expected that this reduction will result in still larger business."

There are now connected to the system 938,670 incandescent lamps, 9,867 arc lamps and 39,122 horse-power in motors. The corresponding figures for 1907 are 863,313, 10,339 and 35,095.

At the annual meeting of the company directors were re-elected, with the exception that C. F. Adams, 2d, succeeded Robert Bacon, recently resigned.

MONTREAL STREET RAILWAY COMPANY.

The preliminary report of the Montreal Street Railway Company for the fiscal year ended September 30 last, shows gross earnings of $3,677,432, an increase of $173,789, and total income of $1,591,049, an increase of $136,958. There was a surplus, after charges and dividends, of $235,687, a decrease of $36,571. The sum of $200,000 was set aside for appropriations, leaving $35,687, a decrease of $40,454.

AMERICAN LIGHT AND TRACTION COMPANY.

The American Light and Traction Company reports net earnings for the twelve months ended September 30 of $2,579,266, an increase of $189,368, and surplus of $597,208, an increase of $114,620. Following are the figures, with comparisons:

Net earnings, $2,579,266, an increase of $189,368; dividends, $1,301,058, an increase of $75,048; balance, $1,278,208, an increase of $114,320; reconstruction reserve, $681,000, a decrease of $300; surplus, $597,208, an increase of $114,620; previous surplus, $2,720,820, an increase of $482,588; total surplus, $3,318,028, an increase of $597,208.

MASSACHUSETTS ELECTRIC.

The operating companies of the Massachusetts Electric have declared the same dividends as a year ago, which means a declaration of four per cent on Old Colony and five per cent on Boston & Northern Street Railway stocks. These dividend payments will put into the treasury of the parent company a total of $880,837, and after allowing for miscellaneous income and deducting $157,500 interest on the $3,500,000 notes, should enable the Massachusetts Electric to show a dividend balance of better than $750,000, or, say, 3.6 per cent.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

The American Telephone and Telegraph Company has issued a financial statement for the nine months ended September 30, showing a surplus after dividends of $1,423,311, an increase of $1,169,220. The detailed income account for the period named is as follows:

Dividends, $10,034,016; interest and other revenue, $7,297,154; telephone traffic (net), $2,981,607; real estate, $120,134; other sources, $566,415; total earnings, $20,999,329; expenses, $1,571,755; net, $19,714,573; interest, $3,714,637; balance, $13,712,935; dividends, $9,289,024; surplus, $4,423,311, an increase of $1,169,220 over the previous year.

AURORA, ELGIN & CHICAGO.

The Aurora, Elgin & Chicago Railway's report for the year ended June 30, 1908, shows earnings as follows: Gross, $1,401,107, an increase of $69,122; expenses, $766,977, an increase of $44,697; net, $634,130; increase, $24,425; charges, $334,408; increase, $15,308; surplus, $299,722; increase, $9,117; preferred dividend, $155,000; balance, $144,727; common dividend, $93,000, leaving a net balance of $51,727.

MEXICAN TELEGRAPH.

The report of the Mexican Telephone and Telegraph Company for the month of August and six months ended August 31, shows as follows: August gross, $32,492; expenses, $17,881; August net, $14,611; six months gross, $196,925; expenses, $107,991, an increase of $7,787.

UNITED RAILWAYS OF ST. LOUIS.

The report of the United Railways of St. Louis for the month of September and nine months ended September 30, 1908, compares as follows: September gross, $887,344; decrease, $13,262; expenses, $554,164; decrease, $34,719; September net, $333,180; decrease, $8,543; charges, $234,380; increase, $1,976; September surplus, $98,800; decrease, $10,519. Nine months' gross, $7,860,624; decrease, $255,712; expenses, $5,073,080; decrease, $125,946; nine months' net, $2,787,544; decrease, $129,766; charges, $2,087,330; decrease, $96,399; nine months' surplus, $700,214; decrease, $33,367.

WESTERN UNION TELEGRAPH COMPANY.

The annual report of President Robert C. Clowry, of the Western Union Telegraph Company, for the year ended June 30, 1908, made to the stockholders at the annual meeting on October 14, shows that the capital outstanding is $99,817,100, of which $30,131.51 belongs to and is in the treasury. The revenues for the year were $28,582,212.09, a decrease of $4,274,194.16, and the expenses for the year were $25,179,215.33. The net revenue was $3,402,996.76, a decrease of $2,921,213.29. The profits were $1,670,746.70, a decrease of $3,233,402.29. The statement of expenses for the year showed operating and general expenses, including taxes, of $19,069,813.70; rental of leased lines, $1,546,-

181.87; maintenance and reconstruction of lines, $139,357.92; equipment of offices and wires, $423,861.84.

The net growth of the plant in poles and cables was 2,831 miles; in wire, 38,231 miles. There was a decrease in offices of 907, due principally to the fact that railroad companies have closed many small telegraph offices in consequence of the enactment of laws shortening the hours of labor. At most of these places messages are accepted and telephoned to an office of the company to be forwarded to their destination. Of the total of 1,359,430 miles of wire at the close of the year, 485,801 miles were of copper, and 873,629 of iron. The number of messages decreased 12,433,264, due to the depression in business and to the strike of operators, which began early in August of last year and continued until November 7. The average tolls per message transmitted by the company were the same as the previous year, but the cost so increased due to the strike that that branch of the business showed a small loss for the year. This loss ceased as soon as conditions became normal. Notwithstanding the abnormal expenses during the strike, the expenses for the year were reduced $1,352,980.87.

For the past few years liberal appropriations have been made for the maintenance of the company's line, and the plant is therefore in good condition.

The automatic printing telegraph owned by the company, and mentioned in the last report as having been put in operation at many of the principal cities, has been further extended to Washington, Cleveland, Cincinnati, Kansas City, Omaha, Denver and Nashville.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

The report of all associated Bell Telephone operating companies, not including long-distance lines, of the American Telephone and Telegraph Company for August and eight months ended August 31, is as follows:

August telephone revenue, $9,950,400; operating and maintenance expenses, $7,292,500; net, $2,657,900; sundry earnings (net), $452,900; total net earnings, $3,110,800; interest, $614,500; available for dividends, $2,496,300, which compares with $2,270,300 for August, 1907. Eight months' telephone revenue, $78,792,100; operating and maintenance expenses, $57,892,300; net, $20,899,800; sundry earnings (net), $3,415,900; total net, $24,315,700; interest, $5,144,300; available for dividends, $19,171,400, comparing with $17,477,700 for the corresponding months of last year.

KINGS COUNTY ELECTRIC LIGHT AND POWER.

The Kings County Electric Light and Power Company, including the Edison Electric Illuminating Company of Brooklyn, reports combined earnings for the quarter and nine months ended September 30, compared as follows:

July 1 to September 30:	1908	1907
Gross	$898,659	$843,376
Operating expenses	431,219	446,895
Net	$467,440	$396,481
Replacement and depreciation	108.340	63,198
Balance	$359,100	$333,283
Charges	151,640	151,640
Surplus for dividends	$207,460	$181,643
Quarterly dividend	200,000	200,000
Surplus for quarter	$7,460	$18,357
January 1 to September 30:		
Gross	$2,675,382	$2 516,211
Operating expenses	1.855,879	1,292,972
Net	$1,419,503	$1,223,239
Replacement and depreciation	303,338	177,711
Balance	$1,116.165	$1,045,528
Charges	454,920	454,929
Surplus for dividends	$661,245	$590,608
Dividends paid	600,000	564,000
Surplus	$61,245	$26,608

The following statement was issued with the earnings:

"The earnings of the Kings County Electric Light and Power Company for the quarter ended September 30, as also for the nine months of the year to date, maintained an increase in gross business of six and one-half per cent in comparison with the previous year, when times were exceedingly prosperous; the company has effected radical economics, the operating expenses being three and one-half per cent less than the previous year, making a gain of eight per cent in net earnings over operating expenses.

"The depreciation charges have been increased by more than seventy per cent, but this does not represent money spent, but only earnings set aside as a reserve against which replacements are charged as they take the place of depreciated or abandoned property. The Kings County company makes a large depreciation charge each month as a regular expense, and the credit to this fund after deducting all actual expenditures is now in excess of $500,000. Notwithstanding this very large increase in depreciation charges, however, the earnings of the company after deducting fixed charges for bond interest show an increase of more than fourteen per cent over last year, and after deducting the dividend for the quarter still show a surplus of $7,460 as compared with a deficit of $18,357 for the same quarter of 1907.

"For the nine months of the year to date the report shows increased earnings of twelve per cent after deducting all charges, including bond interest, and a surplus over and beyond dividends of $61,245, as compared with $26,608 for the preceding year.

"The September quarter shows a gain in percentages over the average for the three quarters, which indicates clearly that business conditions are improving, and that the report for the full year will be even better than that for the nine months just ended."

The Increasing Application of Electricity to Agricultural Operations.

This subject is exhaustively treated in a series of articles appearing in the *Elektrotechnische Zeitschrift.* As in other countries, there is a growing scarcity of labor also in the farming districts of Germany on account of emigration to the cities. One result of this has been the development of machinery suitable to replace human labor and increase the productivity of agricultural operations. Thus the number of steam plows in use in Germany has increased from 836 in 1882 to about 3,000 in 1905; threshing machines from 75,000 to 300,000, while the number of farm laborers has diminished from 9,700,000 to 7,000,000 during the same period. The cost of maintaining the draft animals during the idle times, which is estimated to be about 290 million marks a year in Germany, has been another factor in causing an increasing use of machinery. America and England were first to introduce practical agricultural machinery, but Germany is at present not behind in this field. There are many electrically-driven machines now in use, as seed-grain cleaners, weeders, plows, mowers, automatic reapers and binders, potato harvesters, beet pullers, threshing machines, irrigating plants, etc. These are all machines intended to increase the raw product, but there is also a large field for machines that will diminish the cost of agricultural operations, as lifting, unloading and transporting arrangements in barns and fields, and considerable work has already been done in this direction. In the dairies electrically-driven machinery is also extensively employed. The articles contain many tables showing the comparative costs of identical operations by hand and by electrically-driven machinery, with the results invariably in favor of the latter, also numerous illustrations, among them one of an eighty-horsepower four-share plow in operation, the current being supplied from a nearby trolley line.

Electric Furnaces in Germany.

In transmitting the following report on electric furnaces in German steel works, Consul Thomas H. Norton, of Chemnitz, says that apparently it is only a question of time until the crucible processes will be entirely superseded:

"Hitherto electric furnaces in Germany have been used chiefly for the treatment of small quantities, but now the leading works are beginning to employ them on an extensive scale for handling large quantities of metal. At the close of 1907 one of the most important steel works in the empire engaged in the production of cast steel for gears, as well as of the softer varieties of malleable cast steel for automobile construction and for minor machine parts, decided to replace its battery of crucible furnaces by a large electric fusion furnace. The main cause for the change was the desire to materially lessen the cost of fusion while not lowering the quality of the steel, but, on the contrary, improving it, if possible.

"The old equipment consisted of thirty-two furnaces, each containing six crucibles with a capacity of seventy-seven pounds. They are replaced by a single electric furnace of 250 horse-power, capable of holding a charge of a metric ton (2,205 pounds). A duplicate furnace is likewise installed and kept as a reserve for emergencies.

"Electricity is supplied from the large works of a company near Cologne, which furnishes a three-phase current of 5,200 volts to quite a large territory near the Rhine for both power and illumination. Alterations in the current intensity are so slight that connection is made directly, without the interposition of a regulator, between the furnace and the transforming station. At the latter, a three-phase rotatory current, reduced to a tension of 110 volts, is supplied.

"The production of cast steel in this furnace has been carried on since the beginning of 1908 without interruption, and with such a degree of success that the results are well worthy the attention of American steel manufacturers. Details of the cost and process generally are herewith reproduced in some fulness, on account of the far-reaching importance of this revolution in the central feature of one of the leading industries of the United States.

"The main product of the furnace has been cast steel, containing about .06 per cent phosphorus, .03 per cent sulphur, and from .08 to .18 per cent carbon. Occasionally charges of tool steel have been cast, containing from .7 to 1.3 per cent of carbon, with and without the addition of nickel, chromium, or tungsten. The material employed is ordinarily slugs, cuttings, turnings, and other waste of wrought iron, costing from $14.28 to $15.47 per metric ton (2,205 pounds); $12.96 to $14.04 per short ton. A fusion, including the refining, lasts about five hours and involves a consumption of about 900 kilowatt-hours for one metric ton of cast steel. The entire charge of one ton is poured at once. When the furnace is kept in continual use the magnesite lining lasts for about seventy operations, *i. e.*, twenty to twenty-five days. A stoppage of five days is required for each renewal, but during this period the reserve furnace is employed.

"The cost of the electric current is exceedingly low, on account of the large amounts consumed. It amounts to four and one-half pfennigs (1:071 cents) per kilowatt-hour, so that the expense for a single operation is about forty marks, or $8.64 per short ton.

"The total cost of cast steel, thus produced, per metric ton, is as follows:

For	Cost.
Amortization of cost of plant	$1.19
Raw materials, including additions, chromium, etc	16.66
Electric current, including heating during intervals	10.71
Renewal of magnesite lining	2.85
Labor	2.38
Electrodes	.60
Water for cooling purposes	.12
Total	$34.51

"This amounts to $31.32 per short ton, and is materially less than the cost of crucible steel.

"The manufacturing firm notes in addition these advantages in the electric process, as compared with the old method: (1) Cheaper raw material can be employed in the place of the more expensive Swedish iron formerly required; (2) in fusing quantities of a ton at a time it is possible to produce homogeneous masses of a distinct, well-defined grade; (3) the molten steel leaves the furnace at a much higher temperature than when prepared in crucibles, is therefore in a more liquid condition, and is easily transferred to ordinary ladles, preparatory to pouring into the molds of small castings.

"These electric furnaces are arranged on the Stassano system, and are supplied in all sizes for charges varying from 400 pounds to ten tons, and are adapted for the fusion of metals of every kind. The construction is shown by the designs forwarded (and filed for inspection at the Bureau of Manufactures).

"The furnace for cast steel is constructed of iron plates, heavily lined with magnesite bricks. Carbon electrodes enter by three openings on the sides, and are so adjusted as to terminate slightly above the surface of the molten metal, whereby the heat of the arc is absorbed almost entirely by the contents of the furnace, and but a small portion is radiated upward, to be reflected from the concave dome.

"A thorough mixing of the component parts of a charge is effected by mounting the furnace on an axis, slightly inclined from the vertical. A steady revolution about this axis is maintained through a cogged connection, with a dynamo of five horse-power, the edge of the furnace resting on ball bearings. This rotation causes the lower layers to gradually rise to the top of the molten mass, and brings about a thoroughly uniform mixing. The electrode supports are inclosed in cylinders and surrounded by a current of cold water. These supports are in rigid connection with hydraulic cylinders, by means of which the movements of the electrodes are under perfect control.

"A fusion requires three and one-half hours to be complete; a further period of one and one-half hours is requisite for the removal in succession of phosphorus and sulphur, and the final deoxidation of the contents of the furnace. No interruption occurs in either the current of electricity, or in the supply of water for cooling the electrode supports, while the furnace is in rotation. Special devices have been provided for both purposes.

"The services of three workmen are required to conduct an electrical furnace, change electrodes, transport the raw materials, etc. Furnaces of the type in question are now being introduced in Germany for the treatment of other metals and alloys, and it is apparently only a question of time before the crucible processes hitherto in such general use will be completely superseded."

The Chicago Electric Club.

The Speakers' Committee of the Electric Club, of Chicago, Ill., announces the following programme for November: November 4, business meeting; November 11, address by William Carroll, city electrician, on "Street Lighting—Past Present and Future"; November 18, address by Thomas I. Stacey, treasurer of the Electric Appliance Company, on "Chicago, the Great Central Market"; November 25, Frederic P. Vose, attorney for the Electrical Trades Association, on "Contracts."

Expense of Conducting New York State Public Service Commissions.

According to a statement prepared by Secretary Travis H. Whitney and made public recently at the office of the Commission of the First District, the two Public Service Commissions are not costing the taxpayers of the State and city so very much more than did the commissions which they succeeded. The statement of the expenses of the commission is prefaced with the following:

"So much criticism has been made of the expense imposed upon the State and upon the city of New York by the two Public Service Commissions that it is important to make a comparative statement as to such expenses."

The statement contains the following comparative tables:

"The expenses of the Rapid Transit Commission (to which the Public Service Commission for the First District succeeded), estimated on its expenditures for its last six months (which ended in the middle of its fiscal year), were $921,459.10.

"The expenses of the Railroad Commission, estimated on its expenditures for its last nine months (which ended before the end of the fiscal year), were $101,578.20.

"The expenses of the Gas and Electric Commission, estimated on its expenditures for the last nine months (which ended before the end of its fiscal year), were $60,171.80.

"The expenses of the state inspector of gas meters, estimated on his expenditures for the last nine months (which ended before the end of his fiscal year), were $23,440.67.

"Thus the total annual expenses of the various commissions to which the present Public Service Commissions succeeded were $1,106,649.77."

Compared with these annual expenses are the following expenses of the two Public Service Commissions for the year ended June 30, 1907:

"The expenses of the Public Service Commission for the First District upon rapid transit matters under the Rapid Transit act requiring an engineering force of about 300 employés, $600,000.

"The expenses of the Public Service Commission for the First District to carry out its duties under the Public Service Commissions law and the Railroad law, $366,861.32.

"The total expenses of the Public Service Commission for the Second District under the Public Service Commissions law and the Railroad law, $234,282.09.

"Total expenses of the two Public Service Commissions under the Public Service Commissions law, the Railroad law and the Rapid Transit act, $1,201,143.41.

"It will thus be seen that the net increase in the expenses to the State and city for the two Public Service Commissions over the annual expenses of the officers whom they succeeded was only $94,493.64."

In conclusion Mr. Whitney writes:

"This increase is less than the average annual increase of the expenses of the commissions which were abolished, and shows that the two commissions have done not merely the work of the preceding commissions but also all of the work involved in the duties imposed by the Public Service Commissions law which had not heretofore been exercised by any state body.

"It is to be noted that the Public Service Commission for the First District did the rapid transit work under the provisions of the Rapid Transit act at an expense which is $321,459.10 less than the expense of the Rapid Transit Commission for its last year, although the number of employés on rapid transit work was greater than that under the Rapid Transit Commission.

"Omitting the expenses of the rapid transit work done by the Public Service Commission for the First District, it will be seen that the total expenses for the efficient regulation of public service corporations afforded by the Public Service Commissions law are $601,143.41."

The Rental Value of a Power Plant.

"The rental value of a power plant depends upon its character and efficiency to produce power cheaply.

"The cost of producing power in small amounts is very much greater than in large amounts, and the amount which the lessee should pay may be obtained in comparison with the cost of producing the amount of power required with a reasonably efficient plant with steam power or by some other means. Thus, supposing the power to be rented is water power and plant, its value can be determined by estimating the cost of producing a uniform power by water power, supplemented by steam power if necessary, and comparing the cost of producing the same amount of power by steam power alone, in each case adding such charges as the lessee is to assume. The difference, if in favor of the water power, will represent the value of the power for the length of time the estimated cost covered.

"If the power plant be a steam plant, it is possible that it has no rental value; that is, it may be so wasteful that it would pay to replace or change parts of it to bring it into an economical state. If it is an economical plant, and is to be run by the lessee, he should pay such rent as will cover depreciation and a fair rate of interest, and assume repairs, insurance and taxes, or pay enough rent to cover them.

"In the same way, if power is sold the lessee, the proper amount to pay per horse-power per year will vary with the amount which he requires.

"As the amounts of power grow smaller, the cost of producing it is larger, and therefore a larger price per horsepower per year must be paid.

"The charges for small amounts of power seem to vary from fifty dollars to one hundred dollars per horse-power per year; but each case should receive careful attention."—*From paper by Charles T. Main, mill engineer, Boston, Mass.*

New New York Transportation System.

Arrangements have been completed, it is announced, for the purchase from the Interborough Rapid Transit Company, of New York city, of the Pelham Park & City Island Railroad and the installation thereon of the American monorail system. At its meeting last week the Public Service Commission for the First District, New York, received the application for the change of motive power from horses to electricity and the installation of the monorail system, and referred it to a committee of the whole. It is anticipated that the system of transportation will be in operation three months after approval has been given by the utilities board.

A corporation known as the Monoroad Construction Company has been organized with a capital stock of $1,500,000, in which the Interborough company will have an interest, to construct and equip the road with the monorail system.

It will be remembered that this system is the one which was exhibited at the Jamestown Exposition last year.

At that time it was announced that a road between New York and Newark was to be built without delay. Legal obstacles were, however, encountered in places where the promoters of the project had every reason to believe there would be none, which have postponed that work.

Changes in the Electrical Inspection Service, New York City.

Commissioner John H. O'Brien, of the Department of Water Supply, Gas and Electricity, of New York city, has placed Charles F. Lacombe, chief engineer of light and power, in charge of the electrical bureaus of that department in all the boroughs, and at Mr. Lacombe's request has assigned Hubert S. Wynkoop, electrical engineer in charge of the Brooklyn bureau, as assistant engineer.

This action accomplishes a long-desired result, namely, the placing of the various bureaus of electrical inspection under one head in order to secure uniformity of routine and rulings throughout the entire city. Heretofore considerable confusion had been caused by the absence of a central authority to whom disputes, applications for approval of appliances and proposed changes in the rules might be referred.

The personal equation will be largely eliminated as to approval of appliances, materials, etc., by the formation of an advisory board, consisting at present of Mr. Lacombe, Mr. Wynkoop and Professor George F. Sever, of Columbia University, consulting electrical engineer to the department. The department has an agreement with the university to the end that the latter makes such tests of appliances as may be required. The well-equipped laboratories of the university will thus be available for the department, and all applications for approval which require tests will be referred to Professor Sever in the first instance, who will submit a report to the advisory board. The board will then submit a recommendation in the matter to the commissioner, whose approval makes the decision final. Frequent bulletins will be forwarded to the borough officers of the bureau, so that the engineers and chief inspectors of each borough will be advised simultaneously of the action taken.

With a realization that the department and the insurance inspectors are working along different lines of interest toward a common end, an arrangement is being made to effect closer relations with the underwriters and the lighting companies than have existed heretofore.

Considerable complaint has existed in the past over the difficulty experienced by contractors and material men—even by the department chief inspectors themselves—in securing general rulings on doubtful points or information in advance of changes in the rules or of approvals or disapprovals of appliances. It is hoped to overcome this criticism by using the electrical papers of the city to announce contemplated changes in the rules, so that interested parties may have an opportunity to present their arguments, and to give to the public from time to time substantially such information as will be issued to the borough officers of the bureau. Furthermore, except in the cases of grave danger, no changes will be put into effect "at once," and every effort will be made to avoid the unnecessary hardship to the electrical contractors that comes from too swift action.

The three officers of the bureau are all graduate engineers and experienced in the lines of work required of the Bureau of Electrical Inspection.

Improved Conditions in the Electrical Companies.

The gross business of three big electrical companies, says the *Wall Street Journal*, has shown an average improvement of close to forty-five per cent from the low point at which sales were running during the depth of the depression. The statement continues:

"At the present time the General Electric, Westinghouse Electric and Western Electric are doing a total gross business of about $94,000,000, as against $65,000,000 at the low point. This is an improvement in sales of $29,000,000, or forty-four per cent.

"The largest actual improvement has of course been shown by the General Electric, but in percentage of improvement the Westinghouse Electric outstrips either of the other two companies, a fact which very probably has considerable connection with the success of the reorganization plans.

"The present rate at which gross sales are running, the rate at the low point, the recovery and percentage of recovery for each of the three companies are shown in the following comparison:

Company.	Present Rate. Gross.	Rate Low.	Recovery	Per Cent. Recovery.
General Electric.	$42,000,000	$30,000,000	$12,000,000	40
Westinghouse.	22,000,000	18,000,000	9,000,000	69
Western Electric	30,000,000	22,000,000	8,000,000	36
Total.	$94,000,000	$65,000,000	$29,000,000	44

"In a general way the effect of the 1907 panic upon the sales of electrical apparatus has been to force the demand back to the standard obtained in 1903 and 1904. In the case of Western Electric the presence of special conditions in the telephone field reduced gross sales to a level with those for the year 1901."

A Communication from Mr. George H. Guy.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

My attention has been called to the fact that my name has been unwarrantably used several times recently as "secretary of the New York Electrical Society," by way of giving apparently the endorsement of the society to the subject matter. The latest instance of this kind is the circulation of a postal by the Phillips Publishing Company, in which the attention of the members of the society is called to an article in a November magazine, in the words: "At the suggestion of Mr. Guy, secretary of the New York Electrical Society, I wish to call your attention to an inspiring article," etc.

I wish to say that this is not only impertinent, but absolutely unfounded. The society's year-book, with list of members, is freely given to those desiring information concerning the society. Application in this case was made for a copy, which was furnished, as usual, but without the slightest "suggestion" from me of any kind whatsoever. It is rather hard that such official courtesy should be abused.

I desire therefore to take this opportunity of saying that in no one instance where my name as secretary of the New York Electrical Society has been used in this manner has there been the slightest warrant for any consent or permission on my part, and I wish to say, if it need be said, that no one has a keener sense than myself of the impropriety that would be involved in such action by me.

Yours truly,

GEORGE H. GUY.

New York, October 26.

Approves Zone Basis of Fare Collection.

The up-State Public Service Commission, New York state, on October 14 in dismissing a complaint seeking reduction in fare from ten to five cents between Albany and Watervliet sets forth that there is no injustice in the practice of street railway lines in fixing their rates of fare on a zone basis instead of a mileage basis.

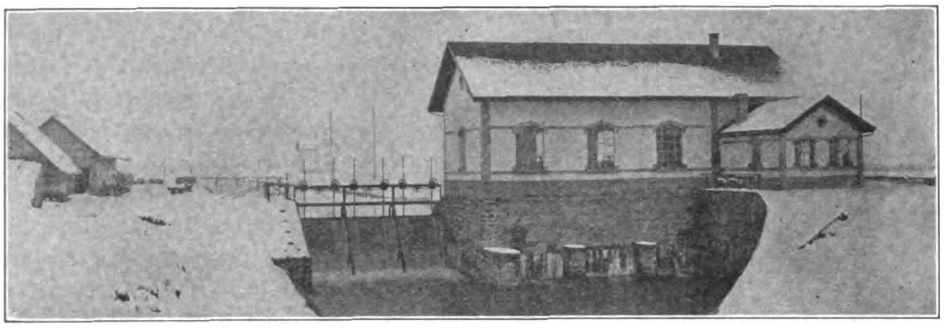
Illinois Central to Electrify Chicago Tracks.

Electrification of all tracks of the Illinois Central Railroad within the city of Chicago, Ill., was authorized at the annual meeting of stockholders on October 21. The stockholders also passed a resolution urging the directors to "proceed with all reasonable despatch in electrifying the service."

A Practical Application of Asynchronous Generators.

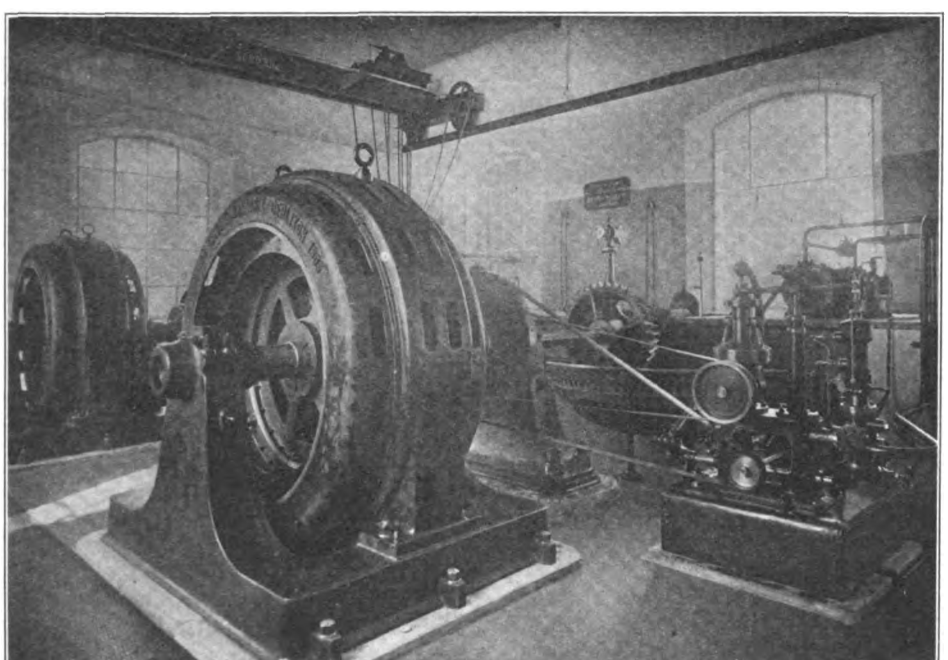
By Frank Koester.

AN interesting example of the parallel operation of two asynchronous generating stations with a single synchronous station is found at the Rhein Binnen canal, Switzerland, and the following brief description includes the essential features of this installation.



Main Generating Station, Montlingen.

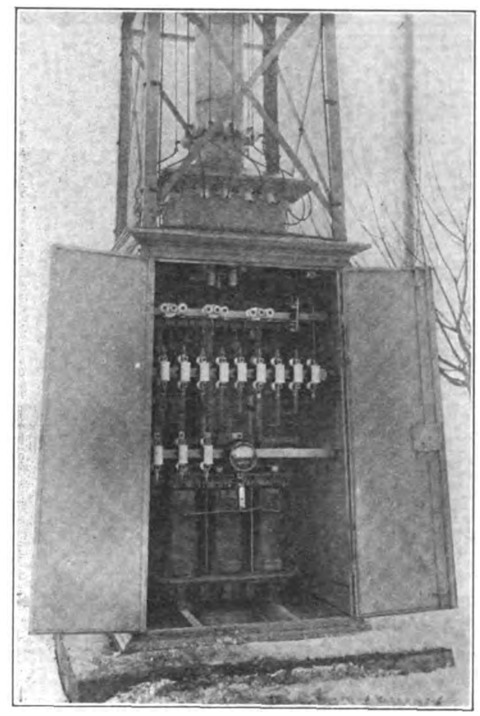
In order to prevent the Rhein from overflowing its banks during flood season in the region near Lake Constance, the governments of Switzerland and Austria have taken steps to regulate the flow by means of canals. They built on the Austrian side, besides several small canals, the Vorarlberger Binnen canal, and on



Interior of Synchronous Generating Station.

the Swiss side, the Rheintalischer Binnen canal. The latter canal, owing to the contour of the region, is constructed with three levels: One has a drop due to irregularity of water supply of from 9.8 to 11.5 feet; another from 17.5 to 21.2 feet, and the other from 31.8 to 35 feet. These heads are respectively utilized by three power plants. One is located at Lienz, another at Blatten three miles below, and the third at Montlingen, 2.4 miles below Blatten. For an economical reason the Oerlikon Company, of Oerlikon, Switzerland, which supplied the electrical equipment for all three stations, and the transmission system, proposed to make the station at Montlingen the main plant and those at Lienz and Blatten auxiliary plants, and equipped the former with synchronous, and the latter with asynchronous, generators, operating them in parallel.

The auxiliary stations with their asynchronous generator equipment do not require special excitation, as they are thrown on the line after the main station is in operation. Owing to the characteristics of an asynchronous generator, it is only necessary that they be near synchronism before being thrown on the line, thus doing away with synchronizing apparatus, delay in synchronizing, and skilled attendants. The whole regulation is done from the main plant. The disadvantage is that the auxiliary plants depend on the main plant for excitation, which also has to furnish the charging current for the line, thus forcing the synchronous generators to work under a low power factor, which is increased as more asynchronous generators are thrown on the line.



Type of Street Transformer Station.

This disadvantage, however, is greatly reduced by the lowering of first cost and maintenance of the auxiliary plants.

The main plant at Montlingen is at present equipped with three 250-horsepower Francis turbines, mounted upon vertical shafts and bevel geared to synchronous, three-phase generators of 10,000 volts and fifty cycles, making 250 revolutions per minute. Each generator has its own exciter mounted on the overhanging shaft. The generator leads are bare, mounted on insulators and run in trenches to the switchboard.

The switchboard is divided into five panels, three for generators and two for outgoing lines. Each generator panel has a main and exciter ammeter, the lever for the generator oil switch, and a hand wheel to control the excitation. The hand wheels can be interconnected by a shaft so that they can be operated simultaneously. The phasing of the synchronous generators is done with only one-phase lamp and a voltmeter, which are mounted on one of the feeder panels. Each of the lines is equipped with an automatic oil switch and an ammeter. One integrating wattmeter totals the entire output of the plant. The switchboard contains only low-tension apparatus; all the high-tension switch gear is located in reinforced concrete compartments in the switching room behind the switchboard.

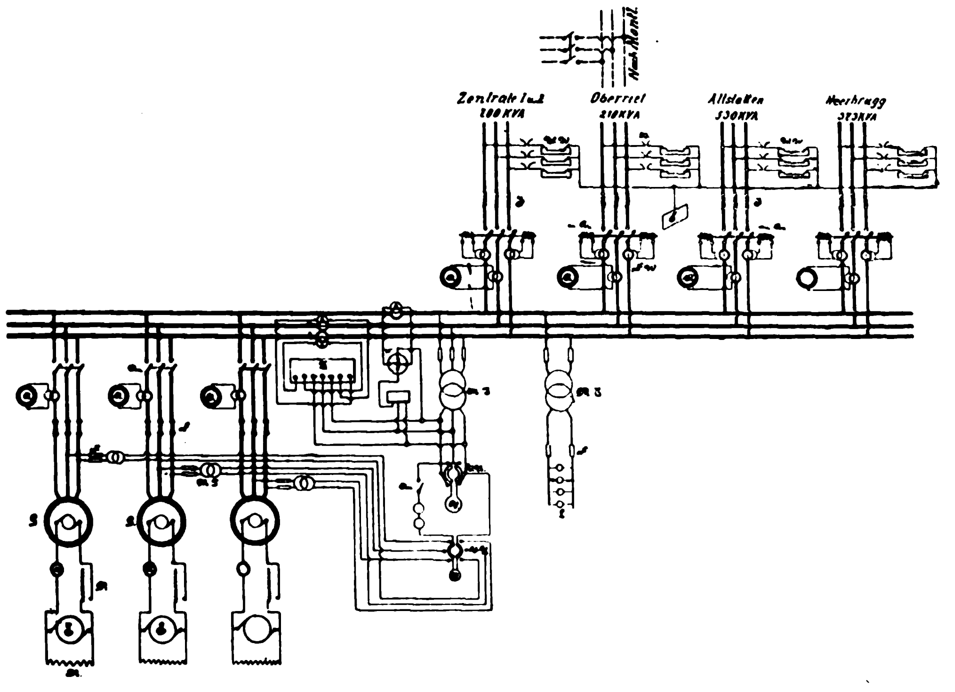
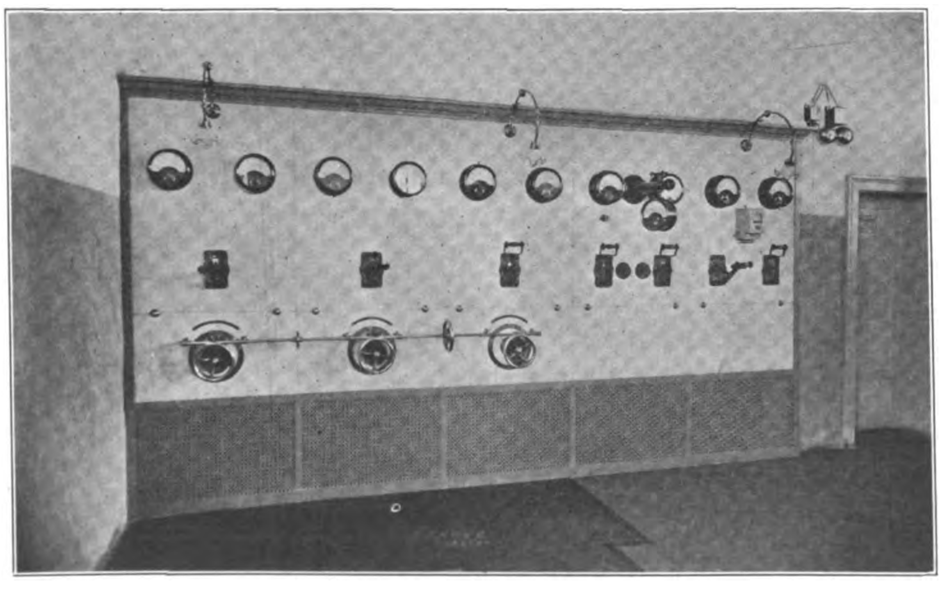


DIAGRAM OF CONNECTION, MONTLINGEN STATION.

G=Synchronous Generator.
E=Exciter.
A=Ammeter.
V=Voltmeter.
W=Wattmeter.
Z=Integrating Wattmeter.
Au=Switch.
Auau=Automatic Switch.
VU=Bus-Bar Voltmeter.
S=Fuse.
R=Rheostat.
SW=Potential Transformer.
MT=Series Transformer.
I=Choke Coil.
WW=Water Rheostats.



SWITCHBOARD OF SYNCHRONOUS GENERATING STATION.

In the room above this are the protecting devices, each phase having a choke-coil and series of horn lightning arresters, connected to water rheostats. To properly inspect the latter two, they are provided with disconnecting switches.

The outgoing feeders leave the switching house on the third floor. For lighting the station there is installed a 1.5-kilowatt single-phase transformer, and for operating the motors in the repair shop there is a six-kilowatt, three-phase transformer.

The two auxiliary stations are in every respect, in regard to equipment, identical. Each plant has a 250-horse-power Francis turbine, similar to those in the main station, also operating the generators by bevel gearing. The asynchronous generators are 10,000 volts, fifty-cycle, operating at 250 revolutions per minute. The equipment of the switchboard and switching room is similar to that of the main plant, with the elimination of the apparatus for excitation and synchronizing apparatus.

The receiving current from the two asynchronous stations and the distribution of power is controlled from the synchronous or main plant at Montlingen. From here run lines to Oberreit, Alstätten and Heerbrugg, the latter two being connected by a separate line, thus forming a ring system. At Alstätten there are three 100-kilowatt transformers, stepping down from 10,000 to 2,000 volts. In Heerbrugg there are two 100-kilowatt transformers stepping down from 10,000 to 230 volts. The 2,000-volt current is distributed to a number of smaller transformer stations which are either of masonry or steel, a type of the latter being shown in the accompanying illustration. The current is used chiefly for induction motors for manufacturing purposes, and as there is no separate lighting curcit, the current is distributed by the three-wire system.

Long Acre Electric Light and Power Company.

The Long Acre Electric Light and Power Company on October 24 got from Justice Bischoff, in Special Term of the Supreme Court, a writ of certiorari to review the action of the Public Service Commission for the First District, state of New York, denying its application for permission to issue $10,000,000 preferred stock with a specified dividend of seven per cent; to issue $50,000,000 worth of six per cent, fifty-year gold bonds, only $12,000,000 of which is to be issued at present, and for permission to install electric wires and an underground system.

The company also demanded a rehearing of the entire matter, and the court directed the Public Service Commission to file in the Supreme Court the record of the hearings before it.

The petition on which the writ was issued was signed by John C. Sheehan as vice-president of the Long Acre Electric Light and Power Company. He set forth that the original application of the company to the Public Service Commission was refused, and that on October 23, after a rehearing, the Public Service Commission again denied the application.

The American Street and Interurban Railway Engineering Association.

Report of the Wednesday Afternoon and Friday Morning Sessions of the Convention Held at Atlantic City, N. J., October 12 to 16.

WEDNESDAY AFTERNOON SESSION.

THE Wednesday afternoon session of the American Street and Interurban Railway Engineering Association was called to order at 2.30 o'clock, the first order of business for the afternoon being the report of the Committee on Control. The report of the previous sessions of this convention, which was held at Atlantic City, N. J., October 12 to 16, was given in last week's issue of the ELECTRICAL REVIEW.

E. W. Olds, chairman of the Committee on Control, explained that it had not been possible for the members of the committee to devote to the work of preparing the report the proper attention needed to give it the necessary completeness.

The report contained two contributed papers, one by F. E. Case, of Schenectady, N. Y., describing the Sprague-General Electric automatic control, and the other by William Cooper, of Pittsburg, Pa., describing the controlling apparatus manufactured by the Westinghouse Electric and Manufacturing Company.

The discussion of this report was opened by Paul Winsor, of the Boston Elevated Railway Company. He called attention to the commutation of the brushes which are now being placed on the market, and stated that the brushes and commutator will stand tremendous overfeeding. During the last year or so, in Boston, the company has changed the resistance steps on every equipment on the road in order to get an even control. Mr. Cooper in his paper considers an acceleration of five miles per hour possible. Mr. Winsor did not think this could possibly be the case. He said that in elevated service an acceleration of this nature would throw passengers from their seats. His company believes very strongly in automatic features of control. There has been trouble caused by the dash-pots sticking. In service he gets about a mile and a half acceleration on the level. With a heavily loaded car it is not as high as that. There is considerably less trouble with automatic equipments now than there was a few years ago. In his opinion, however, the platform controller, where it can be used, is preferable. Mr. Winsor described the relay system for indicating, which utilizes a buzzer or alarm bell to indicate to the motorman that he is starting up too fast.

In discussing this report, Mr. Doyle stated that in New York his company had made a number of observations on the operations of motormen, and had discovered that there was a difference of from thirty to thirty-five per cent in the amount of current used under similar conditions. He was of the opinion that if the manufacturers of controllers could devise something that would indicate the extent of coasting of trains and the correct acceleration, that a reduction in current consumption could be secured. His scheme for measuring current used was to employ an ordinary time clock, which, as soon as the motorman shut off his controller, would start. While the train was coasting the clock would run and measure up the amount of time spent by the train in coasting. Mr. Doyle believed it would be a good plan to have the Committee on Control or the Committee on Maintenance give this matter consideration, and after some discussion a motion to this effect was adopted.

Mr. Munger stated that after a car had been overhauled and was about ready to be placed in service, the shopmen take the car out on the track and an ammeter is placed in the motor circuit. This is a direct-current ammeter, reading up to 500 amperes. One man handles the car while the other watches the ammeter to see that every point is taken easily. If the car does not notch up satisfactorily it is taken back into the shop and the trouble is located and adjustments made in the resistance until the car accelerates perfectly. The man who reads the ammeter has a stop-watch, and he notes the length of time consumed in the acceleration, which is taken from starting up to the point where the motors go into full multiple with all resistance out. Mr. Munger thought sufficient attention was not given to the matter of coasting, and he said that it was necessary every once in a while to bring up a number of motormen who paid no attention whatever to coasting. If a device could be procured which would keep a record of the amount of coasting done, it would be a valuable adjunct to the service. The matter of multiple-unit control for city service, he said, should receive attention, but if automatic acceleration could be secured, it was better than anything a motorman could do, no matter how careful he was in notching up. While the automatic feature may be charged with failures once in a while, it compares more than favorably with the failures which are the result of the motorman's notching up his car too fast.

Mr. Case, of the General Electric Company, said that a careful analysis had been made of the sticking of the dash-pots, and it had been found that it was due in a great measure to the condensing of moisture in the dash-pots when the car was laid up. This moisture runs down between the plunger and the cylinder and causes sticking. As the clearance between the plunger and the cylinder is very small, it requires only a very little moisture to cause trouble. He believes that with new designs this difficulty has been entirely overcome, because, when the relay is at rest there is no space within the dash-pot, and consequently no moisture can be precipitated to cause sticking.

Mr. Cooper, taking up the statement made by Mr. Winsor with regard to acceleration and retardation, stated that five miles acceleration or retardation could be secured with perfect control. Recent breaking tests have been made, which demonstrate that a retardation of five miles an hour can be secured without any uncomfortable jolting.

In answer to a question concerning the use of the ammeter and stop-watch, Mr. Munger stated that the rate of acceleration is adjusted by the stop-watch, and the effort is made to adjust the resistance so that every tooth and peak is the same. The time for full acceleration is fixed at eleven seconds. Mr. Munger also stated that adjustments were made every 60,000 miles.

The report of the Committee on Power Distribution was presented by W. J. Harvie, chairman. This report included a paper entitled "Application of the Theory of the Catenary to Electric Railway Work," by R. L. Allen, Syracuse, N. Y.

The report is divided into a discussion of the following subjects: Feeders, working conductors, return system, conduit system. It seems to be the standard practice with low-tension underground feeders to use saturated paper-insulated, lead-encased cables, the paper being five-thirty-seconds inch in thickness, and the lead from one-eighth inch to five-thirty-seconds inch in thickness. One large company is using five-thirty-seconds inch rubber insulation with a triple-braid cover without lead sheath. This company seems to endorse this method without hesitation. It seems to be the general opinion that some kind of fireproof protection is needed on the outside of the lead cable sheath in manholes. Some roads are using asbestos saturated with a solution of silicate of soda. A split-tile protection is recommended by one of the large roads. The majority of reports received by the committee indicate the use of No. 00 round wire on city and interurban work for ordinary trolley conductors. A number of companies, however, are using No. 0000 wire on interurban work and for renewals on city work. Regarding a standard height for trolley wire, the committee believes it good practice and recommends that height of trolley wire above top of rail be standardized at nineteen feet. The majority of roads reporting show the use of clinch ears on work now in service. Some roads, however, on which grooved trolley wire is used, are employing mechanical clips, but they find that when these mechanical clips are to be replaced it is usually necessary to substitute the clinch ear. It appears that electric railway companies are using all types of straight-line hangers and insulators, with the round-top bell-type predominating. It is the experience of electric railway companies that both wood and iron poles are subject to excessive deterioration at the ground line. Many companies have begun the practice of using so-called wood preservatives for wood poles, but up to the present time none of these has been able to show definite results. For iron poles the committee recommends without qualification the use of an iron sleeve shrunk on all iron poles at the ground line. This sleeve should be two feet in length, and so placed on the butt section as to have the middle point of the protecting sleeve at the ground line when the pole is set in place. The committee recommends that iron poles be purchased complete with this protecting sleeve. Of six roads reporting, three use the over-running type, and three the under-running type of third rail. Wood, reconstructed granite and composition insulators are used on the over-running type of rail. Wood, porcelain, semi-porcelain and composition insulators are used on the under-running type. The spacing of third-rail supports is generally ten feet, with a maximum in some instances of eleven feet, and a minimum of five feet. The weight of brackets varies between nine pounds with the over-running rail, and thirteen to twenty pounds for the under-running rail. The committee recommends a spacing of ten feet on all third-rail construction where thirty-foot conductor rail is used, and eleven feet where thirty-three-foot conductor rail is used. None of the companies reporting over-running third-rail construction uses protection throughout, while the under-running type is protected by wood or fibre. The majority of companies reporting show the use of No. 0000 grooved trolley wire for catenary work. The committee recommends this size and shape. All companies show the use of the mechanical clip, and there seems to be no doubt that this will continue to be modern practice. A rigid form of suspender is recommended by the committee. For messenger cable the committee recommends the use of the highest strength cable that can be obtained, in order to develop the full advantage of the catenary type of construction. The cable should be of unwiped wire. The subject of insulating supports for the messenger cable on high-tension service resolves itself into the use of porcelain entirely, the shape of insulators depending largely upon the voltage used. Strain insulators for heavy strains should also be made of porcelain. For steady strains and pull-offs the use of wood is permissible where moderate voltages are used, and a combination of wood and porcelain for higher voltages. A more recent development in supporting devices for catenary work indicates the use of structural steel bridges rather than poles.

In the paper contributed to the report by Mr. Allen, the following conclusions are presented: The use of a light plow steel messenger cable strung to a small sag. The hangers themselves should be as light and flexible as is consistent with strength and durability. The hangers should be spaced twenty or thirty feet to take care of the expansion or contraction. There is no reason why spans of 300 feet or more can not be used.

The discussion of this report was opened by a communication from R. D. Coombs, of the Pennsylvania Railroad. Mr. Coombs endorses generally the suggestions made by Mr. Allen, and states that no system can be successful which does not practically eliminate sparking and undue wear of the current collector. At present no definite decision can be made as to whether the single catenary construction or the secondary catenary construction is better suited for eastern climatic conditions and American operating requirements. The successful type must accommodate itself to changes in temperature and provide a trolley wire on which the collector may run smoothly. From an operating standpoint the construction should not involve unnecessary supports over the tracks, and long spans are therefore desirable. Mr. Coombs is of the opinion that spans in excess of 300 feet will be both economical and practicable.

Contributing to the discussion of this paper, Mr. Ayres stated that he had originally equipped his road with trolley wire and mechanical clips. A strong tension had to be applied at the base in order to keep the collector on the wire at high speeds. A heavy hammer blow was developed at the hanger, which caused cutting and kinking. It was found expedient to throw out the mechanical clip and use an appliance with copper ears. This gives better results and puts the wear on the lips of the ear, which can be replaced, rather than on the trolley wire, which is more expensive to replace.

Mr. Reed stated that in his opinion, if there was a breakdown in the insulation of a lead-protected cable, the trouble was accentuated by the metal covering.

Mr. Winsor stated that one of the reasons why his company had tried cables without the lead cover was due to the fact that if a bad short-circuit occurred on an underground cable, the trouble did not stop there. Other cables are affected, sometimes at the same time, or, more often, the trouble turns up a good deal later.

Mr. Corning stated that he had had much trouble due to the burning out of lead cables, and in order to guard against this the practice had been introduced of cutting the lead sheath in each manhole, taking a ring out of the sheath about a quarter of an inch wide, and filling the space with rubber tape, heating it, and making what might be called a rubber joint at each of these points. The sheath is made continuous again by a short copper wire around the joint to take care of the return current on the sheath.

Mr. Palmer stated that varnished-cambric cable was being used a good deal more extensively than many members of the association were aware. He knew of large orders which had been placed lately for a good deal of construction, and it was because of the trouble caused by electrolysis that a decision was made in favor of the cambric-covered cable.

Mr. Kelsay stated that his operating conditions were rather extreme from the standpoint of height of trolley wire. He has a limited service where a car operates on a wire from fourteen to twenty-two feet high. The state law requires the trolley wire to be twenty-two feet over railroads. There is another piece of road which is forty miles in length, where the trolley wire is very low, in some cases fourteen or fifteen feet. He has tried to maintain poles so that they will operate successfully over the range from fourteen to twenty-two feet. This is a condition which should not be imposed on any trolley.

Mr. Hayward stated that his road had been compelled to enter into agreements with railroads to maintain the trolley at twenty-two feet at the crossings. It seemed to him that this requirement introduced an element of danger. A pole that is built to ride on a trolley wire of the standard height of nineteen feet is more liable to come off the wire at twenty-two feet than at nineteen feet.

The session was then adjourned to meet Friday morning.

FRIDAY MORNING SESSION.

The first matter for consideration was the report of the Committee on Car and Car-House Wiring.

The committee reported that it had been unable to give proper consideration to the question of whether it was possible to construct standard specifications for car and car-house wiring. The rules of the National Electrical Code concerning the installation of heaters, the size of bonds, and the lighting of cars, were made a part of the report, and the rules which were adopted by the Electrical Committee of the Underwriters' National Electrical Association as a result of a conference with representatives of the committee and representatives of various heater manufacturing companies were given as follows:

"Truss plank heaters to be mounted on not less than one-quarter-inch fire-resisting material, the legs or supports for the heater providing an air space of not less than one-half inch between the back of the heater and the insulating material."

Concerning outlets, the following paragraph is provided:

"Each outlet to be provided with an approved porcelain receptacle or an approved cluster, no lamp consuming more than 128 watts to be used."

The code was also altered to include the following rule:

"All lighting and stationary motor circuits must be thoroughly and permanently connected to the rails or to the wire leading to the outside ground return circuit."

Mr. Ayres said that it was his opinion that in many cases the Underwriters established rules which were too stringent and burdensome. The requirement that truss plank heaters should be mounted so that the current-carrying parts are four inches away from woodwork is certainly unnecessary and absurd. As far as the size of lamp was concerned, he did not see why street railway operators should be limited in the size or the current consumption of incandescent lamps.

Rule 34 of the National Electrical Code, which reads: "Lighting and Power from Railway Wires. Must not be permitted, under any pretense, in the same circuit with trolley wires with a ground return, except in electric railway cars, electric car-houses and their power-stations; nor shall the same dynamo be used for both purposes."

He said that his company had an office building and a number of waiting rooms lighted from its own circuits. This is perfectly proper, and it should not require any special dispensation to do it. The rule ought to be modified so that electric railways could use their circuits for lighting under proper construction anywhere.

Mr. Roberts said he thought the committee should take up the matter of procedure in the case of lightning storms, and also the wiring arrangements of cars laid up in the car-houses at night. He said there should be some standard established, because it has been his experience that different inspectors look upon the installation in an entirely different way.

The report of the Committee on Operating and Storage Car-House Designs was presented.

The report stated that the idea of setting forth the principles of a standard car-house design was dropped because it was shown that, however desirable it might be from some points of view, the standardizing of car-house designs is impracticable for the reason that the outline of a car-house is governed by the size, grade and outline of the lot, the requirements of the road in question, its geographical position, and the ordinances of the city or town in which it is located. The subject is treated in the report by considering the principal problems entering into the designing and operating of storage car-houses.

The discussion of this report was opened by M. Schreiber, who said that the track layout should be made as flexible as possible, and that in yards, if practicable, it is desirable to keep the cars moving head on, irrespective of whether it is necessary to approach the barn in either direction. If the terminal is on a main line, the arrangement of special work should be such that the least interference is presented to regular operation.

To meet present conditions in car-storage houses a three or four-track bay seems to be best suited. This allows a low pitch and short-span roof. The report of the committee states that the three-track bay is objectionable, but Mr. Schreiber considers that this arrangement is sometimes very desirable, especially where the barn is a long one or when in dividing up the property the width does not work out in multiples. He did not agree with the committee in the matter of heating, which considered that the use of hot water was especially meritorious with forced circulation. The report also stated that the heating apparatus should be placed in a room cut off from the remainder of the house by fire-proof walls, and should be located centrally with regard to the places to be heated. Mr. Schreiber considered that if the area was large enough to justify a blower system or hot air, that this was the only heating system to install.

Mr. Adams said that he was not quite sure that the committee's recommendation to use flush transfer tables was a good one.

Mr. Winsor said that his company has twenty-four or twenty-five operating houses, and uses nothing but flush transfer tables. The flush table will allow the use of the whole space of the table at night for car storage. There are only a few hours of the day when all the storage room is needed for cars, and this is at a time when cars are not being shifted.

Mr. Lindall did not agree with Mr. Winsor that the flush transfer table was a good thing. It limited the movement of cars in the house at night after the cars are all put in, and handicapped the car-cleaning end of the work.

Mr. Adams called attention to the suggestion in the report which read as follows: "While the Underwriters stipulate that no section of the house shall contain more cars than amount in value to $200,000, the committee believes that no road should expose more than a certain per cent of its rolling stock to the risk of destruction by any one fire, as the loss of cars means the loss of revenue."

He said that the Fire Underwriters desired to limit the figure to a somewhat lower valuation, but that the committee had finally persuaded them to hold up to the $200,000 valuation.

E. W. Olds stated that a considerable advantage would be gained if the companies built their car-storage houses so that one section could be burned out entirely without affecting other portions of the storage area. He also raised the question as to whether the flush transfer table should be recommended for general shop service.

Mr. Lindall replied that the flush transfer table has a decided advantage, inasmuch as material can be handled by trucks across the floor much better than with a pit transfer table. He did not know that there were any other advantages.

The report of the Committee on Way Matters was presented by Mr. Schreiber.

This report included contributions by C. B. Voynow, on "A Proposed New System of Street Railway Construction"; by H. M. Steward, on "The Life of Manganese Steel Rail on Curves," and by Howard F. Weiss, on "The Open-Tank Method of Preserving Timber."

Mr. Voynow's suggestion consists essentially of a track built with a T-rail with a projecting flange above the tread, which would guide the car, and a flangeless wheel. The flange on the rail would take the place of the flange on the wheel with some of the following advantages: The entire system would be of unbroken main line. The manufacture would be simplified, and most of the system could be built of the same rail as straight track. It would cost at least twenty-five per cent less than at present. There would be no possibility of car derailments on account of the tongue kicking or riding on a movable tongue. The rail section would be easy to roll, would conduce to a long life of the head, and the joints would have longer life on account of its being centre-bearing for both car and wagon traffic. The wheel would wear better because it could be chilled through the entire surface, and the chill made deeper. It would be simple to manufacture so far as the casting is concerned, as well as grinding or finishing.

In opening the discussion on Mr. Voynow's contribution, G. L. Wilson said that he thought this form of design would invite all passing teams to use the rail. He did not believe it would be advisable to favor such a radical change in the rail section. He thought that the resistance offered by dirt and obstacles on the track would be much increased, and the liability of derailment greater than at present.

C. Boardman Reed said he thought that on special work, particularly at curves, where guard rails are now required, a rail of the type suggested by Mr. Voynow would have to be renewed much oftener.

W. J. French stated that during the past year, in Utica, N. Y., and also in Syracuse, permission had been secured to use T-rail in the paved streets. These streets are used for ordinary city traffic, and it has been demonstrated that the pavement wears well and that there is no more danger from breakage of wheels than with flat girder rail. Also, the construction is more stable and rational than the girder construction.

R. C. Cram, of New Haven, stated that it has been found that if the authorities can be convinced that T-rail construction is the best for all concerned, the question simply resolves itself into the proper pavement.

Mr. Voynow said that the advantages of this type of rail were hardly appreciated. He would not consider it an ideal rail, but its advantages as far as special work, wheel construction, less exposure of rail in the street, effect on pavement and noiselessness are concerned, are very great. As to interurban cars entering the cities, all the tracks that are laid at present in cities have the maximum depth of their trams about one and one-quarter to one and one-eighth inches, and interurban cars having a standard wheel flange of one and one-eighth inches can not enter the city tracks. This rail makes provision for such service.

The contribution by Mr. Weiss to this report was presented, and the author explained that the only companies that have really taken the question of wood preserving up on a practical basis are some electrical companies in California. The working outfit costs about $400, including a tank with a second-hand boiler and pump. The various preservatives are injected into the body of the pole. The Government simply carries out the work to the point of proving its value to the companies.

This contribution to the report created considerable discussion. Ernest F. Hartmann stated that the application of a preservative is better than applying an oil paint. Oil is a preservative, but it is also a vegetable compound and decays the same as any other vegetable matter. The antiseptic action of any preservative material on partially decayed wood will help to a considerable extent. The Boston Elevated Railway Company is treating its ties by the open-tank immersion process, and it costs the company from sixteen to eighteen cents per tie. Something like 90,000 ties have been treated, and it is understood that the results are entirely satisfactory. Crossarms have been treated at Bangor at a cost of $8.68 per thousand feet. At Norfolk gum trees have been treated by the open-tank method, at a cost of twenty-three cents per tie. At Columbus, Ga., the cost of treatment is thirty-one cents per tie. At Denver the cost of treatment is seventeen cents per tie.

Mr. Cram said that his experience had taught him that it is not a good thing to treat green timber with any kind of preservative process.

Mr. Hartmann replied that the trouble with this installation was that no provision was allowed for drainage, and that when the blocks became thoroughly wet they split up. If the wood-block pavement were properly grouted there would be no trouble.

FRIDAY AFTERNOON SESSION.

It was decided to pass over the discussion of the question box, and the first business of the afternoon session was the hearing of the report of the Committee on Economical Maintenance.

The report recommends that, under average conditions, the practice of shopping car bodies for general overhauling yearly is the most economical. The committee recommends that the replacement of steel tires or steel-tired wheels with rolled-steel wheels be given careful consideration. The report also suggests that where track and special work is particularly severe on flanges, and where conditions permit a material reduction in the diameter of the wheels by wear, the rolled-steel wheel may be found to be more economical than the cast chilled wheel. The committee feels that there is general need of better knowledge on the part of persons responsible for the use of material as to the most suitable material for the purpose required and the checking of such material to determine its quality. It is suggested that the association could do valuable work in the preparation of suitable specifications for materials, and recommends for consideration the appointment of committees for this work. The committee is so convinced of the necessity of a system of accounting which would show the minimum average and maximum costs of maintenance for various classes of equipment that it recommends the appointment of a committee jointly with a committee from the Accountants' association for the purpose of giving this subject thorough consideration.

This report was discussed at length, it being the consensus of opinion that standard specifications for the purchase of material would help the purchasing agents very materially in securing the best material at uniform prices. The suggestions for the establishment of standard forms of accounting would also allow a comparison of maintenance charges, which would effect great economies in every system.

Following the discussion of this report, several amendments to the constitution and by-laws were made.

The report of the nominating committee was presented as follows: President, Paul Winsor, Boston; first vice-president, F. H. Lincoln, Philadelphia; second vice-president, W. H. Evans, Buffalo; third vice-president, W. J. Harvie, Utica, N. Y.; secretary and treasurer, John W. Corning, Boston. Executive committee: William Roberts, E. O. Ackerman, L. L. Smith, Martin Schreiber.

It was voted that the secretary be authorized to cast one ballot for these candidates.

On motion of Mr. Roberts a cordial vote of thanks was extended to Mr. Simmons, the retiring president, for the able and courteous manner in which he had conducted the affairs of the association.

President-elect Winsor was escorted to the chair and addressed the members briefly, after which the convention was adjourned.

The American Street and Interurban Railway Transportation and Traffic Association.

Report of the Wednesday and Thursday Sessions of the Convention Held at Atlantic City, N. J., October 12 to 16.

THE report of the Monday and Tuesday sessions of the American Street and Interurban Railway Transportation and Traffic Association was printed in the last issue of the ELECTRICAL REVIEW.

The Wednesday session was called to order at 10 A. M. with President Allen in the chair.

The discussion of the report of the Committee on Electric Mail Service was opened by Gen. O. H. Harries. This report, which was compiled by C. H. Hile, was composed largely of extracts from the United States Post-Office Department reports on electric railway mail service. This indicated the general opinion of the Government with regard to the compensation which should be allowed electric railway companies for the carrying of United States mail.

General Harries pointed out that the electric railways did not carry, as a rule, any other variety of business at a loss. There was no reason why the electric carrier should discriminate in favor of the Government, but he stated that very little could be accomplished as long as the electric railways continued to carry the mails at the present rate. So long as one company accepts mail at a low rate, this rate will be made the average compensation to all the others. There will be no action by Congress either so long as companies are found who will carry mail at the existing rate. The blame for this condition rests on the carrier, who insists on doing business without profit. The only remedy for this condition is for all the companies to refuse to accept contracts on the present basis.

Mr. Hippee stated that his company, in Des Moines, Iowa, carried United States mail in pouches and also carried four mail boxes on each car. The mail is collected at the main station by Government collectors and mail carriers, and the pouch mail is carried to substations and to the eastern side of the city. The mail is put on the cars by a representative of the Post-Office Department, and taken off the cars by one. The company receives compensation at the rate of three cents per mile for closed-pouch service. There is no limit to the number of pouches that can be carried, except that there is a general understanding with the postmaster that a car shall not carry more than three or four pouches on the front platform.

Mr. Brady, of Anderson, Ind., stated that the Indiana Union Traction Company has had a limited experience in handling material on interurban lines. It has two contracts, both of long standing, one of which involves the handling of mail by pouches from Anderson to Alexandria, a distance of about ten miles, and for which compensation is received at the rate of three cents per mile. The total compensation is between $45 and $50 per month, which is lessened somewhat by an occasional fine. Both cities have been growing, and the mail-pouch service is being extended considerably. It has been found, however, that although the service has extended several miles further, and the amount of mail that is carried has been doubled since the beginning of the contract, no extra compensation has been received.

After considerable discussion it seemed to be the consensus of opinion that there should be some strong action taken, looking to a more equitable compensation for the carrying of mail, notwithstanding the fact that it was appreciated that this was a sort of accommodation which was naturally undertaken by a public service company.

The report of the Committee on Freight and Express Service was presented, and this was supplemented by a paper entitled "Progress to Date in Carrying Freight and Express Matter by Electric Roads—Some Mistakes That Have Been Made and Their Remedy," which was prepared by C. V. Wood. The report and paper were read by G. W. Parker.

The discussion was opened by E. H. Hyman, general manager of the Cleveland Traction Company. Mr. Hyman said that the whole question of freight and express service depends entirely upon local conditions. If either freight or express business is carried on in the right locality it can be made to earn money, but both services can not be carried on in one locality at a profit. Where one system attempts to operate both freight and express service there is always the liability of contention among the shippers and always confusion regarding the shipments.

B. E. Wilson said that if the road has terminal facilities such that it can handle car-load lots, and sidings that will hold trains of four or five cars, it should attempt to do business on a car-load basis; but where the road has small sidings and is not allowed to move ordinary box cars into a city, it is positively out of the question for it to consider car-load business.

During the discussion of this report the matter of the jurisdiction of the Interstate Commerce Commission came up with regard to the receipt and billing of freight or express from adjacent states. George R. Folds, of the West Penn Railways Company, Connellsville, Pa., stated that a ruling had been handed him by the commission which indicated that if the company handled any traffic which originated outside of the state, the company was under the jurisdiction of the Interstate Commerce Commission, and must comply with its regulations. It would appear that this ruling took a very broad view of the situation, including passengers, express and freight.

H. A. Nicholl, of the Indiana Union Traction Company, stated that the system handles general merchandise in less than car-load lots. In a few instances car-load lots are handled, mainly in the shape of live stock. All of the freight cars are operated as extra trains, and no attempt is made to schedule these trains. Most of the freight business is handled at night, so as to avoid the congestion of the road during the business hours of the day. At the larger terminals the company has its own freight houses and ample side tracks. These are in charge of salaried freight agents, and at the smaller stations the freight is handled jointly with the passenger. Commissions are paid to the agents for this purpose. The company has a well-organized freight department, consisting of a general freight agent and two division freight agents. These men not only solicit business, but take care of the filing of the tariffs, with general oversight of the whole business. The company does not interchange freight with the steam roads. It does, however, with other electric systems. In some instances it operates through trains over other electric lines. The earnings per car per day average about $60. The freight business is operated on a fifty-five per cent basis, and the company earns about four to five cents per mile. The freight business represents about eight per cent of the gross receipts. The company charges to its freight account about every conceivable thing it thinks belongs to the freight department.

In respect to express, the company operates a merchants' despatch, which resembles, along practical lines, express business. For this service a rate of one and one-half times the first-class freight rate is charged. The company does not have a pick-up or delivery business, and it appears that the express business does not interfere with the freight business in any way.

The discussion of the Interstate Commerce Commission rulings was again taken up, several members pointing out the necessity of taking issue with some of these rulings.

P. P. Crafts discussed the experience of the Iowa & Illinois Railway Company with regard to its express and freight business. The company has a contract with the American Express Company on a tonnage basis, and hauls all of the American Express business originating on the Chicago & Northwestern Railway Company into Clinton. The company does not permit the express company to do any local business between the railway company's termini or along the line. A compensation of twenty cents per 100 pounds is received. No compensation is received for articles such as are carried in messengers' safes, nor for currency handled.

With regard to freight business, the company handles about three and one-half car-loads of freight per day. About fifty per cent of this is local, and the balance is part of through shipments which go west on the Chicago & Northwestern from Clinton.

The symposium on the "Possibilities of a Well-Conducted Publicity Department" was taken up, Mr. Warnock presiding.

Mr. Warnock pointed out the conditions which had led to the formation of publicity bureaus by the public service corporations, and emphasized the considerable good which was being effected by having men properly equipped to handle news in such a way that it would be put into the daily press without perversion, and would form the best means of putting to rest the generally unfavorably conception which the ordinary citizen has of the railway company.

The first paper on this subject was presented by Charles E. Flagg, of the department of publicity of the Inland Empire System, Spokane, Wash.

Mr. Flagg considers that the possibilities of a railway's department of publicity depend largely upon the natural environments. The city of Spokane has something over 100,000 population, with five transcontinental railroads, 104 miles of city traction lines, and 200 miles of interurban electric railroads. The Inland Empire System, which now has 225 miles in operation, began less than five years ago as the Spokane Traction Company, city lines, and the Coeur d'Alene & Spokane Railway, interurban lines, between Spokane, Wash., and Coeur d'Alene, Ida. In the matter of publicity, the company uses the daily newspapers, illustrated folders, official time tables and maps, enlarged photos, billboards, street cars, post cards, souvenirs and any other means that appeals to the publicity department as opportune and likely to bring results.

It has been found most practicable to use good-sized display spaces in the evening papers and reading notices in the morning papers. In each suburban town through which the lines pass a small display is run in the weekly newspapers, consisting of a local time table varied with announcements regarding excursion and colonists' rates to and from the East. In the preparation of folder copy, the illustrations are made as large as possible and the type matter brief and concise.

Mr. Flagg advocates picture advertising as one of the most convincing means of publicity. The best views are selected for enlarging, and these are framed and hung in depots and in good locations in public buildings. There are also complete photo albums in the general passenger and publicity departments, as well as on parlor cars.

Mr. Flagg was followed by B. R.

Stephens, of the Illinois Traction System, of Springfield, Ill.

Mr. Stephens described the publicity department of the Illinois Traction System. He believes thoroughly in the use of newspaper space for the publication of time cards and also endorsed the use of folders.

Concerning the expenditure for a publicity department, Mr. Stephens said that on steam roads, as a general rule, an allowance is made in the operating expense of two per cent of the gross passenger earnings for publicity purposes. On interurban roads it would appear that approximately one-quarter of this amount, or one-half of one per cent, is the allowance made for the purpose.

The meeting was then adjourned until Thursday morning.

THURSDAY MORNING SESSION.

The first business of the Thursday morning session was the reading of three papers on the "Possibilities of a Well-Conducted Publicity Department," by George Sabin Brush, of the Boston Elevated Railway Company; Charles W. Lamb, advertising expert, and G. H. Gall.

The discussion on these papers was opened by the reading of a communication from William A. House, president of the United Railways and Electric Company, Baltimore, Md.

Mr. House considers that a publicity department is a welcome step forward in the public service corporation. It is beginning to be realized that the best paying policy is to deal liberally and fairly with patrons and encourage a spirit of co-operation. The adoption of a liberal, progressive and generous policy, backed by a thoroughly organized and enlightened publicity department, was recommended by Mr. House as one of the surest ways to avoid the criticisms so frequently indulged in at the expense of the corporation.

E. A. Kendrick, secretary of the Matthews-Northrup Works, Buffalo, N. Y., made a brief address on the subject of advertising and printed matter.

The discussion on these papers was closed by H. A. Faulkner, passenger agent of the Boston & Northern Railroad, of Boston. Mr. Faulkner considers that it is the best policy to treat the newspapers very squarely, and if this is the practice of the corporation, much good can be secured. He described the information bureau which his company had established, which is under the direction of the passenger department and located with the other railroad offices. This information bureau is fitted up with every kind of literary information, and the attempt is made to get hold of not only what is interesting concerning the company's own system, but everything connected with a scenic effect or railroad situation outside of the New England States. The clerks are instructed to give absolutely impartial information, whether the inquiry is concerning the company's lines or competing lines. Although Mr. Faulkner is an old newspaper man and appreciates very highly their value, he does not place them first in importance for the special uses of the street railway man. He considers that the company's own cars are the best advertising medium that can be found and that as an advertising medium they should be used to the limit. In his system the division superintendents keep the publicity department informed concerning festivities occurring in any locality, and the attempt is made through dasher signs to promote travel in these directions. One of the most valuable publications of the Boston & Northern company is called the "Tri-State Tourist." Forty thousand copies of this are issued per month, and distributed at various points on the company's system in three states.

The report of the Committee on Interurban Rules was presented by J. N. Shannahan.

This report is based on the book of rules adopted at the Columbus convention in 1906. The committee has aimed to harmonize as closely as possible the codes adopted by the various associations during the past two years, and the rules include codes adopted by the Central Electric Railway Association, the New York State Street Railway Association, and the rules of the operating Indiana companies. The committee recommends that the association direct the incoming Committee on Interurban Rules to cooperate with a committee to be appointed by the Railway Signal Association in formulating a new code governing the use of semaphore signals.

It was voted to receive the communication as a progress report and that the committee be continued.

After considerable further discussion of the report it was voted to extend the authority of the present standing committee on interurban rules so that the committee might confer with various public service commissions throughout the United States, and, in its discretion, distribute copies of the rules as presented by the committee.

The report of the Committee on the Operation of Multiple-Car Trains on Interurban Roads was presented by D. F. Carver.

Owing to the lateness of the hour there was no discussion upon this report.

The reports of the Committee on Passenger Traffic and of the Committee on Rules for City Operation were received and written discussion requested.

The report of the nominating committee was presented as follows: President, C. Loomis Allen; first vice-president, R. T. Todd; second vice-president, G. L. Radcliffe; third vice-president, A. W. Warnock. Executive committee: the officers, and G. W. Parker, Detroit, Mich.; H. C. Page, Springfield, Mass.; N. W. Bolen, Newark, N. J.; H. A. Davis, Nashville, Tenn. This report was unanimously adopted and the gentlemen named declared elected.

Mr. Shannahan and Mr. Brush were named as a committee to escort Mr. Allen to the chair, and after a few remarks by the president-elect the convention stood adjourned.

Meeting of the Pittsburg Section of the American Institute of Electrical Engineers.

The regular October meeting of the Pittsburg section of the American Institute of Electrical Engineers was held in the lecture hall of the Carnegie Institute, Pittsburg, Pa., October 13.

The evening was devoted to the presentation and discussion of two original papers. The subject of the first paper was "The Oscillograph and Some of Its Uses," by H. H. Galleher, engineer of the high-tension testing laboratory of the Westinghouse Electric and Manufacturing Company, and the second one was entitled "The Testing of Large Alternating-Current Generators," by L. E. Schumacher, of the dynamo testing department of the same company. The papers were illustrated by lantern slides.

Mr. Galleher's paper dealt with the practical application of the oscillograph to everyday problems and explained its general construction, operation, adjustment and repairs.

Professor S. M. Denton, of the Carnegie Institute, supplemented Mr. Galleher's paper with a talk on the application of the oscillograph to the solving of complex problems in phase relation, and showed how essential this instrument has become in large power-transmission plants as a means of explaining perplexing phenomena. He advocated the purchase of such instruments by high-tension central stations generally.

Mr. Denton then gave an interesting description of the Irwin hot-wire oscillograph, which, he stated, gives great promise as a cheap and sufficiently accurate instrument for such purposes.

The subject was further discussed by R. P. Jackson, S. M. Kintner and A. W. Copley.

Mr. Schumacher's paper dealt particularly with the tests on the large 8,770-kilowatt, 12,000-volt, three-phase generators of the Ontario Power Company at Niagara Falls, which were tested after erection. The methods of testing and some results were given.

The paper was discussed by P. M. Lincoln, W. L. Waters, F. D. Newbury and C. Renshaw, special comment being made on the water rheostat and the use of temperature coils to ascertain temperatures in places where thermometers could not be used.

The next meeting will be held early in November, the subject being "Electricity in Mines," by George R. Wood, consulting engineer. This subject is of great interest just at present in the Pittsburg territory.

The New Haven Electrification.

William S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad Company, which has been operating the Westinghouse single-phase electric railway system on a part of its lines during the last two years, in discussing its experiences with electrification, says:

"The most commercially valuable answer as to the success of electrification on the New Haven is written in the actual operating schedule in the electrification zone. The train minute delays suffered to-day by electrical operation are but a small percentage of those incurred during the period of steam operation.

"As the zone limits in our case were not a terminal proposition, the application of the direct current showed itself to be impracticable. On account of errors, always common of initiative work, the first few months' operation has been a period of interruption which has naturally been annoying both to the road and the public. To-day the delays have disappeared by the removal of their cause.

"The wisdom of the purchase of a locomotive consisting of two individual half units, the whole or half unit being operative by a single crew, has proved itself in the ability of the road to handle seventy-five per cent of traffic with half-unit locomotives, using the whole unit on the remaining twenty-five per cent of trains, whose weight demands the full drawbar. Should future requirements see the advantage of extension of electrification east of Stamford, the system is designedly applicable.

"As to the saving in cost of operation as compared with steam, I would state that operation to-day has not been a sufficient length of time to make this comparison. It may be interesting to note, however, that by exhaustive investigation I have found that one pound of coal burned under the boilers of our central station produces twice the drawbar obtained by one pound of coal burned in the fire boxes of the steam locomotive, or in other words, the fuel bill for electric traction is one-half of that required for steam traction. Other economies will arrive in the low cost of maintenance and repairs of the electric locomotive as against steam locomotives.

"The density of traffic is, of course, the paramount feature as to the savings to be effected by electrification. It is not to be forgotten that, in electrifying, interest, depreciation, insurance and taxes follow closely on the heels of the capital investment in equipment and material necessary to electric operation. The heavier the traffic, the greater will be the economies derived from the two above-mentioned sources.

"It is quite conceivable that the heavy ton-mileage in freight and passenger service on the Atlantic coast line roads will effect savings sufficient to cover the above-mentioned fixed charges on the investment necessary to their electrification.

"The greatest value to be experienced by electrification will be in the tremendously increased traffic capacity of the present track mileages, due to the facility electricity offers in making rapid main line and yard train movement, or, stated in another way, it is thus immediately seen that electrification will permit a tremendous increase of traffic without an increase of track mileage, and thus roads which are up against the requirement of handling their congested traffic by laying new tracks, which, of course, is a most expensive procedure on account of right-of-way difficulties, will be led into providing an equal capacity by electrification of the old trackage."

American Institute of Electrical Engineers' Papers.

To the Editor of the Electrical Review:

About a year or so ago I read an editorial in the Electrical Review regarding the papers read before the American Institute of Electrical Engineers. It was suggested that the number of papers be cut down to one per meeting, together with prepared discussion on same. By such adoption the Papers Committee would have a wider range of choice to select the best papers available, which, in turn, would mean that the authors would be better prepared for questions and answers, and papers would not be read at all which were presented with the apology that they were prepared at the eleventh hour.

It is a great pleasure to note that in this month's proceedings of the American Institute of Electrical Engineers, "the Meetings and Papers Committees propose to accept but one paper for each meeting during the present season, to be followed by prepared discussion."

Supplementary to same, I respectfully suggest the following two points for the assumed benefit of the engineering profession in general:

First, that the Committee on Papers confer with engineers, whether members or not, and secure by invitation, in concrete form, compact researches and studies on subjects covering a wide range, with numerous comparisons drawn.

Second, to invite engineers who are up to date in European practice to present papers on modern European subjects.

Practically all the papers read before the American Institute of Electrical Engineers are of domestic practice; my observation during seven years' residence in the United States is that many of these papers contain what are apparently basic features, but which have existed in Europe for a number of years in every-day practice.

In connection with my latter suggestion it must be borne in mind that the early familiarization with European ingenuities greatly facilitates domestic problems. Further, as an example, permit me to call attention to the fact that the papers presented to the Verein Deutscher Ingenieure (German Society of Engineers) comprise about twenty per cent of foreign, especially American, topics. In addition it is recognized abroad, also to a certain extent in this country, that the European engineer reads more American technical literature than *vice versa*.

What we need is a more frequent and friendly interchange of ideas whereby we can profit from one another. The advantage is fully recognized by competent engineers who make studies abroad to ascertain conditions there. That the argument is not one-sided is shown also by the trips of foreign commissions sent here to study our methods.

Frank Koester.

New York, October 20.

Hudson River Electric Power Reorganization.

The reorganizing committee which has undertaken to readjust the affairs of the Hudson River Electric Power Company in order to meet its financial obligations, has announced the terms of the agreement under which the holders of the $5,000,000 of bonds, whose interest has been in default since August 1, are invited to submit their holdings for participation in the reorganizing plan which is to be announced later.

The bondholders' committee in its original announcement provided that "if the final plan which the committee proposes to submit does not meet with their approval, said depositors may withdraw their bonds within ten days after written notice that fifty-one per cent in face value of the depositors have adopted the plan."

THE KERR MILLS OF THE AMERICAN THREAD COMPANY, FALL RIVER, MASS.

A DESCRIPTION OF THE NEW STEAM TURBINE POWER PLANT.

In the early part of 1907 the American Thread Company decided to make an addition to its plant at Fall River. The old plant consisted of a spinning and twisting mill, dye and gassing house. The power for the main mill was derived from a double tandem-compound engine of about 1,600 indicated horse-power; and the dye and gassing houses were driven by small engines, the power from these and the main engine being distributed throughout the various mills by belts and shafting.

It was decided to drive the new mill electrically, principally on account of the probability that, as the business increased, various additions would have to be made, and the electrical drive lends itself particularly well to this end.

The building of the new plant necessitated the complete rearrangement of the machinery in the old main mill.

It was first proposed to merely make a new arrangement of the shafts and belts, and at some future time—when it became necessary to install a new engine—to change to electrical drive. An accident, which might have had serious results, occurred to the main engine before this plan had been carried out, which decided the management to abandon the engine and immediately install electric drive, not only in the new mill but in the old mill as well. The new power-house described in this article was, therefore, designed to furnish power for the complete plant and is arranged so that it can be conveniently enlarged to care for future power requirements.

The power-house is located on South Watuppa Pond. The tracks of the New York, New Haven & Hartford Railroad run between the power-house and the pond, cutting off a small body of water from the main pond. Connection was made with the main pond at two points, the water being brought into the power-house through one of these connections and a trench, and the water from the condensers flowing into the small pond and thence under the railroad, through the other connection, into the main pond. These connections were placed some distance apart so that the used water would have no tendency to return to the power-house.

The power-house building consists of a turbine room, forty-three feet by fifty-six feet, and a boiler room, fifty-eight feet by 132 feet. The building is of brick with concrete floors and roofs. The boiler room contains twelve horizontal tubular boilers built by the Bigelow Company, of New Haven, Ct., each rated at 200 horse-power. These boilers are hung from beam supports and are brick set, the setting being arranged so that superheaters can be installed in the rear end of the setting. Three Foster superheaters have been installed for the purpose of testing their durability and efficiency. The gases from each battery of six boilers pass through a flue to a Green fuel economizer and thence to the chimney. The flue back of each battery is arranged so that the gases can either pass to the chimney or through the economizers.

All of the boilers are arranged for burning low grades of fuel and are equipped with "Parsons" blowers and arrangement of setting.

A Warren Webster open feed-water heater and purifier is located at the end of the boiler room next to the turbine room.

Two skylights are placed in the roof of the boiler room, one over the firing space and one over the tops of the boilers

The wall opposite the front of the boilers and back of the firing space is made of galvanized iron, as any future addition to this boiler room will be a duplication of the present layout, the new boilers facing the present ones.

The boiler-room floor is level with the yard. Coal will be brought from the storage piles by a conveyer system and dropped in front of the boilers.

The steam piping is arranged so that superheated or saturated steam can be supplied to the turbines or to the auxiliaries, either separately or in conjunction. This arrangement was made primarily for use in testing the efficiency of the different types of apparatus.

The feed water is delivered to the open heater and purifier and is then pumped to the boilers. The feed-water main is of cast iron and so arranged that water can be supplied either from the pond or from the heater and purifier, and delivered directly to the boilers or through the economizer.

The drips from all of the high-pressure steam mains are collected at one point and from there returned to the boilers by the Holly return system.

The turbine room has two floors, but the upper floor where the turbines are located does not extend over the space occupied by the pumps. This space was left open so that the traveling crane, which is of ten tons' capacity and built by the Northern Engineering Company, could be utilized in installing and repairing the auxiliaries as well as the turbines.

The turbine room contains two 1,500-kilowatt Allis-Chalmers alternating-current, turbo-generators; two General Electric seventy-five-kilowatt, direct-current, turbo-generator exciters, and a General Electric switchboard. This apparatus is located upon the upper-floor level.

Incorporated in the main turbines are the various patented features controlled by the builder, the Allis-Chalmers Company, among which may be mentioned channel-shaped shrouds protecting the ends of the blading from injury; machine-cut slots in the foundation rings insuring accurate spacing of the blades; a method of fastening the latter which effectually prevents them from working loose, and improved balance pistons. Other details of special interest will be mentioned briefly under the subjects to which they belong.

The turbines operate at 1,800 revolutions per minute, with a steam pressure of 150 pounds at the throttle, dry saturated, and a vacuum of twenty-eight inches of mercury referred to thirty inches barometer at the exhaust nozzle. Large temporary overload capacity has been provided for in the design of these machines; high efficiency is maintained, and close regulation secured, even under the most unfavorable operating conditions.

The bedplate is divided into two parts, one carrying the low-pressure end of the turbine. The turbine is secured to the former, while the latter is provided with guides which permit the end of the turbine to slide back and forth with differences of expansion caused by varying temperature, at the same time maintaining the alignment.

The "Bulkley" condensers are located outside the building.

The speed of each turbine is regulated within close limits by a governor driven from the shaft through cut gears working in an oil bath. This governor, by means of a relay operates a balanced throttle valve. The entire mechanism is so proportioned as to respond at once to variation of load, but its sensitiveness is kept within such bounds as to secure the best results in the parallel operation of the two turbo-generators in this station. The governors can be adjusted for speed while the turbines are running, thereby facilitating the synchronizing of the generators and dividing the load as may be desired. In order to provide for any possible accidental derangement of the main governing mechanism, there is an entirely separate safety or over-speed governor. This governor is driven directly by the turbine shaft without the intervention of gearing, and is so arranged and adjusted that if the turbines should reach a predetermined speed above that for which the main governor is set, the safety governor will come into action and trip a valve, shutting off the steam and stopping the turbine.

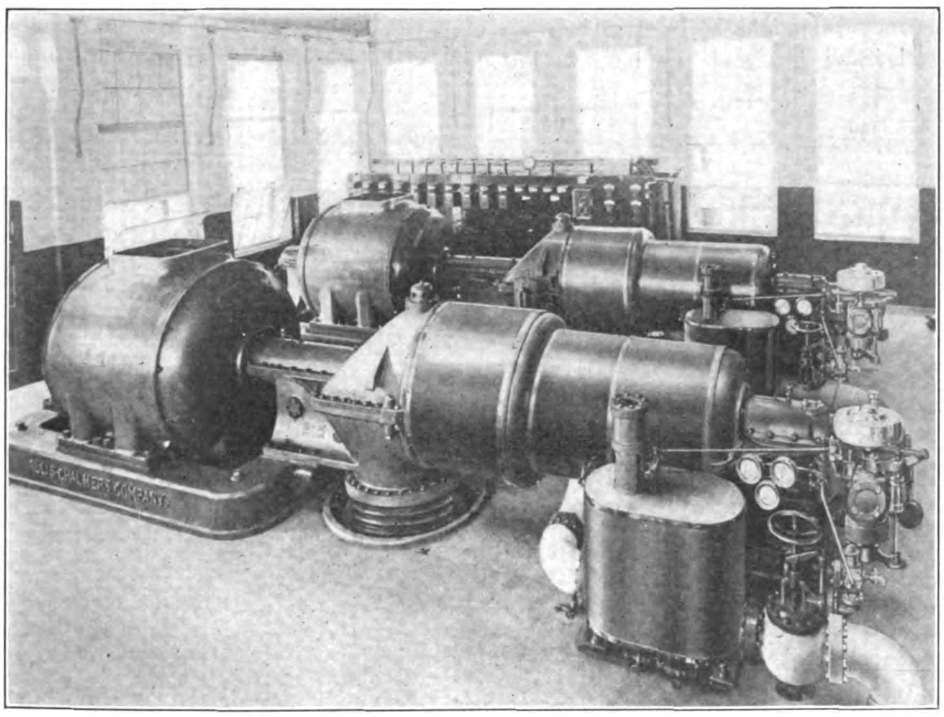
The bearings are of the self-adjusting ball and socket pattern, especially designed for high speed.

The lubrication of the four bearings, two for the turbine and two for the generator, is effected by supplying an abundance of oil to the middle of each bearing by means of a small cycloidal pump driven from the turbine shaft, and allowing it to flow out at the ends. The oil is passed through a tubular cooler with water circulation, and pumped back to the bearings.

It is not necessary to supply the bearings with oil under pressure, but only at a head sufficient to enable it to run to and through the bearings, this head never exceeding a few feet. No oil of any kind is used in the interior of the machines nor in the glands through which their shafts pass. Low oil alarms have been provided for the turbines.

The hot parts of each turbine up to the exhaust chamber are covered with an ample thickness of non-conducting material and lagged with planished steel, so applied that it may be easily removed. The non-conducting covering is also removable at the cylinder joint to facilitate the opening of the turbine for examination.

Between the turbine and its generator a special type of flexible coupling is used to provide for any slight inequality in the alignment of the bearings, to permit axial adjustment of the turbine spindle, and to allow for difference in expansion. This coupling is so made that it can be readily disconnected for the removal of the turbine spindle or of the revolving field of the generator. Provision is made for ample lubrication of the adjoining faces of the coupling.



Two 1,500-Kilowatt Allis-Chalmers Steam Turbines and Generators in the Kerr Mills of the American Thread Company.

The revolving-field alternators driven by these turbines are of the Allis-Chalmers Company's standard type, designed for high efficiency and safe operation at high peripheral speeds. Some of the principal advantages embodied in their construction are summarized as follows:

The field core is built up of steel discs, each in one piece, giving high magnetic permeability and great strength. Coils are placed in radial slots, thereby avoiding side pressure on slot insulation and the complex stresses resulting from centrifugal force, which, in these rotors, act normal to the flat surface of the strip windings. Bronze wedges hold the coils firmly in the slots, making the surface of the rotor a smooth cylinder, reducing windage losses and insuring quick operation. The end connections are securely held by chrome-nickel steel rings.

The stator is completely enclosed, eliminating noise of operation. Coils were completely wound and insulated before being placed on the core, thus obviating the risk of defective insulation. Stator windings are placed in open slots, rendering the coils readily removable. End connections are firmly braced, preventing deformation of coils in case of short-circuit.

For the purpose of obtaining adequate ventilation and for muffling the noise produced by the circulation of the air, the turbo-generators are enclosed in such a manner that the air is taken in at the ends through fans mounted on the rotor shaft which discharge it over the end connections of the armature coils into the bottom of the machine, whence it passes through the ventilating ducts of the core to an opening at the top. This patented system of ventilation is most efficient.

On the lower floor of the turbine room are two engine-driven Lawrence centrifugal pumps for condensing water, one Blake 1,000-gallon Underwriters fire pump, one electrically driven Deane triplex power pump for sanitary water for the mills, one Fairbanks-Morse duplex steam-tank pump for water supply to the heater and purifier, one engine-driven Deane triplex power pump and one Heisler duplex steam pump for boiler-feeding purposes.

The engine-driven triplex boiler-feed pump is arranged so that it is automatically controlled by the opening and closing of the boiler feed valves, a constant pressure being maintained on the feed line. Any lowering or raising of this pressure causes the pump to run faster or slower according to the demand for water.

The switchboard is located on the same floor as the turbines and consists of two panels controlling the exciters, two panels for the main turbo-generators, one panel for a Tirrill regulator, seven panels for the power circuits and one panel connected to the lighting circuits.

This switchboard has a complete equipment of instruments and all switches are oil-immersed, except the main generator switches, which are solenoid-operated circuit-breakers. The feeder mains are carried under ground to each mill through fibre conduits.

Taken all in all, this plant is very complete, being so designed as to secure both maximum economy and low operating costs. The plans for it were made and its construction superintended by S. M. Green, consulting engineer, of Holyoke, Mass.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

System of Simultaneous Telegraphy and Telephony Over Telegraph Wires.

Experiments made by Aurio Carletti under the auspices of the Italian Telegraph Department between Caserta and Piedimonti are here described. The work was undertaken for the purpose of testing the Perego separator of simultaneous telegraphic and telephonic messages, but the device was found unsuitable for use between any two subscribers and could only be employed between the two offices at the extreme ends of the line. Better results were obtained with the arrangement shown herewith. The telegraph currents are separated from the telephone currents by means of a condenser C; T is a telephone transformer of the kind usually employed for connecting a single-wire to a double-wire line; *j* is the jack at the switchboard. In order to make the variable period of the telegraph currents slower and deaden the noise produced by them in the telephone receiver the well-known arrangement of Van Rysselgerghe was employed, which consists chiefly of a coil *g* with strong self-induction connected in series with the line, and of a condenser C of two microfarads in multiple with the line. The coil *g* also serves for resisting the leakage of the telephone currents through the telegraph apparatus, the coil acting in this case as an impedance against the high-frequency telephone currents, so that they will pass preferably through the condenser C and the secondary of the transformer T. To the telegraphic currents, on the other hand, which are continuous, the coil *g* offers only its ohmic resistance. This arrangement gave good results and permitted communication from Piedimonti with subscribers in Caserta, Naples and Rome. However, there still was a considerable leakage of current through the telegraph instrument, which was detrimental. One way of reducing this leakage was to increase the impedance of *g*, but that would have disturbed the telegraph service too much. Furthermore, the impedance depends chiefly on the frequency, and consequently the leakage of the telephone currents will not be equal for all harmonics: it will be greater for the lower sounds and smaller for the higher ones, and thus the voice will be distorted. Another cause of serious disturbance is the intermittent exclusion of the telegraph receiving circuit. In the receiving position the electromagnet of the telegraph instrument will be in series with the coil *g* and add its impedance thereto; in the transmitting position the line is connected to the battery and the telephone currents can leak away freely through the battery, and thus the telephone current will be alternately weak and strong. To remove this difficulty an impedance coil might be inserted between the telegraph key and the battery, but this arrangement would be too complicated and would greatly increase the resistance and inductance of the telegraph circuit. A simpler artifice, which gives the same results, is to put the telegraph receiver in series with the line. In this case the Morse receiver acts also as an impedance, and therefore the coil *g* may be eliminated. An arrangement which has not yet been sufficiently tested, but which might completely remove all the difficulties referred to is to put the transformer T in series with the telegraph line. In this manner all the telephone current is utilized, because it passes entirely through the transformer T, while in the arrangement shown herewith only a part of it passes through the transformer and the remainder escapes at A through the telegraph receiving group. The arrangements described are not suitable when the telegraph wires are disturbed by industrial currents.—*Abstracted and translated from L'Elletricista (Rome), September 1.*

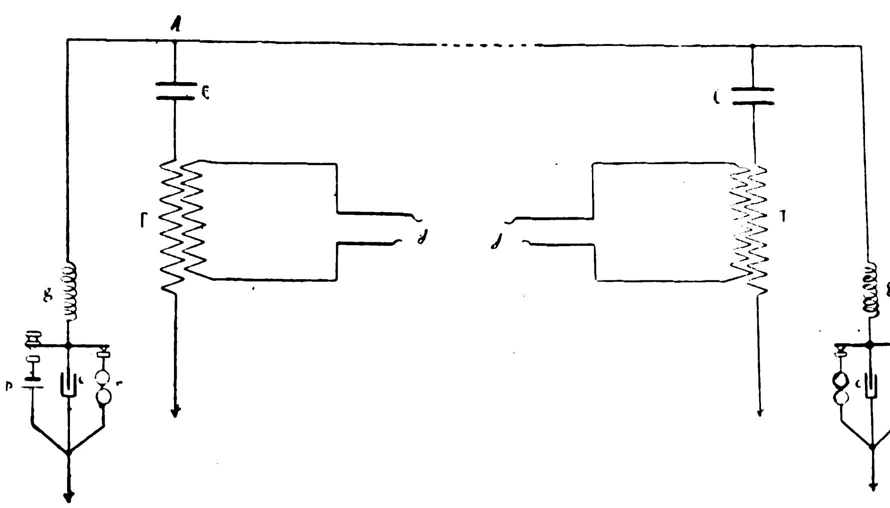


Diagram of Circuit for Simultaneous Telephony and Telegraphy.

Effect of Wireless Telegraph Transmission on a Telephone System.

In the north of England a wireless telegraph station recently caused considerable trouble to the local telephone exchange. The telephone circuit was provided originally with an aerial line, two spans of which came within the staying ground of the wireless mast, which is 225 feet high. These wires were not adjacent to or parallel with any leads or wires of the radiotelegraph system. The telephone wires were twisted in the usual way, and immediately outside the station grounds were connected with wires for other local subscribers. Originally the telephone circuit was provided with a battery at the station for signaling purposes, both wires being used for signaling as well as for speaking. At the wireless station the spark system was in use, absorbing several kilowatts of energy. Not only was the speaking difficult from the telephone station itself, but other circuits traversing the same routes were seriously interfered with and false rings were received from time to time by various subscribers, and sparking was also observed at the telephone exchange. Arrangements were made to substitute cable for the aerial line on the station grounds. Meanwhile the local telephone system was changed over to common battery working. This greatly accentuated the difficulty, due, no doubt, to the fact that one of the wires was normally joined to earth for signaling purposes. The disturbance to speaking was not increased, but the heat coils at the exchange were continually being burned out. The lightning protectors were also affected. A lead-covered cable was buried in the ground and terminated a few yards from the hut by means of unsheathed cable. This reduced the disturbance considerably but did not entirely overcome it. Finally the lead-covered cable had to be extended into the hut and terminated close to the telephone instrument before the difficulty was entirely overcome. At the wireless station an arc system was installed, but no difficulty was experienced with the undue oscillations. —*Abstracted from the Post Office Electrical Engineers' Journal (London), October.*

The Arc Between Identical Electrodes as a Rectifier.

Dr. Johann Sahulka describes some investigations of the rectifying effect of an alternating-current electric arc. In his previous writings he has pointed out that such an effect takes place not only in an arc between dissimilar electrodes, but also, though in a smaller degree, between electrodes of identical material, as carbon, for instance, if they do not have the same dimension or position. With an arc between two equally thick carbons in a vertical position the lower one is always electrified positively toward the upper one, so that outside of the arc a direct current flows in the direction from the lower to the upper one. The difference of potential of the rectified current depends on the intensity of the alternating current; with homogeneous carbon rods, seven millimetres in diameter, it amounted to a maximum of 2.8 volts. If the alternating-current arc is produced between two electrodes of different thicknesses the thinner carbon rod is always electrified positively toward the thicker one; the potential of the rectified current depends on the current intensity and position of the carbons. The alternating-current arc between two identical electrodes is always predominatingly negative toward both electrodes, so that in a branch circuit between either one of the electrodes and a test rod inserted into the arc a strong direct current is obtained. The manifestation of a direct current in an alternating-current arc between two identical electrodes is explained by the unequal temperature of the electrodes. The chief condition for the maintenance of an arc is that the cathode has a high temperature and that the space surrounding it is conducting. If one of two carbon electrodes is hotter than the other, therefore, the current flows through the arc from the colder to the hotter electrode more easily than in the opposite direction, and the corresponding half waves of the alternating current are stronger for this reason. It is evident that this rectifying effect will be increased, if the temperature difference of the two electrodes is made as great as possible, as by cooling one electrode or establishing favorable cooling conditions. If an arc is produced between a carbon rod and a carbon plate, a direct current must flow through the arc from the rod to the plate. The rectifying effect of the arc increases with its length, and it would be expected that it might be lengthened to such an extent as to allow only the passage of those half waves of the alternating current flowing from the carbon plate to the rod. But if an attempt is made to approach this extreme condition, the arc becomes unsteady and breaks off. It is easy, however, to obtain a direct current equal to about one-seventh of the intensity of the entire current. In order to increase the temperature difference still more, he has produced an arc between a carbon rod and a rotating disc. The highest proportion of direct current obtained was thirty-one per cent of the total current consumed, which result is unfavorable. The efficiency might possibly be increased by providing for a better cooling of the disc or by carrying out the experiment in a vacuum. —*Abstracted and translated from Elektrotechnische Zeitschrift (Berlin), October* 1.

Explosion Gas Turbine or Combustion Gas Turbine.

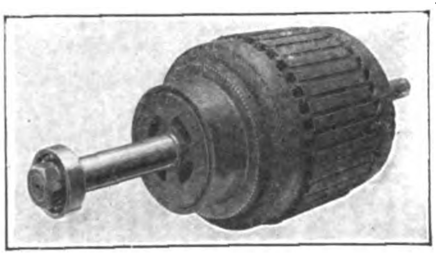
The question which of these two types of turbine offers the greater practical possibilities seems important enough to deserve to be determined by calculation, says Dr. Phil. Wegner-Dallwitz in this article. Whenever reference is made to a gas turbine, it is usually a combustion turbine, although published calculations show that, with the technical means at present available for its construction, the practical possibilities of this engine are very poor, while an explosion turbine can already be constructed which, though its heat economy may not be brilliant, can compete with the steam turbine, particularly in view of its greater simplicity (absence of the steam boiler). In the present article the combustion turbine is dealt with. The operation of such an engine is briefly as follows: Air and gas of a pressure equal to about that of the atmosphere and also of about the same temperature are compressed by pumps to a higher pressure, with an eventual rise in temperature, and are pressed into a combustion chamber, where the gas is burned by aid of the air in such measure as it is delivered by the pump, but so that the pressure in the chamber is not changed by the combustion process and the resulting heat and expansion. The inflow of gas is offset by an equally great outflow. The combustion raises the temperature of the chamber contents and causes them to expand through Laval nozzles to a lower pressure and temperature, whereby they attain a certain velocity with which they flow into any desired turbine system and perform work. The practicability of the combustion gas turbine is largely dependent on the efficiency of the compressor. It seems that only a turbine compressor, which rotates on the same shaft as the gas turbine, can be considered. A compressor of this kind by Parsons has been reported, which is said to compress gases to 1.4 atmospheres with an efficiency of sixty per cent. But it is not indicated whether this figure refers to adiabatic or isothermal compression. In technical circles generally the statements concerning this high efficiency are regarded skeptically. But even assuming this high compressor efficiency to be possible, and taking into account the thermal efficiency of the combustion process, the author reaches the following conclusions: If we are limited to adiabatic compression, the thermal efficiency of the combustion gas turbine at low pressures will be extremely small, and even at the high combustion pressure of fifty atmospheres it will be only 3.4 per cent in spite of the high compressor efficiency. If it should become possible to approach the compression curve to that of the isothermal, then the efficiency will rise to utilizable values at the higher combustion pressures. With a pressure of ten atmospheres in the combustion chamber and isothermal compression the absolute efficiency will be twenty-one per cent. Such a turbine would, therefore, be capable of competing with other engines, that is, if the compression could be effected with an efficiency of sixty per cent. If we figure only with the Parsons compressor under the assumption that the efficiency of sixty per cent really refers to isothermal compression, a combustion turbine could be constructed that would work with a thermal efficiency of three to eight per cent. Such a turbine could not be put on the market.—*Abstracted and translated from Die Turbine (Berlin), September* 20.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Lincoln Variable-Speed Motors.

Considerable success has been attained in shop as well as in electrical results in the last two years by the variable-speed motor of the armature-shifting type made by the Lincoln Motor Works Company, of Cleveland, Ohio, formerly the Lincoln Electric Manufacturing Company. This motor, when it was first put on the market, was described in the September 15, 1906, issue of this paper. Since then the motor has proved itself especially useful for the individual driving of machine tools throughout various machine shops in the United States and Canada. It is also used extensively in the machine shops of the United States Navy. The motor is conservatively rated, as the standard motor without undergoing any change meets the requirements of the United States Army and Navy.



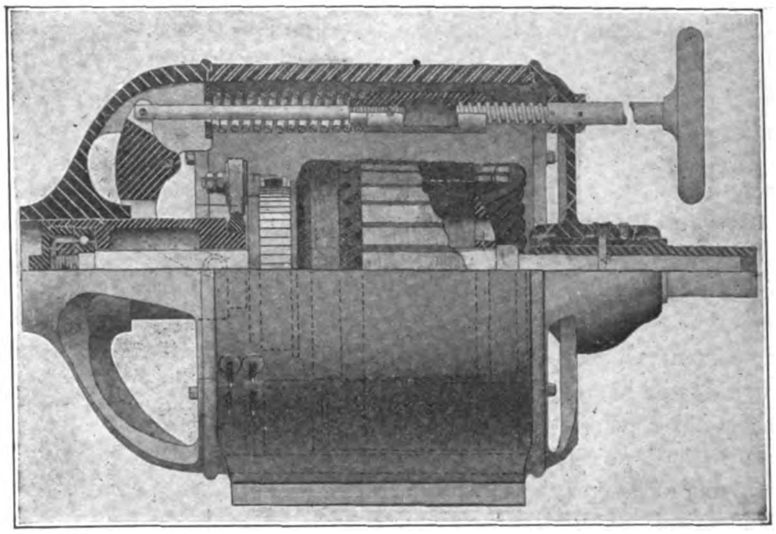
ARMATURE OF LINCOLN VARIABLE-SPEED MOTOR.

The accompanying cross-section shows the principal parts and working mechanism of the Lincoln variable-speed motors. It may be noted that by turning the hand wheel the slightly cone-shaped armature is withdrawn laterally away from the tapered field which at the same time gradually increases the air-gap, decreases the magnetic flux, and increases the speed.

Sparkless commutation is provided by the use of a commutating pole. The Hess-Bright bearing on the commutating end of the armature provides for both the radial bearing and end thrust due to the slight magnetic pull of the armature back toward the field. The pinion or pulley is carried on the sleeve which is the bearing and into which the armature shaft is keyed so the end movement occurs only in the armature shaft.

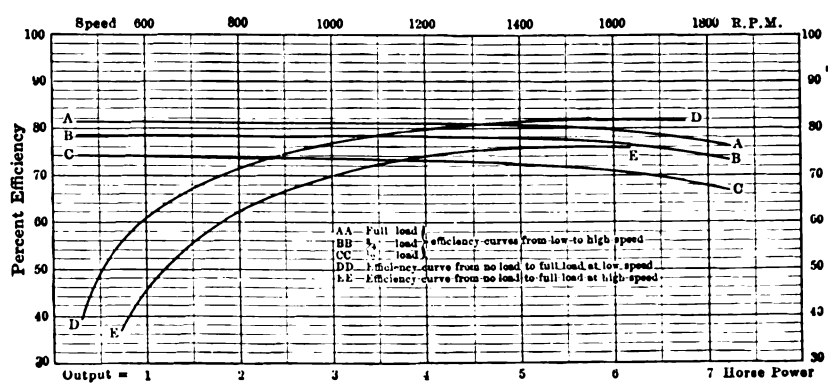
The principal features claimed for the Lincoln variable-speed motors are as follows:

No electrical controller is required. The speed variation is obtained by the simple mechanical device of shifting the armature. The motor is wired up and installed on a regular two-wire circuit in the same manner as any direct-current, shunt-wound, constant-speed motor. The motor is reversible and will run with like results in either direction. Ranges in speed as high as 1 to 10 are practicable. An infinite number of speeds can be obtained at will between the minimum and maximum speed limits of the motor, the speed change being smooth, continuous and gradual. The motor will develop its full rated capacity at all speeds, that is, with constant input the torque varies inversely as the speed, giving constant output. There is no decrease in capacity as the speed decreases. When set for any given speed the motor maintains a constant speed under varying load. In fact, the drop in speed from no load to full load at any speed is exceedingly small, comparing with the best constant-speed motor practice. By the use of special commutating poles, sparkless commutation is obtained to fifty per cent overload when running at any speed in either direction. By the use of steel frames and economical design, a light and compact motor is obtained for a given horse-power rating and efficiency.



SECTIONAL VIEW OF LINCOLN VARIABLE-SPEED MOTOR.

One of the special advantages of the Lincoln variable-speed motors which appeals to foremen and superintendents of machine shops is that if a machine tool is set for a certain speed and the operator stops the machine for calipering, on starting up again, he obtains his original cutting speed.



EFFICIENCY CURVE OF LINCOLN VARIABLE-SPEED MOTOR.

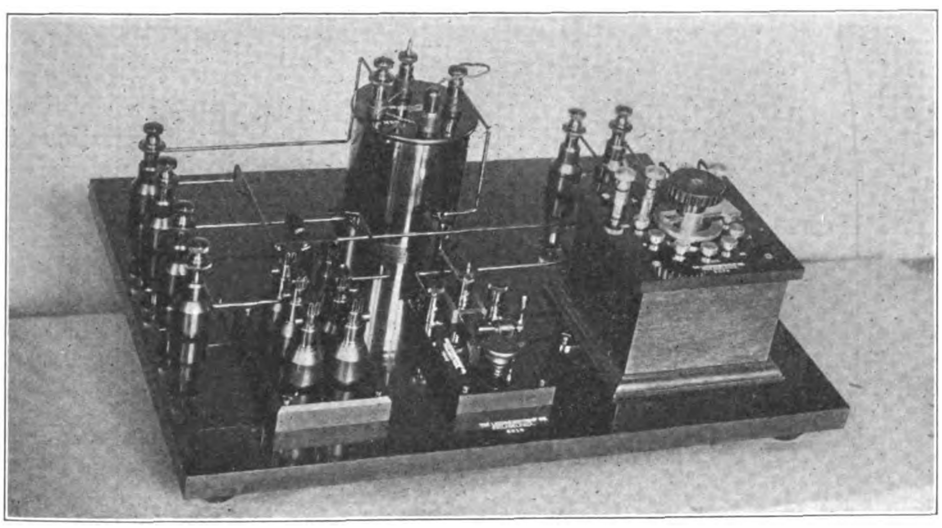
Factory Cable-Testing Apparatus.

The greater the experience of a manufacturer in insulation testing, the more will be the stress which he lays on the complete insulation of all parts of the equipment with which his product is measured. The touch of a damp hand at some critical point, a film of moisture on a hard-rubber surface, or a transient ground on a nearby lighting circuit, may introduce costly errors in the readings of the apparatus by which the quality of his product is gauged.

In maintenance tests, which must necessarily be performed in the field, portability is an absolute necessity in the testing apparatus, and, to a certain degree, the insulation of the various parts of that apparatus from each other and from ground must be sacrificed to secure this primal requisite. In factory measurements, where the testing apparatus is permanently located, it is most distinctly advisable that no precaution be neglected which may guard against the effect of transient grounds, so dangerous because so intangible. It is best to mount the individual instruments of such a set so as to secure for them ample insulation, and then to make their connections entirely visible, and open to frequent inspection. This is best accomplished by running heavy copper wire through the air, making direct connections between the instruments.

The best practice to-day avoids corrugated posts and substitutes the petticoated type. Hard rubber under the action of light deteriorates, owing to the slow conversion of the sulphur in the rubber to sulphuric acid, producing a conducting film over the surface. The petticoated post not only increases the length of the insulating surface, without a corresponding increase in the height of the post, but has the further advantage that in it almost two-thirds of the insulating service is shielded from light, moisture and dirt.

The Leeds & Northrup Company, of Philadelphia, Pa., is making up to order testing outfits comprising high sensibility galvanometer, Ayrton shunt, tenth megohm resistance, standard condenser, and necessary switches and keys. These are mounted, as described and illustrated herewith, on a highly polished base of hard rubber, which is supported on rubber insulators. All connections are polished nickel plate, and contribute to the handsome appearance of the set.

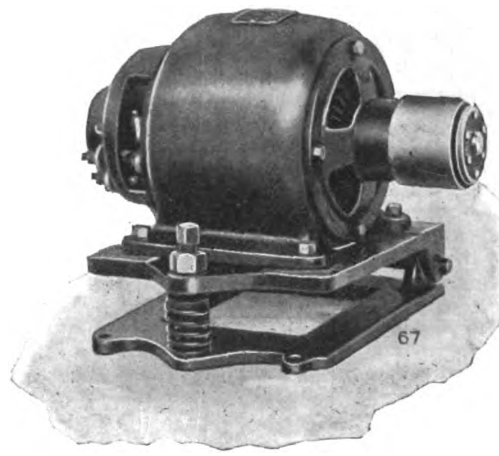


Leeds & Northrup P-83 Testing Set.

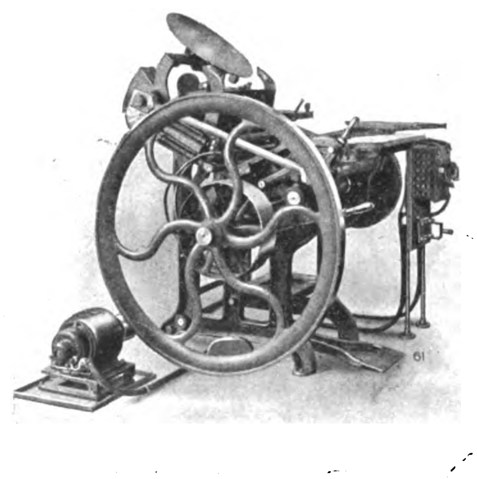
Friction Drive for Printing Presses.

The advantages of electric motor drive for printing presses have become so well known that it is unnecessary to comment upon them. At the present time there is hardly a printing plant of any size that is not driven by individual motors. Many of these, however, still use belts to connect the motors with the various presses.

There are certain classes of light machinery where belts are objectionable, owing to danger to the machine operators and the dirt which is necessarily thrown off. This is particularly the case in printing plants. Here it is very important that there shall be a minimum of dirt in the atmosphere. Compactness of the equipment is also important, as the presses must be capable of arrangement with special reference to light. In driving small printing presses a further objection arises. Presses are seldom run at a higher speed than 200 revolutions per minute, while the small size of motor required is usually built for speeds above 1,000 and even as high as 1,600. This would necessitate using a belt reduction of 5 to 1, or greater; or else a special low speed motor, with higher cost for the same power. When the motor is placed close to the driving wheel of the press, a condition required in printing shops, unless a special motor is used this large reduction means driving a very large pulley from a very small one, which can not be done satisfactorily with belt drive, even with a belt-tightening idler. The idler itself is objectionable, owing to the power which it wastes when made sufficiently tight to be effective.



Motor Equipped with Spring Base for Friction Driving.



Motor with Spring Base Applied to Printing Press.

For these reasons friction drive was adopted several years ago. This works satisfactorily as long as the friction wheel on the motor remains in contact with the driving wheel of the press, but requires considerable attention when the rigid form of motor base is used. Besides, the large flywheel on the standard makes of printing presses seldom runs true, which allows the motor to slip during part of each revolution of the flywheel. To overcome these objections the

Crocker-Wheeler Company, of Ampere, N. J., has devised the spring-base attachment shown in the accompanying illustrations. The motor is mounted on a base supported at one end with a hinge and at the other end by a heavy steel spring. An adjusting screw and locknut are provided so that the spring may be adjusted to any desired tension. The friction wheel of the motor is applied directly to the flywheel of the press. Any eccentricity of the flywheel is taken up by the spring in the motor base, so that the friction wheel makes positive contact throughout the whole revolution of the flywheel.

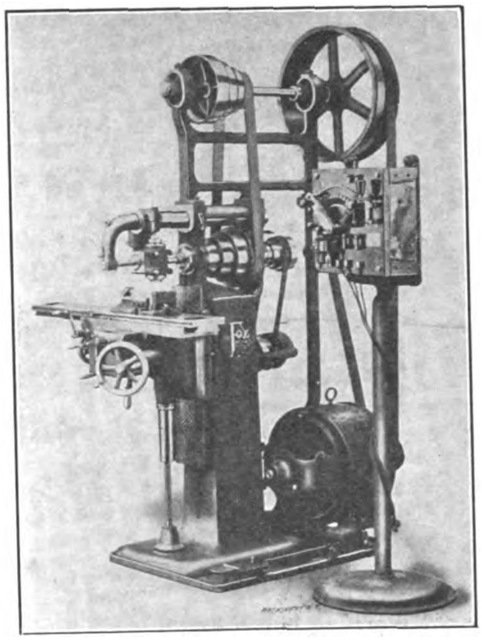
This arrangement permits the use of a high-speed motor, and therefore one of small size and low cost, and makes a very compact equipment. It enables the presses to be placed close together and very close to windows, a very important consideration. The switch and speed regulator are conveniently mounted on a stand or under the feeding shelf near the feeder's right hand, which puts the speed of the press under instant control. The absence of belts adds considerably to the cleanliness of the plant and removes the expense of furnishing new belts occasionally. There is also no belt tightening required, as the spring base, once adjusted, will take up the wear of the friction wheel almost indefinitely.

A large number of motors with spring-base attachments have been recently installed by the Crocker-Wheeler Company in printing plants and the demand for them has become so great that the bases are carried in stock for all of their form L motors from one-quarter-horse-power to two-horse-power. These motors have been on the market a number of years and have become celebrated for their high efficiency and low maintenance cost. They are carefully designed and contain the best of materials and workmanship. They are built in sizes ranging from one-twentieth to five horse-power are of the same rugged construction as the larger machines built by the same company.

Fox Milling Machine.

The simplicity of a machine designed for a wide range of speed is well shown in the accompanying illustration where the Fox light milling machine is shown fitted with a Westinghouse type "S" direct-current motor. The specifications under which this machine was manufactured required the speed of milling spindle to be adjustable over a range of 20 to 1, namely, from twenty-one to 425 revolutions per minute. Although but sixteen speeds were called for in these specifications, and these were obtained by using back gears and speed cones of four steps, it was decided to supply an adjustable speed motor.

This motor has a speed range of 2 to 1, that is, the speed may be varied from 660 to 1,320 revolutions per minute in fourteen steps. This permits of much finer adjustments in the speed of the spindle than would be possible with a constant-speed motor. This means that the cutter may at all times be run at the maximum speed it can stand, whatever the type of work it is performing.



Fox Milling Machine.

The speed of the motor is controlled by means of field regulation, that is, the controller varies the resistance in the field circuit and the motor changes its speed accordingly. This controller is mounted on a pedestal that is independent of the motor, and may be moved somewhat and located at the most convenient point for the workman.

An interesting feature of the outfit is the method of mounting the motor on an extended sub-base which is pivoted at one side. The free end of the motor bracket is supported by the short arm of a foot lever which raises the motor and slackens the tension on the belt and allows the spindle of the machine to come to rest without waiting for the motor to stop. The motor is held in the raised position by a foot catch on the front lever. Depressing the catch allows the motor to settle and tightens the belt.

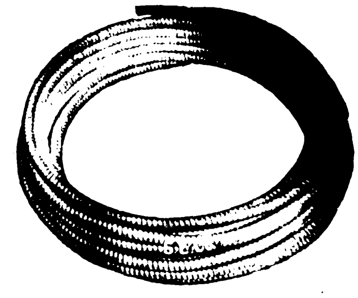
This outfit was supplied by the Fox Company to the United States Government for use at the Navy Yard at Charlestown, Mass. It is supplied with several special attachments which extend its range of work very largely, particularly adapting it for cutting small gears, milling squares, hexagons, etc., including taps and reamers, as well as a large variety of similar work.

This outfit represents the application of a motor to a standard belt-driven milling machine with a special modification of the base for mounting the motor, and shows how compact the complete outfit with a motor may be, even when the method of applying the power has not been altered. The convenience of electric drive is clearly shown, for the speed may be varied within the range of the motor by the movement of the controller handle, which the operator may locate wherever it will be most convenient to reach while at the tool.

A New Type of Conduit.

Beginning with the earliest introduction of a tube for carrying wires for electric wiring, the Sprague Electric Company, New York, has continued its efforts in the perfecting of interior conduit construction.

The latest improvement now introduced by the Sprague company is the single-strip type of conduit shown in the accompanying illustration. This differs from the well-known Greenfield double-strip type in that it is formed with a single strip of galvanized steel, interlocked and gasketed in such a manner as to be extremely serviceable in concrete construction as well as in locations liable to dampness.

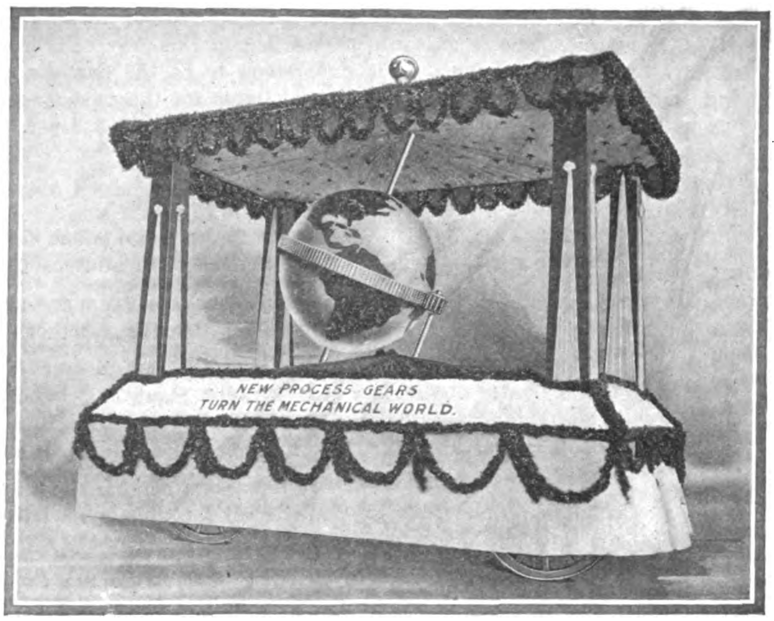


Sprague Single-Strip Conduit.

This new single-strip type of flexible steel conduit is designed particularly for fireproof building construction, but is equally suitable for new non-fireproof work or for the wiring of existing buildings. The company also manufactures a full line of fittings for use with this new type of conduit.

A Prize-Winning Machinery Float.

The accompanying illustration shows a float entered by the New Process Rawhide Company, of Syracuse, N. Y., in the Commercial float parade of the Ka-Noo-No Karnival, which is held annually in Syracuse in connection with the New York State Fair. This float won first prize in the machinery division as "the best appointed and most symbolic." The globe was supported on an upright shaft passing through the centre, and having a bearing at the top and bottom. The globe proper was about five feet in diameter, and was made of one-ply rawhide formed in two hemispheres which were attached to a large gear ring at the centre. Inside the globe there were thirty incandescent lamps, and as New Process rawhide is quite translucent, the night effect was striking. The pinion was of rawhide carried on an upright shaft with a bearing at the bottom. This pinion was rotated by chain drive under the wagon from one of the rear wheels, and imparted motion to the globe when the wagon was moved.



A Prize-Winning Machinery Float.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on November 10 for the following electrical material: Two cabinets and panel-boards, 1,800 feet cable and 4,000 feet rubber-covered wire for delivery at Norfolk, Va.; miscellaneous cable and cable conductors, for delivery at Philadelphia, Pa.; fifty-six grammes of sheet platinum and 585 grammes of platinum wire for delivery at Brooklyn, N. Y.

Electrical Friction Tapes.

In the manufacture of insulating tapes and cloths, the Massachusetts Chemical Company, of Walpole, Mass., has year by year studied the needs of the electrical art, in the development of insulations for all kinds of electrical apparatus under all conditions of operation. Scientific research has steadily kept pace with the exacting requirements of the electrical industries.

The essentials of a first-class modern friction tape, that give it the necessary electrical and mechanical qualifications, are: Lasting quality, chemical neutrality, adhesiveness and moisture-proof quality.

First is the durability of the tape in service—its "lasting quality." It must not only have good initial adhesiveness, but must be free from all risk of drying out under the severe and repeated temperature changes to which it will be subjected, or under atmospheric conditions. When used to insulate joints in line conductors, exposure to alternating extreme heat and cold, and rain and dry weather, winds, acids or alkaline vapors, and varying mechanical strain, must not cause it to unwind, or otherwise affect the continuity and insulation of the protecting envelope that it provides. When used in the insulation of electrical machinery the heating that it gets, buried as it may be in the vitals of the windings where it is subjected for long periods to the maximum temperature attained by the machine in operation, must not deteriorate or "age" it in any way—as by partially carbonizing it—as to lower the insulation which it is depended on to give.

The material of the tape must be perfectly neutral; it must contain nothing that will attack the fabric or the impregnating insulation, or that will undergo chemical decomposition into such corroding substances. This quality is shown in practice by a test of the mechanical strength of the material, made several months after impregnating and coating it with the compound—a tape perfect in this respect showing no loss of strength after such lapse of time. Neither must there be present any substances that can corrode or deteriorate the copper over which the tape is wound.

Adhesiveness is an important feature. The experienced and discerning buyer, in deciding upon a tape that will give genuine and permanent protection to wire joints, and in all uses in the construction of electrical apparatus, looks further than to initial adhesiveness.

Moisture-proof quality is a feature that is specially required in tapes used in connection with the winding of electrical machinery. Owing to the fact that cotton absorbs moisture very readily, tapes to resist moisture must be thoroughly impregnated with the compound, and the latter must be of good quality.

The Massachusetts Chemical Company has recently begun the construction of a new addition to the Walpole factory. This extension, comprising 15,000 square feet of floor space, will be used in connection with the tape department, which has outgrown its present accommodations.

Hudson Tunnels Progress.

William McAdoo, president of the Hudson tunnel system in New York and New Jersey, announced recently that the entire work of construction was nearing completion, and that trains would be running under the river on all lines early next summer.

The tube between Hoboken and Christopher street has been open for several months. The down-town tubes have been completed, save for a small piece of excavation beneath the piers on the New York side, and a small section in the Lackawanna freight yards.

A force of 3,000 men is employed on the work of excavation.

Milwaukee Council Votes for Municipal Light Plant.

The municipal council of Milwaukee, Wis., on October 13, voted to direct the board of public works to build an electric light plant capable of furnishing current for 1,000 arc lamps of 2,000 candle-power each.

Current Electrical News

DOMESTIC AND EXPORT.

NORTHERN CALIFORNIA POWER COMPANY—An issue of $10,000,000 of bonds is contemplated by the Northern California Power Company, Consolidated, to retire the present bonded indebtedness of various subsidiary companies and provide funds for extension. These include the Northern California Power Company, which has a capital stock of $10,000,000. The shareholders meet on November 11 to vote the bonded indebtedness.

NEW POWER COMPANY—The Popo Agie Power, Fuel and Oil Company, capital stock $1,000,000, has filed articles of incorporation and proposes to construct a large power plant near Lander, Wyo., and generate power through the burning of crude oil. This company will be a rival of the Big Horn Power Company, which is building a plant to generate 10,000 electrical horse-power from the flow of the Big Horn River at a point near where the oil-power plant will be located.

CANADIAN PACIFIC RAILWAY ELECTRIC PLANS—Sir Thomas Shaughnessy, president of the Canadian Pacific Railway, says that the company has spent $10,000,000 double-tracking the line between Winnipeg and Thunder Bay in the last year. It will now start on similar work through to the coast, for which $50,000,000 of new stock was voted recently. The company is preparing to operate trains over the mountains for 700 miles by electricity generated by water power.

MEXICAN ELECTRICAL NOTES—The work of installing the underground system of the Telefonos Comerciales of Morelia, Mexico, a corporation made up of local business men, has been completed. The work has been under the direction of the Siemens-Schuckert Werke and cost $40,000. The legislature and the state government of Puebla have conceded a concession to the Cia. Hidro-Electrica de San Agustin, exempting it from all state and municipal taxes for a period of twenty-five years.

WASHINGTON WATER POWER COMPANY LETS CONTRACTS—The Washington Water Power Company, of Spokane, Wash., has awarded a contract to the I. P. Morris Company, of Philadelphia, for the installation of four water-wheels, each weighing 650,000 pounds, and each having a capacity of 9,000 horse-power, with a head of sixty-eight feet. The plant will be located on the Spokane River, fifteen miles west of Spokane, to furnish electric light and power for towns in the vicinity.

MINNESOTA & ONTARIO POWER COMPANY—The Minnesota & Ontario Power Company has been incorporated with a capitalization of $7,000,000. The corporation plans to develop idle water power, establish a paper-manufacturing centre and conduct lumbering operations over a territory of 150,000 square miles. The board of directors is as follows: Edward W. Backus, William E. Brooks, Warren Curtis, John A. Davis, of New York; W. A. S. Peabody, Alexander Smith, of Chicago, and Warren Curtis, Jr., formerly of Corinth, N. Y.

LIGHT COMPANY MORTGAGED—A chattel mortgage for $5,000,000 has been filed at Wapakoneta, Ohio, given by the Indiana Lighting Company, incorporated under the laws of Indiana, to the Central Trust Company, of New York, on all its property in Indiana and Ohio. The mortgage is given to secure a fifty-year four per cent gold bond issue. In addition to all its machinery, pipe lines, gas wells, etc., in various counties, the mortgage covers artificial and natural-gas plants, electric light and power plants in the following cities and towns: Greenville, Ansonia, Lima, Celina, Wapakoneta and St. Mary's, in Ohio, and Ft. Wayne, Lafayette, West Lafayette, Logansport, Peru, Wabash, Frankfort, Lebanon, Bluffton, Montpelier, Geneva and Anderson, in Indiana.

EXTENSIVE SOUTHERN POWER DEVELOPMENT PLANNED —D. G. Zeigler, a consulting engineer and architect, of Atlanta, Ga., has made an inspection of the Suwanee Falls, a few miles above White Springs, Fla., on the Suwanee River, with a view to developing the power at that place. It is said that a large company has purchased the falls and will begin at once the work of development. The falls have a capacity of about 90,000 horse-power in good seasons and a minimum capacity of 30,000 horse-power when the river is high. The concern has a capital of $3,000,000. Blue prints have been made of the territory within seventy-five miles of the falls, extending nearly to Douglas on the north, Thomasville on the west, and taking in Palatka on the south, Jacksonville and Fernandina on the east. It is said that interurban electric lines are to be established between the towns within this circle. One of the lines will go from Valdosta toward Quitman and Boston on the west, to Waycross on the east, thence toward Fernandina and Jacksonville. Another line will go from Valdosta to Jasper and on toward Live Oak, Lake City and other Florida points. Several lines will run out from Jacksonville, Lake City and other large towns in the circle. The territory to be reached in this way embraces over half a million people. It is understood to be the purpose of the company to also furnish power and lights for the various towns. It is said that the power can be developed for about $35 per horse-power per annum.

ELECTRIC LIGHTING.

GUERNSEY, OHIO—Frank C. Smith has applied for a twenty-five-year lighting franchise to light the town of Byesville.

ANDERSON, CAL.—The citizens of Anderson are arranging to have the village electrically lighted by the Northern California Power Company.

CONROE, TEX.—The electric light plant has recently changed hands, F. K. Nance having sold the plant to Lee Ouалline, of Keenan, Tex., who has already taken charge.

CENTRAL CITY, COL.—It is announced that the Hampton Consolidated Mines Company will install a complete electrical plant for the thorough development of the property.

CHATHAM, N. J.—A contract made with the Commonwealth Water and Light Company, of Summit, for a supply of electric current during the daytime has been accepted by the borough council.

CODY, WYO.—The Reclamation Department has decided to install an electric plant at the Corbett dam of the Shoshone reclamation project and to supply electricity at cost to the settlers under the project.

CORONADO, CAL.—The board of trustees has signed a five-year lighting contract with the Coronado Beach Company for fifty sixty-candle-power lamps, the town to pay $87.50 per month for the service.

DELAWARE, OHIO—The Delaware Electric Light and Heating Company has been awarded the contract for lighting the city for the next ten years. The cost of each arc light will be $75 and there are 148 in the city.

BURLINGAME, CAL.—The city council has entered into a contract with the United Gas and Electric Company whereby the company will furnish the municipality with twenty-six arc lights during the coming year for $56.50 each.

BAY CITY, TEX.—A. L. Strong, of New York, has purchased an interest in the electric light and ice plant and will put about $30,000 into the company. The capacity of the ice plant will be increased to forty-five tons daily and a larger generator installed.

WATERLOO, IOWA—The city council at Waverly, where the electric light and water plants were burned recently, has decided to submit to the electors a proposition to issue $30,000 in bonds for the erection of new plants. As the council is limited by law in the expenditure of funds to one and one-fourth per cent of the actual value of the property, a special election must be called to authorize its action.

BURLINGTON, WIS.—The contract for street lighting for five years has been let to the Burlington Electric Light and Power Company. Ten 1,200-candle-power arc lights at $65 each a year and ninety eighty-candle-power incandescents at $27 a year will be used.

ST. LOUIS, MO.—The Glasgow estate is contemplating the construction of a waterworks and electric light plant to supply the 600 acres on the hill to the west of the present city waterworks reservation, and the subdivision of the property for suburban homes.

OSWEGO, N. Y.—Edwin L. Huntington, of Mexico, has sold the electric lighting plant at that place to the Mexico Lighting Company for $15,000. The lighting company has executed a mortgage on its property for $10,000 to Charles A. Peck as trustee.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company will increase its distributing capacity a fourth in the residence and business districts of Minneapolis. This announcement is made by A. W. Leonard, manager. Additional feeders will be put in.

ATLANTA, GA.—On the application of the Knickerbocker Trust Company, of New York, the Gainesville Electric Railway Company has been placed in the hands of a receiver by Judge Newman, of the United States Court here. Samuel C. Dunlap, of Gainesville, was named receiver and his bond was fixed at $10,000.

SPARTANSBURG, S. C.—F. H. Knox, vice-president and general manager of the Electric Manufacturing and Power Company, which concern owns the power plant at Gaston Shoals, on Broad River, states that the company is figuring on building another power plant either on Broad River or at Nesbitt Shoals, on Tyger River.

HUNTINGTON, L. I.—The Huntington Light and Power Company, the stock of which is held principally by Brooklyn and Manhattan men, wno are summer residents here, has decided to more than double the capacity of the plant at Halesite. This is made necessary by the constantly increasing business of the company.

FARRAGUT, IOWA—A company has been formed by Farragut citizens, with J. J. Whisler at the head, to be known as the Farragut Light and Power Company, and this company will take over the franchise secured by J. A. Masters and J. J. Whisler. The contract provides for forty street lights at a minimum price of $300 per year.

WAYCROSS, GA.—J. E. Wadley, president of the Waycross Electric Light and Power Company, has offered the entire electric light plant, with present contracts, to the city of Waycross for $50,000. If no inclination is shown on the part of the city to purchase the plant, Mr. Wadley will have it enlarged considerably and improved throughout.

LA CROSSE, WIS.—Preliminary steps are being taken in order to determine the advisability of establishing a municipal lighting plant in this city. The plant will cost about $40,000 and will be used to serve only the city buildings and the streets. Application will be made to the state railroad commission to ascertain whether permission will be granted to erect the plant.

DAYTON, OHIO—F. M. Tait, general manager of the Dayton Lighting Company, has closed a deal for the purchase of the Middletown Electric Lighting Company's plant. The purchase price, it is understood, is $100,000. Associated in the deal are Albert Emanuel and L. A. Coppock, of this city. The Middletown plant needs repairs and the company expects to spend about $50,000 for this purpose.

BATAVIA, N. Y.—Judge Hazel, of the United States District Court, at Buffalo, has appointed Marc W. Comstock, a Buffalo lawyer, as receiver for the Genesee County Electric Light, Power and Gas Company. The company has been in business but a few months and distributes Niagara power in Batavia, Oakfield, Akron and Clarence, obtaining its power from the Niagara & Lockport company.

NEWBURGH, N. Y.—The Public Service Commission, Second District, has consented to the lease by the Electric Light Company of New Paltz to the Newburgh Light, Heat and Power Company of the right to use, so far as it may be practicable, for a term of ten years, part of its electric pole system in the village of New Paltz, and to string and erect thereon a high-tension transmission line.

AUGUSTA, GA.—Incorporation of the Georgia Power Company, of Gainesville, is announced. The concern has been formed with a capital stock of $500,000 to develop water-power properties and build electric plants for distribution of power among manufacturing plants and also to promote cotton-mill building in this territory. Jack J. Spaulding, H. G. Pryor and James A. Rudolph are the incorporators.

GRIDLEY, TENN.—The village board of trustees has entered into contract with two citizens, Messrs. Miller and Kirk, for arc lights to illuminate the business section of the town. There are to be sixteen arcs in all. Miller and Kirk agree to supply the sixteen arcs for $83.33 per month. Work on the plant is to be started at once, and it is hoped to have the system in operation by February 1.

BRISTOL, TENN.—Judge S. K. J. Kirkpatrick, J. Frank Toney, W. S. Erwin and W. T. Tucker and others have made application for a charter for the Southern Electric and Power Company, which proposes to do business at Erwin, Unicoi County, using the water power of the Chuckey River. The purpose of the company is to light the town of Erwin by electricity and to eventually furnish power for power purposes.

LUCEDALE, MISS.—At a recent meeting the Lucedale Light and Power Company was organized with the following officers and directors: Dr. W. D. Ratliff, president; C. N. Buffum, vice-president; P. J. Goodman, secretary and treasurer; Dr. W. D. Ratliff, C. N. Buffum, T. A. Banks, G. M. Luce, F. M. Young, Dr. J. A. Dorsett and T. R. James, directors. Work on the installation of an electric light plant has been started.

STOYESTOWN, PA.—Stoyestown and Sprucetown will be lighted this winter by electricity, according to the men at the head of a new light company recently formed and granted a franchise. A plant will be located between the two towns and work on its construction will be started soon. The poles are being planted along the principal streets of the town. The officers of the company are as follows: President, Daniel Long; secretary, Valentine Muller; treasurer, Earl Fulton.

DANVILLE, IND.—The Danville Light, Heat and Power Company has purchased ground along the Big Four Railroad, on the south edge of Danville, and will at once begin the erection of a new and much larger power plant. The building will be of steel, brick and cement and will be 50 by 114 feet. The new plant will furnish a twenty-four-hour service, and in addition to lighting Danville, will also furnish the current for Plainfield and Brownsburg and to farmers along the line.

PINE BLUFF, ARK.—A deed has been filed transferring all of the property of the old Pine Bluff Light and Water Company to the Pine Bluff Corporation. The property was recently publicly sold to satisfy judgment in Federal Court. The purchase price was $450,000. Mortgages signed by the Pine Bluff Corporation to the New York Trust Company for $750,000 were also placed on record. The proceeds of this transaction will be used in rebuilding the gas, water and electric plants to be operated by the company.

SCRANTON, PA.—George N. Tidd, general manager of the Lackawanna Valley Electric Light and Power Supply Company, of this city, which was recently taken over by the American Gas and Electric Company, makes the announcement that the latter concern has made an appropriation of $200,000 to be expended on the local plant. It is proposed to change the service from 1,200 to 2,300 volts. The transformers will be renewed and the plant given a thorough overhauling. A transmission line from Scranton to Carbondale will be erected.

DENVER, COL.—Electrical power for mines and mills in Clear Creek County will be furnished by the Continental Mines, Power and Reduction Company, which has just completed a hydroelectric water and power transmission plant at Yankee. Water power is secured by impounding the waters of River Fall River, Cumberland and Silver creeks. The three streams are united and carried by means of an 8,000-foot flume to a fore-bay and penstock. From the penstock to the power-house there is a fall of 550 feet. George H. Sethman is consulting engineer of the power company.

ELECTRIC RAILWAYS.

BERKELEY, CAL.—The town board has granted the Key Route Company a forty-eight-year electric railway franchise.

BALTIMORE, MD.—R. W. Beall, of the real estate firm of Moore & Hill, is behind a project for the building of another electric line between Baltimore and Washington, D. C.

IOWA CITY, IOWA—Iowa City voters will pass upon the granting of a franchise for the construction and operation of a street-car system in Iowa City at the general election November 3.

SHERMAN, TEX.—Citizens of Sulphur, Okla., have begun active work to build a road from there to Sherman. The line will connect with the electric interurbans running to Oklahoma City, Dallas and Fort Worth.

OMAHA, NEB.—At a meeting of the Independent Transportation Company, of this city, it was decided to abandon the proposition to establish an automobile bus line, and instead to plan for a track railway with gasolene motors or electric cars.

CLEVELAND, OHIO—The Municipal Traction Company has awarded a contract to the Cincinnati Car Company for the changing of fifty old-style cars to pay-as-you-enter cars. Side seats will be replaced by cross seats, with centre aisles.

WACO, TEX.—It is announced that a bonus of $100,000, right of way and franchises in Waco, Temple and Marlin, will be given the parties who will build the interurban connecting these towns. The offer was decided on at a joint conference here.

SYRACUSE, N. Y.—Work has been started on the final survey of the extension of the Rochester, Syracuse & Eastern electric road from Port Byron to this city, and it is expected that building operations on the road will be commenced the first of the year.

TRENTON, N. J.—Chancellor Pitney has continued the receivership of the Camden & Trenton Railway Company, with Wilbur F. Sadler as receiver, until December 29, that the bondholders' committee may confer further, looking toward a reorganization of the company.

BUFFALO, N. Y.—The Pinckerton Construction Company, of Philadelphia, has been awarded a contract for completing an important link of the trolley system of the Buffalo Southern Railway, from the Seneca street city line. The contract covers a six-mile stretch from the city line.

SNOHOMISH, WASH.—Application has been made to the city council for a street-car franchise for the operating of an electric system of railways in the city. The application was made by J. M. Shawhan, formerly chief clerk of the Oregon Railway and Navigation Company, and J. D. Brown.

EDGEFIELD, S. C.—The incorporators of the Augusta & Edgefield Electric Railway have awarded the contract to survey the line to Jones, Requarth & Kelsey, of Charleston. The survey will cover two routes, one from Augusta to Newberry, *via* Edgefield and Saluda; the other from Augusta to this place and to Greenwood.

SPRINGFIELD, ILL.—Officials of the Illinois Traction System announce that the right-of-way for the proposed Saline county line connecting Carrier's Mills with Eldorado and incidentally a step in the direction of the proposed Cairo-East St. Louis line has been secured and that operations on that road will be inaugurated at once. A franchise to operate cars through Eldorado has been granted.

SPIRIT LAKE, IOWA—At a meeting of Spirit Lake aldermen and citizens, presided over by A. B. Funk, it was voted that the Sioux City-Spirit Lake interurban line be granted a franchise on the streets of that city, together with an electric light franchise and the use of a ten-acre tract of land for the location of a power-house and terminals.

HARRISBURG, PA.—Governor Stuart approved an application for the extension of the route of the Cumberland Railway Company, which was granted a charter recently, to operate in Middlesex Township, Cumberland County. The extension covers thirteen miles of Carlisle streets and the various townships in that vicinity. W. E. Glatfelter, of Balfour, is the president.

JEANNETTE, PA.—The contract for grading and building the Jeannette, West Newton & Monongahela Valley Street Railway has been awarded to the A. W. Sperry Company, of Connecticut. Engineers are at work setting the grade stakes and the contractor will follow with a large force of men grading and building the road. The intention at present is to build the road from Jeannette to West Newton and later to the Monongahela Valley.

WASHINGTON, D. C.—The Washington, Alexandria & Falls Church Electric Railway has placed on record a mortgage on all of its property to secure an issue of $1,000,000 in bonds. The Girard Trust Company, of Philadelphia, is trustee under the mortgage, the object of which is to pay off two previous mortgages aggregating $350,000 and to devote the remainder to repairs and purchase of new equipment. The company was recently relieved of receivership.

SAN RAFAEL, CAL.—At a meeting of the board of supervisors Charles Murphy, a San Francisco capitalist, made application for an electric railroad franchise to include practically all the towns of Southern Marin. He plans to run one trolley line from Sausalito to Mill Valley, another from Mill Valley junction across the marshes to Belvedere and Tiburon and a third from Alto station to Corte Madera, Larkspur, Kentfield, Ross, San Anselmo and San Rafael.

PITTSBURG, PA.—A new traction system is proposed here to connect with the Pittsburg Railways Company and traverse portions of the suburbs. The Carnegie & Castle Shannon Railway Company, Banksville & West End Traction Company and the Liberty & West Liberty Traction Company are being formed to develop sections south of the Ohio and Monongahela rivers. They have applied for permission to construct lines on the new country roads to the several towns indicated in the names of the companies.

DOYLESTOWN, PA.—It is said that the Philadelphia Rapid Transit Company has acquired control of the Philadelphia & Easton Electric Company, which runs a trolley line, thirty-six miles long, from here to Easton, which cost more than a million dollars to build. This will give a continuous line from Philadelphia to Easton under one management. It is also reported that the company operating the trolley line from here to Bristol will furnish a certain amount of money to build the Doylestown-Perkasie trolley, provided a certain sum is subscribed by those interested along the line.

TAYLORVILLE, ILL.—A contract has been let by the Taylorville Light and Heat Company for the construction of the street railway track and overhead equipment to the Chicago Installation Company for $61,800. The track is to be four miles and 100 feet long and will extend from the extreme northeast end to the extreme southeast part of Taylorville. The company also purchased forty acres of land from L. D. Hewitt at the southwest terminus of the track for the purpose of laying out a city park. The power-house is now under course of construction. The company is capitalized at $150,000.

MOLINE, ILL.—Engineer W. H. Kimball has made his report to the stockholders of the proposed Davenport and Manchester interurban road of the result of the preliminary survey. The report shows that the Manchester line will be 94.9 miles, exclusive of sidetracks and one or two branches that were merely investigated. The cost will be $1,242,610, exclusive of railroad crossings, sidetracks and depots. The cost of fencing in the right of way will be $30,800 additional. George T. Baker, who has been president, has resigned and the road is at present under the direction of J. A. Voorhees, vice-president. F. W. Rank, of this city, is secretary.

COOPERSTOWN, N. Y.—The Oneonta & Mohawk Valley Railroad, an electric line connecting Herkimer and Oneonta, has been sold by auction to Joseph A. Starrett, New York. The sale was made under mortgage foreclosure brought by the Knickerbocker Trust Company, of New York. Mr. Starrett was the only person present who qualified to bid, and his first offer of $200,000, the minimum figure set by the order of the court, was accepted by the referee. The sale was made subject to receivers' certificates and other obligations amounting to over $300,000. It is reported on good authority that the purchase was made for Herbert T. Jennings, who as promoter constructed the road.

PERSONAL MENTION.

MR. CLEMENT C. SMITH, of Milwaukee, Wis., has been elected president of the Wisconsin Electric Company to succeed O. C. Fuller.

MR. BERTRAM M. DOWNS has been elected vice-president of the Brookfield Glass Company, with headquarters in the United States Express Building, New York city.

MR. F. V. L. SMITH, who has been in charge of the Sprague Electric Company's office in New Orleans, La., since its establishment, has opened a branch office for the company in Atlanta, Ga. Mr. Smith will be in charge of both offices.

MR. J. M. BAKER, for several years district manager for the New England Telephone and Telegraph Company at Lynn, Mass., has been promoted to the office of district plant chief, with headquarters at Salem. Fred A. Phillips has been placed in charge of the Lynn office.

MR. MATTHEW A. SAMMETT has severed his connection with the Montreal Light, Heat and Power Company as engineer in charge of tests and design, and will hereafter devote his entire time to consulting engineering work, with headquarters in the Canadian Express Building, Montreal, Canada. Mr. Sammett has had a wide experience in the electrical field, having been connected for a long time with the General Electric Company and a number of other companies.

LORD NORTHCLIFFE (Alfred Harmsworth), the celebrated English publisher, and Lady Northcliffe spent some time last week inspecting the power developments at Niagara Falls. On the morning of October 21 Lord and Lady Northcliffe visited the plant of the Ontario Power Company, on the Canadian side. After inspecting the plant Lord Northcliffe declared that the transmission of electric power to such great distances was a wonderful thing, and expressed his belief that in time that section of the country would be one of the greatest manufacturing centres of the world. Lord Northcliffe had not visited Niagara Falls in fifteen years and was greatly impressed with the growth of the city since his earlier observation.

OBITUARY NOTE.

COLONEL W. W. RIDER, of Allentown, Pa., during the past two years traffic manager of the Consolidated Telephone Companies of Pennsylvania, died on October 24 from typhoid fever at St. Luke's Hospital, South Bethlehem, Pa., aged fifty-eight years. He was connected with the telephone business many years.

NEW INCORPORATIONS.

YONKERS, N. Y.—Westchester County Automatic Telephone Company. $100,000.

HARRISBURG, PA.—Macungie Electric Light, Heat and Power Company, of Macungie. $5,000.

DENVER, COL.—Telluride Power Company. Capital increased from $2,500,000 to $10,000,000.

BOSTON, MASS.—Rock Hill Telephone Company, Boston. To carry on a telephone and telegraph business. $50,000. President, S. R. Smith; treasurer, P. Workman, Rock Hill, S. C.

ALBANY, N. Y.—Summit Telephone Company, of Schoharie County. $2,500. Directors: George Skidmore, Eli Baker, Alvin Joslin, C. F. Wharton, Frank Cox, of Summit, and Myron Grey, of Fulton.

LITTLE ROCK, ARK.—Eldorado Telephone Company. $50,000, all of which is subscribed. Incorporators: P. C. Blain, president; W. P. Ritchie, B. Arrett, T. F. Gaughan, B. C. Powell and H. S. Powell.

RICHMOND, VA.—Craig Water Power Company, Roanoke. To generate power for use in Roanoke. $5,000 to $200,000. A. L. Sibert, president; L. A. Scholz, vice-president; Henry Scholz, secretary and treasurer, all of Roanoke, Va.

ALBANY, N. Y.—Dwaas Electric Company. $20,000. Directors: Edward E. Sabourin, Sandy Hill; George Gifford, Schenectady; Harold J. Werner, Mechanicsville; Adam Rathgeber, New York city; Andrew T. G. Wemple, Schenectady, and Alfred Stoodley, Schenectady.

ELECTRICAL SECURITIES.

The market last week, while not displaying any very pronounced upward tendency, gave unmistakable evidence of the soundness of underlying conditions. The presidential election is still an important factor in the situation, but from the present indications it would appear that a considerable betterment in business generally is to be hoped for. The iron and steel trade shows some improvement, although, as elsewhere, a hesitating pre-election tone tends to curtail betterment.

Dividends have been declared upon the following electrical securities: Electrical Securities Company; semi-annual dividend of 2½ per cent, payable November 2. Montreal Street Railway Company; quarterly dividend of 2½ per cent, payable November 2. Butte Electric and Power Company; quarterly dividend of 1¼ per cent, payable November 2. American District Telegraph Company of New York; regular quarterly dividend of 1 per cent, payable November 15 to stock of record November 1. Ohio Traction Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable November 2. Montreal Light, Heat and Power Company; regular quarterly dividend of 1½ per cent, payable November 16.

ELECTRICAL SECURITIES FOR THE WEEK ENDED OCTOBER 24.

New York:	*Closing.*
Allis-Chalmers common	11¼
Allis-Chalmers preferred	35½
Brooklyn Rapid Transit	49¼
Consolidated Gas	144
General Electric	140
Interborough-Metropolitan common	10
Interborough-Metropolitan preferred	29⅛
Kings County Electric	125
Mackay Companies (Postal Telegraph and Cables) common	79½
Mackay Companies (Postal Telegraph and Cables) preferred	69
Manhattan Elevated	136
Metropolitan Street Railway	24
New York & New Jersey Telephone	114
Western Union	60¼
Westinghouse Manufacturing Company	81

At a meeting of the board of directors of the Western Union Telegraph Company all of the present officers and members of the executive committee were re-elected.

Boston:	*Closing.*
American Telephone and Telegraph	127
Edison Electric Illuminating	230
Massachusetts Electric	50
New England Telephone	120
Western Telephone and Telegraph preferred	70

Philadelphia:	*Closing.*
Electric Company of America	9¾
Electric Storage Battery common	36
Electric Storage Battery preferred	36
Philadelphia Electric	11
Philadelphia Rapid Transit	22⅝
United Gas Improvement	87¼

Chicago:	*Closing.*
Chicago Telephone	124
Commonwealth Edison	108¼
Metropolitan Elevated preferred	—
National Carbon common	68
National Carbon preferred	110

DATES AHEAD.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

Association of Car-Lighting Engineers. First annual meeting, Chicago, Ill., November 18.

National Society for the Promotion of Industrial Education. Annual meeting, Atlanta, Ga., November 19-21.

International Independent Telephone Association. Annual convention, Chicago, Ill., December 1-3.

American Society of Mechanical Engineers. Annual meeting, New York city, December 1-4.

American Roentgen Ray Society. Annual meeting, New York city, December 28-30.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

American Association for the Advancement of Science. Annual meeting, Baltimore, Md., January, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

TELEPHONE AND TELEGRAPH.

HAMILTON, ONTARIO—The city council has granted a new franchise to the Bell Telephone Company.

WICHITA, KAN.—A new $12,000 multiple switchboard is being installed in the offices of the Independent Telephone Company.

MINNEAPOLIS, MINN.—The Rolling Stone Telephone Company will conduct a rural telephone system in the vicinity of Rolling Stone with a capital stock of $10,000.

INDIANAPOLIS, IND.—An underground telephone system is to be placed at Fort Benjamin Harrison which will cost between $12,000 and $15,000. Work has been commenced.

CHARLESTON, W. VA.—The Charleston Home Telephone Company will install during the next year 50,000 feet of new cable, which will accommodate 1,000 additional subscribers.

GAFFNEY, S. C.—A corps of telephone men is at work building a telephone line from Gaffney to Pacolet, a distance of about eighteen miles. About twenty telephones will be installed along the route.

DUBUQUE, IOWA—At a meeting of the directors of the Interstate Telephone Company and the local Bell company, held in Dyersville, a contract for toll connections between the two companies was signed.

SAN BERNARDINO, CAL.—The city councilmen have notified the Home Telephone Company that work on the underground system must be commenced within sixty days and completed within six months from date.

LEESVILLE, TEX.—Business men of Leesville and farmers on the route are building a rural route telephone from this place to Union, Wilson County, connecting with the one running through that county; also from there to Nixon and Dewville.

LA CROSSE, WIS.—The Wisconsin (Bell) Telephone Company has absorbed the Western Wisconsin Telephone Company, which has 1,500 subscribers and exchanges in Galesville, Arcadia, Trempealeau, Fountain City, Blair, Ettrick, Whitehall and Independence.

ELDORA, IOWA—The contract for the erection of a building for the Eldora telephone exchange has been let to F. X. White, of Eldora, whose bid was $4,760. The erection of the building is to be begun immediately, and it is to be ready for occupancy by January 1.

SIOUX FALLS, S. D.—Under an order from Judge Carland, of the United States Court, the property of the Citizens' Telephone Company, of Sioux Falls, has been sold to the New State Telephone Company, of Iowa. The purchasers say the local system will be maintained as an independent company. The New State company bid in the property at $94,700. The bidding started at $50,000.

MAHANOY CITY, PA.—In order to improve its telephone system throughout the lower western sections of Schuylkill County, the officials of the American Union Telephone Company are building new lines. During the ensuing two months there will be about seventy-five miles of additional wire strung. The first extension consists of a line from the central station at Pottsville to a point in Mount Carbon.

SHELBURNE FALLS, MASS.—At the annual meeting of the stockholders of the Heath Telephone Company it was voted to authorize the directors to execute a lease of the lines and property of the Deerfield Valley company, a sublicensee of the New England company, and arrange with the latter for long-distance connections, provided satisfactory terms can be made. The following directors were elected: W. E. Kinsman, F. L. Totman, A. J. Patterson, F. H. Smith, W. A. Barber, C. S. Goodwin and H. Newell.

TROY, N. Y.—At a meeting of the stockholders of the Buskirks & South Cambridge Telephone Company Amos Broughton was elected chairman and George Cornell secretary. The report of the treasurer showed a balance on hand of $235. The following directors were elected for the ensuing year: Edward Whiteside, Edgar B. Chase, G. Grant Rich, Charles King, Fred M. Dewey, Ira S. Durfee, Edwin T. Cornell, S. S. Sisson and Harmon Beadle. At a meeting of the directors Edward Whiteside was chosen president, Edgar B. Chase vice-president, Ira S. Durfee secretary and Fred M. Dewey treasurer.

INDUSTRIAL ITEMS.

THE LOMBARD GOVERNOR COMPANY, Ashland, Mass., in bulletin No. 110, gives brief descriptions of those types of Lombard governors which are most frequently used. In addition to the descriptive matter there is incorporated a series of letters concerning the satisfaction many prominent power-users have had in adopting these governors.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, is distributing some attractive literature devoted to Jeffrey "Century" rubber-belt conveyers, conveying machinery for sawmills, lumber mills and wood-working plants, coal tipples and shaking screens (bulletin No. 22), and coal-washing plants and equipment (bulletin No. 27).

THE SPRAGUE ELECTRIC COMPANY, New York city, is distributing circulars Nos. 432 and 433, the former describing a new line of fittings for use with its flexible steel conduit, and the latter describing the new single-strip type of flexible steel conduit, designed especially for fireproof buildings. Copies of these circulars will be sent upon request.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., in circular No. 3702, describes its new Type CR feeder regulator and the benefits to be derived from the use of such apparatus in connection with alternating-current lighting systems. This regulator is designed for operation on single-phase, 220-volt, sixty-cycle circuit, and may be used with either hand or sprocket control.

THE PHILIPS METALLIC GLOW LAMP WORKS, LIMITED, Eindhoven, Holland, has published a very interesting bulletin describing the Philips metallic glow lamp. The filaments in these lamps are composed of fine pure metal, and the lamp is stated to have a life of 1,000 hours. The lamps are made suitable for burning in any position, and a special form of packing insures against breakage.

MURALT & COMPANY, New York city, have secured the contract for the enlargement and improvement of the hydroelectric plant of the Riverhead Electric Company, of Riverhead. Long Island. The old water-wheels now in use will be taken out and new Trump turbines of the vertical-shaft type will be installed. The electrical equipment will be of the three-phase, alternating-current type, with a frequency of sixty cycles, operating at 11,000 volts. There is also an auxiliary steam plant for emergency purposes.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has issued a folder describing and illustrating its new push-button intercommunicating telephone system. Five views showing wall and desk-set styles, both open and closed, are given. The accessibility and rigidity of these sets are clearly shown in the illustrations of the open views. Both wall and desk sets are finished in either oak or mahogany, and are made up very attractively. Copies of this folder will be sent to any one interested upon request.

THE WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., announces that its catalogue A3 and catalogue A4, covering Ward Leonard navy-type motor-starting panels, fulfilling specifications of the Bureaus of Construction and Repair, Equipment and Steam Engineering, Nos. 2 M1. 1906, should not be used in quoting upon the latest specifications dated 1907 and 1908 of the Navy. Enclosing cases for panels are specified in these latest specifications, and several minor changes. Until the company's new bulletin is issued, customers should write for special quotations.

THE CINCINNATI MILLING MACHINE COMPANY, Cincinnati, Ohio, is distributing a catalogue devoted to high-power millers. This catalogue illustrates an entirely new line of horizontal and vertical milling machines. The machines are built on the unit system, each group of mechanisms being assembled as a complete unit. All the units are interchangeable between the horizontal and vertical machines. This makes it possible to supply these machines not only with constant-speed drive, but with right-angle drive, constant-speed motor drive and variable-speed motor drive. A change from one style of drive to another is easily made.

THE STANDARD GAUGE MANUFACTURING COMPANY, which has been actively engaged in the manufacture of indicating and recording gauges at Syracuse, N. Y., will move its plant and main office to its new factory at Foxboro, Mass., on or about November 1. Through this change the manufacturing capacity will be greatly increased, since the two main buildings alone have available floor space of one hundred thousand square feet, besides separate buildings for the foundry, blacksmith shop, carpenter shop and power plant. The growth of the Standard Gauge Manufacturing Company has been steady since its inception in 1899, so that this epoch in its development will not surprise its many patrons. The sales offices addresses will be as heretofore: New York, 1770 Hudson Terminal, Fulton Building, and Chicago, 725 Monadnock Building.

Record of Electrical Patents.

Week of October 20.

901,322. ELECTRICAL ACCUMULATOR. Charles Busch, New York, N. Y. Filed July 15, 1908. The active surface is held by burs on adjacent perforated electrodes, and an elastic binder holds the electrodes together.

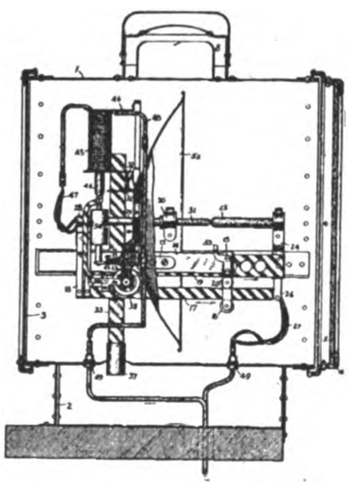
901,331. ELECTRIC RAILWAY SIGNAL. Edward A. Everett, Detroit, Mich. Filed June 27, 1906. The circuit is closed by means of a liquid conductor, and means are provided to open the contact should the fluid conductor fail.

901,332. INSULATING MATERIAL. Willis E. Everette, Tacoma, Wash. Filed May 17, 1906. The material is formed of insoluble fireproof threads composed of calcium, aluminum, silicon and oxygen.

901,336. AUTOMATIC ELECTRIC LIGHTING SYSTEM. Carl J. Gardeen, Columbus township, Anoka County, Minn. Filed December 5, 1907. The system includes a storage battery, a battery for an ignition system, a generator which may act as a motor by reversing the polarity of the armature, and circuit-closing and regulating switches.

901,341. ALTERNATING ELECTRIC-CURRENT MACHINERY. Alexander Heyland, Brussels, Belgium. Filed May 2, 1903. A commutator is provided for simultaneously commutating and decomposing a portion of the current.

901,368. APPARATUS FOR MAGNETIC SEPARATION. Clarence Q. Payne, Stamford, Ct., assignor to the International Separator Company. Filed October 3, 1903. The rotating cylinder is composed of alternately disposed magnetizable laminæ, and revolves in a magnetic field.



901,432.—Arc Lamp Headlight.

901,372. TELEGRAPHY. Louis M. Potts, Baltimore, Md., assignor to the Rowland Telegraphic Company, Baltimore, Md. Filed March 9, 1907. The constants in one circuit are balanced until the constants in a plurality of circuits are brought into equilibrium.

901,377—901,378—901,379—901,380—901,381—901,382—901,383. ELECTRIC RAILWAY SYSTEM. William Robinson, Brooklyn, N. Y. A series of patents embracing broad claims for an electric railway system, employing both direct and alternating currents, signal and relay systems, and means for insulating against the propulsion current sections of the track other than that occupied by the train in motion.

901,393. DEVICE FOR TESTING CANS. Charles W. Sleeper, Lancaster, N. H. Filed April 25, 1908. An incandescent lamp is placed in the bottom of the receptacle.

901,397. APPARATUS FOR RECORDING AND REPRODUCING BY THE TELEGRAPHONE PRINCIPLE. Harve R. Stuart, Wheeling, W. Va. Filed March 2, 1908. The telephone diaphragm imparts movement to a vibratory shaft which energizes reciprocal electromagnets.

901,422. CONNECTOR FOR ELECTRICAL CONDUCTORS. Frank B. Cook, Chicago, Ill. Filed April 2, 1908. The external surface of a tapered one-piece sleeve is threaded to engage with nuts gripping the strands over a wedge piece.

901,423. SWITCH FOR CHARGING AND DISCHARGING STORAGE BATTERIES. James H. Cormick, Belleville, N. J., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed February 29, 1908. Means are provided upon one panel for effecting different connections.

901,424. ELECTRICALLY CONTROLLED SWITCH. Archibald S. Cubitt, Schenectady, N. Y., assignor to General Electric Company. Filed April 22, 1908. Means are provided for varying the permeability of the current-carrying coil.

901,427. VAPOR ELECTRIC APPARATUS. Leonard E. Dempster, Schenectady, N. Y., assignor to General Electric Company. Filed October 31, 1904. The conductor is embedded in a radiating sleeve consisting of a vitreous material.

901,432. ARC LAMP HEADLIGHT. Richard Fleming, Lynn, Mass., assignor to General Electric Company. Filed June 16, 1905. The electrodes and arc-lamp carriage are supported on horizontally disposed rack rods.

901,440. DYNAMOELECTRIC MACHINE. Arthur L. Hadley, Fort Wayne, Ind., assignor to General Electric Company. Filed May 14, 1906. The field pole has a central section of laminæ interposed between two side sections.

901,441. SELECTIVE SIGNALING SYSTEM. Orlando W. Hart, Fall River, Mass. Filed August 10, 1907. A transmitting device is provided with means to cause a signal to become set.

901,445. PRIMARY BATTERY. Karl Heintz, Munich, Germany, Filed December 26, 1907. A galvanic cell of the Bunsen type with a sulphuric-acid solution and a nitric-acid solution separated by means of a carbon diaphragm.

901,448. FUSE HOLDER. Bryson D. Horton, Detroit, Mich., assignor to Horton-Massnick Company, Detroit, Mich. Filed August 29, 1904. A spring making indication on the exterior of the fuse is attached to the fusible material.

901,477. ELECTRIC RAILWAY SYSTEM. William Robinson, Brooklyn, N. Y. Original application filed July 20, 1904. The working conductor is formed in independent sections, and the power-current feeder is normally disconnected therefrom.

901,479. ELECTRIC PROTECTIVE APPARATUS. Charles A. Rolfe, Adrian, Mich., assignor, by mesne assignments, to Rolfe Electric Company, Rochester, N. Y. Filed April 20, 1903. A non-conducting softenable material is placed in combination with circuit-controlling, spring-actuated devices.

901,497. CARBON ELECTRODE. Joseph T. Szek, London, England. Filed September 23, 1907. The electrode is provided with longitudinal grooves throughout its length and a transverse groove at its base.

901,498. CONDENSER. Elihu Thomson, Swampscott, Mass., assignor to General Electric Company. Filed May 5, 1904. The dielectric sections are graded.

901,499. COMBINED MOTOR AND COMPRESSOR. Charles P. Tolman, New York, N. Y., assignor, by mesne assignments, to the Roteng Manufacturing Company. Filed November 16, 1905. The motor and compressor are mounted on a mechanically continuous shaft.

901,506. VAPOR ELECTRIC APPARATUS. Willis R. Whitney, Schenectady, N. Y., assignor to General Electric Company. Filed October 31, 1904. A metal tube forming one electrode is sealed about the other electrode.

901,509. SWITCH FOR CHARGING AND DISCHARGING STORAGE BATTERIES. Asbury G. Wilson, Wilkinsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed February 28, 1908. Two pairs of discharging knives in combination with two pairs of clip contacts pivotally supported.

901,512. RHEOSTAT. Paul H. Zimmer, Schenectady, N. Y., assignor to General Electric Company. Filed May 20, 1907. The controlling arm is spring-pressed toward its initial position, and a circuit-controlling element is independently spring-pressed and arranged to hold the spring pressure from the said arm.

901,513. INDUCTION-MOTOR CONTROL. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. Filed July 12, 1906. Means are provided for connecting the primary windings of two polyphase induction motors in parallel with one phase connected to the source, and means for connecting either motor mechanically to the load.

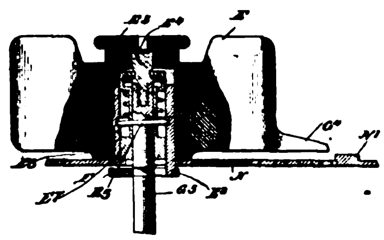
901,514. SYSTEM OF MOTOR CONTROL. Hans Alexander, Berlin, Germany, assignor to General Electric Company. Filed May 20, 1907. Means are provided for controlling the field strength of the generator to vary the voltage supplied to the motor.

901,529. ARC LAMP. Richard Fleming and Cromwell A. B. Halvorson, Jr., Lynn, Mass., assignors to General Electric Company. Filed May 16, 1904. The electrodes are given a somewhat violent engagement at intervals in the operation of the lamp.

901,540. COMBINED ELECTRIC ALARM AND LIGHT. William A. Lindsey, Narberth, Pa. Filed July 18, 1907. A relay-controlled lamp system is interpolated in the alarm circuit.

901,570. TELEPHONIC TRANSMITTER. Frederick G. Warrell, Lansdowne, Pa., assignor to the Euelectric Company. Filed October 3, 1907. The loose material occupies all the space between the vibrating diaphragms.

901,593. OUTLET BOX. Harry A. Coffin, Malden, Mass. Filed January 12, 1907. Means are provided for limiting the vertical movement of the bushing and covering plate.



901,630.—Operating Means for Circuit-Controlling Devices.

901,613. ELECTROMECHANICAL REGULATOR FOR ELECTRIC TENSION. Joseph M. C. Herrgott, Valdole, France. Filed April 27, 1906. The solenoid-operated plunger is assisted by the action of pneumatically or fluid-controlled valves.

901,614. CIRCUIT-BREAKER. Edward M. Hewlett and Theodore E. Button, Schenectady, N. Y., assignors to General Electric Company. Filed October 22, 1904. The circuit-breaker is provided with a scale and means for indicating the adjustment of the armature on the scale.

901,627. INSULATOR. Royal T. Langlan, Boston, Mass. Filed December 10, 1907. The two separable sections have abutting faces, one section constituting a spacer and the other being formed to enclose the lower end of a bolt.

901,630. OPERATING MEANS FOR CIRCUIT-CONTROLLING DEVICES. Julius K. Lux, Washington, D. C. Filed July 31, 1906. Means are provided to allow the indicator to rotate independently of the switch when power in excess of a predetermined amount is applied thereto.

901,649. SPACE TELEGRAPHY. Oscar C. Roos, Newton, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed June 10, 1907. An elevated conductor has a parallel branch circuit connected in series therewith, containing capacity and inductance in each of its branches.

901,668. SAFETY APPARATUS FOR RAILWAYS. Samuel L. Adelson, New York, N. Y., assignor of one-half to Maurice Adelson, New York, N. Y. Filed March 18, 1908. The track apparatus is arranged in blocks, and the alarm is carried in the car.

901,669. MULTIPARTY-LINE TELEPHONE-EXCHANGE SYSTEM. Garrison Babcock, Rochester, N. Y., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Filed August 4, 1904. A normally open passing contact switch at the substation is adapted to momentarily close the circuit upon depression of an associated receiver hook.

901,672. MULTIPLE-SWITCHBOARD JACK. Jules A. Birsfield, Rochester, N. Y., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Filed February 13, 1905. The bending of the switch spring affects the bending area of the supporting shelf.

901,683. SUPERVISORY SYSTEM. Merritt S. Conner, Chicago, Ill., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Filed March 5, 1904. In a supervisory signal an armature is provided, absolutely controlling a circuit through the said signal.

901,684—901,685—901,686—901,687—901,688—901,689. TELEPHONE-EXCHANGE SYSTEM. Merritt S. Conner, Rochester, N. Y., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. A series of patents covering various features of a telephone-exchange system.

901,696. TELEPHONE-EXCHANGE SYSTEM. William M. Davis, Chicago, Ill., assignor, by mesne assignments, to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Filed April 26, 1901. A combination with a telephone switch hook at subscriber's station for opening and closing the telephone circuit thereat.

901,698. AUTOMATIC TELEPHONE-EXCHANGE SYSTEM. Bert G. Dunham, Chicago, Ill., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Filed October 5, 1904. An automatic telephone system.

901,704. RECEIVER. John S. Goldberg, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Filed November 23, 1903. The casing consists of a continuous one-piece shell of magnetic material, of which diametrically opposite regions are oppositely polarized.

901,738. SUBSCRIBER'S TELEPHONE CIRCUIT. Howard M. Post, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed July 31, 1905. The path for the signaling circuit contains the coils of a suitable ringer.

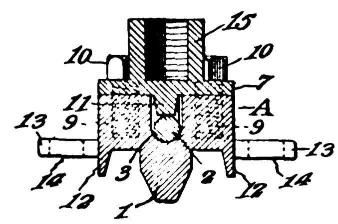
901,758. ELECTROLYTE. Abraham Van Winkle, Newark, N. J., assignor to the Hanson & Van Winkle Company, Newark, N. J. Filed October 24, 1907. The electrolyte comprises fluoride of zinc in solution.

901,765. MAGNETIC SEPARATOR. Reuben I. Wright and Homer E. Frost, Cleveland, Ohio, assignors to the Electric Controller and Supply Company, Cleveland, Ohio. Filed May 10, 1907. Mechanical connections with the valve-operating mechanism close the switch contacts prior to the opening of a hopper valve.

901,785. TELEPHONE SYSTEM. Elmer R. Corwin, Chicago, Ill., assignor to Corwin Telephone Manufacturing Company, Chicago, Ill. Filed December 26, 1906. A multiple selectively controlled telephone-exchange system.

901,816. TROLLEY-WIRE ANCHOR. Allan McIsaac, Hartford, Ct. Filed March 4, 1908. A horizontal plate-like bridge-piece has a tongue extending into a reciprocal groove for gripping the wire.

901,847. ELECTRIC MAIL-DELIVERING AND COLLECTING MACHINE. Otto E. Stout, Ozark, Ill. Filed June 30, 1908. The combination of a trackway and a motor-driven movable carrier.



901,816.—Trolley-Wire Anchor.

901,850. TELEPHONE-RECEIVER HOLDER. George J. Thomas, New York, N. Y. Filed August 14, 1907. An arm is pivotally mounted upon the bifurcated portion of a telephone-receiver holder.

901,861. TELEGRAPHIC SOUNDER. Vincent C. de Ybarrondo, Los Angeles, Cal. Filed May 6, 1907. An attachment comprising a U-shaped metallic member in combination with a hammer.

901,869. PROTECTOR FOR TELEPHONE TRANSMITTERS. Josef Baumgarten, New York, N. Y. Filed January 18, 1908. The mouthpiece is furnished with a collapsible funnel of flexible material.

901,871. ELECTRIC HEATER AND DRIER. George N. Blanchard, San Francisco, Cal., assignor of one-half to the Electric Manufacturing Company, San Francisco, Cal. Filed February 21, 1908. The air is discharged through a pyramidal electric resistance fixed within a tube.

901,878. TROLLEY-WHEEL BEARING. William M. Caswell and Joseph A. Schofield, Warren, Pa. Filed December 16, 1907. The bearing comprises fixed and hinged sections.

901,885. ELECTRIC CONTACT SPRING FOR TROLLEY HARPS. Albert L. Cole, Auburndale, Mass., assignor to United Copper Foundry Company, Boston, Mass. Filed September 28, 1905. A normally compressed washer portion is expansible both radially and transversely.

901,894. INDICATOR FOR TELEPHONE CALLS. Eugene T. Ducharme, Boston, Mass. Filed November 15, 1907. An indicator disc is carried upon the clapper arm.

901,899. ELECTRIC SIGNALING SYSTEM FOR RAILWAYS. William J. Higgins and Christopher J. Sheridan, Buffalo, N. Y. Filed December 27, 1907. A motor actuates the danger-signal semaphore arm in combination with secondary coils mounted upon the car.

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AND
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CONTENTS.

PUBLISHER'S ANNOUNCEMENT.

With the present issue the ELECTRICAL REVIEW, of New York, and the WESTERN ELECTRICIAN, of Chicago, join forces, and make their bow as the "ELECTRICAL REVIEW AND WESTERN ELECTRICIAN." The success with which both these journals have been conducted in the past is an assurance that the combination of forces will create a great national electrical weekly of influence and value to readers and advertisers alike. The ELECTRICAL REVIEW is the product of twenty-seven years' service in the development of all that is best in the electrical industry. The WESTERN ELECTRICIAN was founded in Chicago twenty-two years ago, maintaining a prominent position as a thoroughly representative journal, receiving the support of the entire western electrical fraternity.

In consolidating these two publications the editorial and business organizations of both have been continued and merged, and the western and eastern offices have the support of strong editorial and business departments. Those characteristics which have made each journal distinctive, and which have been rewarded with loyal support, will be preserved, and a constant effort made to improve the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN along every line which good judgment and the necessity of the electrical reading public may dictate. This journal will continue to be of interest and value to the technical man with its contributions and editorials concerning highly specialized fields of research and operation; and along those lines which interest the practical man and indicate the best methods of conducting public service utilities of the smaller size, the paper will be strengthened in every direction.

THE ELECTION.

On November 3 the voting citizens of the United States cast their ballots and elected to office for the conduct of the national administration the candidates of the Republican party. So considerable was the majority that it would appear that the question, shall the people rule, has been definitely settled nationally for the next four years at least. The policies of the present administration have been endorsed, and the attitude of all good citizens should now be to support the incoming administration without respect to partisanship. The constant betterment in industrial circles which has been going on for the past three or four months has been an indication of the growing confidence of investors in general in the stability of the institutions in which their fortunes were involved. It remains now for a healthy continuation and stimulation of this confidence to bring about a new era of prosperity, and a golden opportunity for all men to make the best of life and liberty and the pursuit of happiness.

Statewise it appears that in those commonwealths where public service commissions have been inaugurated through legislative action, and where a change in administration might have jeopardized the continuation of these commissions, that the will of the people has spoken for their continuance. Already there has been a concession of admiration on the part of public utility corporations for the sanity and benevolence of properly governed and practically restricted regulating commissions, the companies realizing that no commission can effect the confiscation of a real investment so long as the courts are open to the public and the public service corporation alike. The old bugaboo of municipal ownership seems not to have been raised at all in the recent campaign, and it can be stated with little prospect of controversion that municipal ownership has died a peaceful death, and that its demise has been due to the turning on of the light of intelligent publicity by the public service corporations in the largest cities in the country, particularly those where public service commissions have been instituted.

In Illinois the International Improvement Commission issued a circular asking votes in favor of a proposed $20,000,000 bond issue to be used in constructing a waterway from Lockport to Utica, Ill. This will provide an important link in the deep waterway from the lakes to the gulf. The matter came up before the voters as an amendment to the constitution permitting the bond issue. The present drainage canal extends twenty-nine miles from the south branch of the Chicago River, in Chicago, to the city of Lockport, where it connects with the Desplaines River. There is a further extension of one and three-quarters miles to the powerhouse between Lockport and Joliet, where there are at present three 4,000-kilowatt generators, a fourth being in process of erection, and where four more are to be installed as the power demands require. Under the plans of the International Improvement Commission four power plants are to be erected, with a gross estimated development of 140,000 horsepower. The returns from the ballots on election day showed a tremendous majority in favor of the issuance of the bonds. Not only is the state of Illinois interested in this development, but the entire West has congratulated itself upon the active interest which the voters of Illinois have taken in this issue, because it required not only a majority of the votes cast to be in favor of the bonds, but every vote that was not cast for or against it counted against the issue.

The great publicity which has recently been given to the conservation of our waterpower resources, to the canalization of our barely navigable rivers, and the necessity of the development of our inland waterways and our cheaper sources of power going hand in hand, has directed the attention of all thinking men to this problem, and it is only through this publicity, which has been secured through the open-minded and forceful co-operation of the press of the country, that the result announced herewith has been possible.

CAN WE USE A NEW COMBUSTIBLE?

For years the dream of inventors has been the production of power by some direct means of breaking down the chemical associations which render inefficient, to a high degree, so many of our present-day methods of utilizing the potential energy of our known combustibles. Great effort upon the part of assiduous workers, and the expenditure of large amounts of money, have resulted time after time in apparent failure, and today it would not appear that we are not much nearer the solution of this problem than we were several decades ago. Within the last few years there has not been chronicled much in the way of development in this direction, so that the suggestions made by Mr. Edward C. Warren, in the current issue of *The Engineering Magazine,* in an article entitled "Fuel for Power Generation," should excite considerable interest.

Mr. Warren delivers himself of the postulate that "power costs nothing." By this he means that we should secure our means for the provision of energy, not by any elaborate process of combustion, which apparently wastes the material involved, but we should use our combustibles under much the same conditions as we utilize the power of the waterfall; that is, by simply taking as a natural thing the energy-producing condition, and being obliged to expend money only for the harnessing of the natural element.

It is ingeniously pointed out that Nature, in bringing back to the watershed in the form of rain and dewy precipitation the source of power which has already caused the mill to grind and the water turbine to turn, points the way to the short-circuiting of the ordinary cycle of the utilization of our known combustibles. Carbon and hydrocarbons, our most popular forms of fuel at the present day, in combination with oxygen, form a combustible material. After the generation of heat the atom of carbon unites with its two atoms of oxygen, and ages are necessary to bring about the reorganization of these elements, through the evolution of plant life, so that the matter which is being used up today will not be available again for the present generation.

Why not use hydrocarbon for fuel? This is the leading question in Mr. Warren's communication. Its symbol is H, its chemical equivalent is 1, its heating value in combustion with oxygen is 60,000 British Thermal Units per pound. What are the special qualifications of hydrogen as a fuel? Its heating value per pound is four times that of the best coal. But where are the natural deposits or supplies of hydrogen? All of the foregoing belongs to Mr. Warren. He is of the opinion that the supply is inexhaustible, and that its natural cycle through the processes of isolation, combustion and re-isolation is so short as to render feasible a continuous re-use of the same volume of fuel substance. It has the practicability of perfect combustion, without ash, smoke or soot, without vitiating gases; for the sole product of combustion is water. The combustion being perfect, the product of combustion is aqueous vapor, immediately condensable and susceptible of ready decomposition, and yielding ready to hand, not merely the original volume of hydrogen, but the oxygen requisite for its immediate recombustion. With this statement the author concludes that we shall derive our supply of both hydrogen and oxygen from the waters of the earth, and that we shall simply insert or interpose our mechanisms or harness in a natural fuel cycle, and derive unlimited supplies of power by intelligently short-circuiting a naturally simple and expeditious cycle of one of Nature's elements.

So far so good. The elucidation of a practicable and commercial means of isolating the constituent elements of our projected combustible is left for another time and place. The matter is worthy of investigation. Possibly there are flaws in the author's reasoning. If so, we shall be sure to hear of them in the near future. He says that the power user has never asked the chemist whether this were possible, and that because someone long ago instituted the use of certain forms of combustibles, and let it go at that, that we have been content to plod along the lines laid out for us and utilize in wasteful fashion that which in the nature of things must some day be materially exhausted. The subject is of great interest, and the fuel problem of the future is pregnant with the possibility of development. Mr. Warren's further ideas on the subject will be watched for and welcomed.

A DIFFICULT PHASE OF POWER SOLICITATION.

In most large communities where the central-station power business has shown a gratifying growth in the past few years there exist a number of private plants which for one reason or another are extremely hard to convert to the operating company's service. The chances are that each of these isolated installations has been approached at least three or four times by representatives of the central station, with the apparent net result of making little or no progress. When a rival interest like a local gas company is hard at work to keep out the electric motor, the problem of securing this business is rendered doubly difficult. To give up the attempt to secure the business, however, is poor policy, and the central station should never erase the name of an isolated plant from its list of prospects. Sometimes it may be a year or two before any chance occurs to introduce the subject of power purchase to the isolated-plant owner, but the probabilities are that if the conditions are watched with keen attention, some day there will be an opportunity to install at least a small motor-connected load as an entering wedge. Unless the plant is operated with more than ordinary skill it is almost certain to fail to give continuous service at some critical period, and even if there are no interruptions, it is probable that the total operating costs, if rigorously set down, would surprise the owner, especially where new types of equipment are in service.

Close observation of the growth of the isolated-plant-owner's business, the need of fresh space in his store or factory, occurrence of accidents, probable excessive cost for repairs, troubles with labor in the engine or fire room, complaints of other parties regarding noise, smoke or dirt, with the possibility of interesting him in new designs of motors or lamps specially adapted to his conditions, should all be kept in mind. The acceptance of some famous rush order for a manufactured product may require more power to prevent severe overloading of the existing apparatus. Or again, the motor drive may permit the rearrangement of machinery in such a fashion that the efficiency of production will be increased many per cent. Conditions alter in the isolated plant, as in every other commercial agency, and by never ceasing to watch for a turning point in affairs it is probable that the central-station man will in time have some chance to show what he can do.

In some cases where the power rates offered by a central station are lower than those of a rival gas company, the owner has been known to advance the argument, that by installing tungsten lamps he can reduce his output enough to give a good margin for future power requirements. The effect of so reducing the load on a gas-engine equipment of low power is at once apparent to an electrical engineer, but it needs to be emphasized in a way that the private-plant owner will not fail to appreciate. Any notable reduction in load on a small prime mover means a serious loss in economy, which can often be figured pretty closely in terms of dollars and cents. When a local gas company is obliged to pay the cost of installing a gas-engine equipment in an isolated plant, the price being gradually paid back by the owner on installments along with his monthly bills, it is clear that electricity is pushing matters close to the wall. In order to gain a good customer of this sort there would seem to be no reason why the central station could not adopt the same plan with regard to motor installations in exceptionally hard locations. It will pay to emphasize to the owner facing such a proposition from a gas company that by the time the gas engines are paid for the depreciation is certain to have rendered them worth but a small percentage of their original cost, unless the most expert skill is available for the care of these small units.

THE PENNSYLVANIA ELECTRIFICATION.

From time to time announcement has been made that various commissions had under way the study of plans for the electrification of the terminal zone of the Pennsylvania Railroad. The great expansion of the local service of this transcontinental system by reason of its tubes under the Hudson River, Manhattan island, the East River, and in Long Island, in connection with the Long Island Railroad, has made imperatively necessary the utilization of electricity as a means of propulsion. It is with satisfaction therefore that we read the announcement that an appropriation of $5,000,000 has been made to begin the work of electrification, and that a contract has been let to a large manufacturing company to lay down the initial electrical equipment.

American Electrochemical Society.

Fourteenth General Meeting, New York, October 30-31.

The fourteenth general meeting of the American Electrochemical Society was held in the city of New York on Friday and Saturday, October 30 and 31, 1908. The session of Friday was held in the chemistry building of the College of the City of New York.

President Edward G. Acheson of Niagara Falls, N. Y., called the meeting to order on Friday morning at 9:40 o'clock.

The first paper considered was "The Use of a Mercury Cathode in the Determination of Metals," by A. Harold Porter and Francis C. Frary. The conclusions reached in this paper are:

1. The electrolytic determination of zinc in a mercury cathode gives low results, due to loss of both zinc and mercury in the process of washing with alcohol and ether.

2. Pure mercury does not lose weight appreciably when washed with water, alcohol and ether, nor by liberation of hydrogen on its surface even at high temperatures (100 degrees).

3. The loss in weight during washing seems to be peculiar to zinc, since copper amalgam shows no signs of it, and the determination of copper by means of mercury cathode is quite satisfactory.

The discussion was opened by Dr. H. E. Patten, who requested that the exact voltage, current and current density used in these determinations be given in the final report on the subject.

Walter T. Taggert then discussed the subject at length, giving details of the methods he had successfully used and precautions that must be observed to get reliable results.

Prof. J. W. Richards also spoke critically about the paper.

The second paper, entitled "The Passivity of Nickel and Iron," by Dr. E. P. Schoch, was read by Dr. Patten. The author was led into his study of these phenomena while working on the potential of the reversible electrode. The paper was briefly discussed by W. D. Bancroft and Dr. Patten.

A paper on "Chemical Energy," by J. E. Mills, was then presented. In this paper the author seeks to ascertain the ultimate origin of energy liberated in a reaction and show its amount varies under different conditions. The argument is based on the reaction occurring when the gases hydrogen and oxygen combine to form water. Among the conclusions reached is one that the attractive forces, whatever their nature, whether chemical, molecular, magnetic, electrical or gravitational, which proceed from a particle are definite in amount. If this attraction is exerted upon another particle the amount of the attraction remaining to be exerted upon other particles is diminished by an exactly equivalent amount. The relationship between chemical and electrical forces is considered in its bearing on the conductivity of substances. This paper was briefly discussed by E. Durant and L. F. Guttman.

Prof. Charles Baskerville, director of the laboratory of the College of the City of New York and chairman of the local committee that had arranged for the meeting, then presented President John H. Finley of the College of the City of New York.

President Finley welcomed the society in a pleasant speech, in which he grew reminiscent of the chemical and general scientific training he had received in his early college days and contrasted it with the advances that had been made in the teaching of science at the present time.

G. A. Hulett then presented his paper on "Equilibra in Standard Cells." It was discussed at length by Dr. W. D. Bancroft, who argued that the basic salt cannot coexist with mercury sulphate except at one concentration of the sulphuric acid.

A paper was then read by G. W. Morden on "The Formation of Nitric Acid from Air by Means of Low-voltage Direct Current." The discussion was participated in by A. L. Cushman, F. A. Lidbury, L. F. Guttman and the author. It related mostly to the influence of the portions of the arc, from which the gases were removed, upon the composition of the gas. As the arcs were only from three to six millimeters in length, with four millimeters average, conclusive results on this point were not obtained.

FRIDAY AFTERNOON SESSION.

At the afternoon session the first subject considered was introduced in an informal address by Prof. A. F. Ganz on "The Corrosion of Underground Structures." He said the corrosion of underground metal surfaces may be divided into two general classes, first, corrosion due to purely chemical causes or ordinary rust; second, corrosion due to electrolysis from stray electric currents. Whether or not all chemical corrosion is also electrolytic in its nature does not alter this decision from the standpoint of the practical engineer.

When an electrical engineer is called upon to make an electrolytic investigation of, say, a pipe system, he may have two distinctly separate problems to solve. The first problem is to determine the electrical conditions of the metal system, that is, the potential at various parts of the system with reference to the surrounding ground, and with reference to other underground metal. He must determine the current flowing, and if possible the point where the currents leave the structure for the ground, because these are the points where corrosion may develop. If in this investigation he finds that the system is in electrolytic danger, then his second problem is to recommend some method whereby the danger can be substantially removed and at a reasonable cost, which is always an important element.

Attention was called to a wholly incorrect method which has been used in this country, and has been published in a certain class of electrolysis reports, in which the potential differences are measured between pipe and rail, and the earth resistance is measured at the same points, or to be more correct, the resistance is measured between the pipe and rail, which is called the earth resistance between these two points. This resistance is then divided into potential difference, and the current so found is stated to be the current flowing between these points. This is repeated, every block for a given system, and the currents are added up, and the total current so found is stated in all seriousness to be the current which flows in that street between the pipe and rail. The absurdity of that method should be clear to all, and every member of the society was asked to take every opportunity to show up in every possible way such fallacious methods, because they have done a great deal of harm.

The question has often been asked whether the steel foundations for bridges and buildings which are usually imbedded in concrete are also suffering from corrosion, due to these stray railway currents. These metallic underground structures do not have the same opportunity of picking up currents from any extended area. There is one case, however, where such structures may be in serious danger. If a pipe comes in contact with such a structure mechanically, as is sometimes the case, and the pipe is carrying current, it is positive to the surrounding ground. Under these circumstances a current picked up over an extended negative piping area may be delivered to the metallic underground structure and, leaving it, produce corresponding electrolytic corrosion. In a number of instances special precautions have been taken to insulate the steel foundations of structures from piping systems, and it seems to be a safe precaution to take in all cases.

Where dangerous conditions in an underground system are found, the second problem that the electrical engineer has to meet is to recommend proper preventive measures which will not be prohibitive in cost. It is there that the electrical engineer can get the most help from the electrochemist. If the underground metal system is continuous it may be connected to the negative return system of the electric railroad. That is, however, a matter which invariably greatly increases the current flow on the pipes and produces other dangers. For instance, at a high resistance point, which may develop in the joint, the current may shunt around such a point and produce corrosion. The greater danger, however, lies in the danger that such a bonded system is to all other underground metal systems. If one connect one piping system to the negative bus-bar, one renders it highly negative to all other underground metallic structures and introduces current flow to this pipe system, and thereby this system becomes a part of the railway return circuit and a party to any damage that may be done.

Professor Ganz then submitted five questions which embodied the points that he wished to open up for general discussion. The first related to the activity or passivity of iron in street soils. As Professor Harber of Karlsruhe, who is investigating this question pretty thoroughly, concludes that under the ordinary soil conditions iron is always in the active state, that practically the passive state does not exist in underground metal systems, the question was raised what can be done to render active iron passive. Some one had suggested to cover an underground pipe with lime for that purpose. Question No. 2 referred to means for identifying the causes which have produced a given corrosion. As a practical example of this, Professor Ganz showed a number of lead cable and pipe samples that had been submitted to him to find out whether they were pitted by electrolysis. Question No. 3 was, "Can we protect an underground metal structure, such as a piping system, by coating it with an insulating material in such a way as to prevent current entering or leaving that pipe?" Question No. 4 related to the breaking up of the continuity of underground metallic structures, as, for instance, by the use of insulating joints, the point being whether this method can make such a pipe system substantially safe from electrolytic corrosion. The last question was, "What is a safe current density per square foot of pipe surface for current leaving for ground?"

Dr. Allerton L. Cushman called attention to corrosion of plates of steamships and of pipe lines remote from electric circuits that was as destructive and of the same nature as that known to be due to electrolysis by railway return currents, and argued that this corrosion is due to electrolytic action whether an extraneous current is present or not.

Maximilian Toch corroborated what Dr. Cushman said with reference to the corrosion of these pipes and plates. He said it is settled in his mind that all corrosion is an electrolytic function. That is the fundamental basis of it. He believes that stray electric currents aggravate this corrosion. With reference to coating gas pipes with asphaltum, it was found by a natural gas company that built a pipe line from Peoria to Chicago and coated it with asphalt about a quarter of an inch on the inside and half an inch on the outside, that since fuel gas is a powerful solvent for all bituminous compounds, in a very short time the entire pipe was so clogged up with the dissolving bitumen and bituminous compounds that it became useless, so that bitumen or asphalt or tar should be excluded from the interior of a gas pipe.

Professor Ganz said the distinction he made in his remarks was not a distinction between chemical corrosion and electrolytic corrosion, but a distinction between corrosion produced without outside electric currents and corrosion produced with outside electric currents, which is an engineering problem. He knew of some private corporations owning very considerable underground pipe systems—one in particular where a single pitting in a pipe caused a damage of $50,000 indirectly, and these companies will gladly spend any reasonable amount of money if a method can be devised for permanently protecting such important pipes. He did not propose this method for the distributing system for water or gas in any city where the whole system would have to be treated, but there are many cases of importance, such as high-pressure lines, where generally any reasonable expense will be gladly paid if permanent protection can be assured.

Carl Hering believed that current cannot leave the pipe for the soil, that is, if there are liquids in the soil, without causing corrosion. There is one method by which a pipe might possibly be protected. If there is a pipe from which it is known that current is going to flow out, by attaching to the pipe metallically a block of zinc buried in the ground, any current which is bound to go into the ground would prefer to leave through the zinc than through the pipe, because it takes less voltage, and as long as the zinc is there and is not destroyed the pipe would be protected, the zinc being replaced after it is consumed. As to coating pipes to prevent corrosion, while this may prevent it, where it keeps the electrolyte from coming in contact with the pipe, such coatings are very apt to be injured in spots, which means that the corrosion instead of being spread over a large surface will be condensed into a small surface, and will therefore do all the more damage, because if the current is condensed on a small area it will eat through the pipe in shorter time. What current density is a safe limit should be answered by saying definitely none. That is, no current density leaving the pipe is safe, because one never knows whether it is going to leave from that area or to be confined to a quarter of a square inch. In a number of cases, when a pipe was in danger at a certain place and was protected there, it was thought that that was sufficient. To Mr. Hering this seems very incorrect reasoning, as it simply shifts the danger point to another place.

R. H. Gaines cited a case of a pipe line near the city of Rochester, where all the elements of corrosion showed that it was simply due to stray currents, yet no potential difference could be found with the millivoltmeter between the pipe and the ground, and there was known to be no source of commercial electricity anywhere in the neighborhood.

The discussion of Professor Ganz's subject was concluded by I. L. Roberts, W. D. Bancroft and S. S. Sadtler.

A paper on "Correct Methods of Measuring Stray Currents," by Dr. Clayton H. Sharp, of the Electrical Testing Laboratories, New York city, that was on the programme for Saturday morning, was then taken up. Dr. Sharp had no written paper and presented his views on the subject verbally. The chief point to be found out is whether there is at any point any considerable amount of electric current leaving the pipes. The problem is easily stated, but it is not so easily answered, for the reason that in general it is not possible to destroy the continuity of the system of piping in order to insert instruments, and it is not possible to insert instruments in the surrounding soil without disturbing the conditions as they actually exist in practice.

The electrical instrument which is used chiefly in investigations of this nature is the voltmeter or the millivoltmeter, and this instrument has sometimes been used with very distressing and alarming results. However, one can gain a great deal of information by the proper use of the voltmeter. One may feel quite sure that where the trolley line and other structures are positive in potential with respect to the pipe, the pipe is quite safe. Also, that where the pipe is positive to other structures, that it may be in danger. It is wrong to conclude that, because it is so, that it is actually in danger—for instance, it may be quite well insulated by passing, say, to dry sand or gravel from moisture, so that the discharge of electricity from the pipe to the soil electrolytically is prevented.

Having determined by the use of the voltmeter what the possible danger areas are on a system of piping, the next step is to determine the current flowing on the pipe, and especially the current leaving the pipe. To determine this the most satisfactory method would be to interrupt the electrical continuity of the pipe by inserting an insulating joint, and then spanning that joint with wires passing through an ammeter and measuring directly. This, however, is often not feasible. Consequently, it is necessary to revert to indirect methods for measuring the current. The principal one is by means of the fall of potential on the pipe. Electrical connections are made at two points on a single length of pipe to a sensitive low-reading voltmeter, preferably one of high internal resistance, and the indications of this voltmeter or millivoltmeter are read over a sufficient period of time to show what the average condition of the pipe is. Then, if the resistance per unit length of pipe is known, it is possible to interpret these millivolt readings in terms of amperes of current flowing on the pipe. The difficulty with this method is the determination of the resistance per unit length of pipe. Now pipes are made in standard sizes and of material which varies a good deal, but which has fairly fixed average values of resistance, and since it very often happens that one is concerned only with rather rough quantitative values, one assumes from the known dimensions of the pipe, and the known resistances of the material, the resistance of the length of pipe which is being dealt with, and in this way makes the interpretations of current.

It is possible sometimes to get at a rather better value by resorting to a procedure which consists in attaching to the pipe heavy leads that are brought out and connected with an ammeter. The potential difference between two portions of the pipe close to the place where these heavy leads are brought out is measured when these leads are not connected, and again when they are connected through the ammeter, and at the same time the value of the current, as shown by the ammeter, is measured. In the second case, when the ammeter is in circuit, the potential difference as shown by the millivoltmeter will be less than in the first case, and the reduction of voltage due to drawing a certain measured current from the pipe, gives an indication of the resistance of that length of pipe. For instance, if we find that by connecting the heavy leads we reduce the potential difference between the two points on the pipe to one-half of its former value, then we know surely that the original current flowing through the length of pipe was twice what the ammeter indicated.

However, the problem not only involves the determination of the current flowing in the pipe, but more particularly the current which is escaping from the pipe. How shall we determine that? The only way Dr. Sharp knows of doing that without seriously disturbing the normal conditions of the pipe is by taking some potentiometer measurements of the current flowing on lengths of pipe separated from each other by suitable distances. This may be taken by suitable instruments, and observers reading at the same time, or by sensitive and accurate recording instruments, which are also obtainable for this purpose. The interpretation of these results will give at least a rough measure of the current which is leaving the pipe at points between.

We can also get some indications of the probable escape of current from the pipe by exploring the electrical condition of the soil in its vicinity. If we start from the pipe and find a continuous fall of potential as we go from point to point away from the pipe, the indications are that current is flowing along such lines, and that these lines are stream lines of electricity. In making measurements of this kind it is advisable of course to use electrodes not subject to error due to polarization, that is, electrodes in zinc-sulphate solution, or similar electrodes, and make the measurements by a method which does not draw any current so as to eliminate resistance drop at the point where the electrode is inserted in the soil, that is, some form of potentiometer is indicated as the proper one here. Professor Harber's earth ammeter, as it is sometimes called, is also used for this purpose.

The discussion of Dr. Sharp's address was rather brief, Dr. Carl Hering questioning the value of the shunt method. Dr. Sharp admitted that it was satisfactory only with pipes of moderately high resistance.

The paper on "Electrolytic Corrosion of the Bottom of Oil Tanks," by A. A. Knudson, was then read and discussed by S. S. Sadtler, Carl Hering, A. L. Cushman, C. F. Burgess, W. H. Walker and J. W. Richards.

A paper on "The Function of Oxygen in the Corrosion of Metals," by W. H. Walker of Boston. It was not discussed.

Professor Baskerville was then called on to make an address. He spoke at length on the equipment and general educational work of the College of the City of New York, and particularly of the methods used in its chemical laboratories.

"The Theory of Electrolytic Paints," by Dr. W. D. Bancroft, was next presented, and its reading was followed without further discussion by "Simple Methods for the Prevention of Electrolytic Corrosion," by Prof. Maximilian Toch.

A. A. Knudson added another question to those that Professor Ganz had presented, which he set before the convention in the following words: "I have in mind two wrought-iron water pipes which are undergoing corrosion probably from chemical processes. These pipes run in a creek partly submerged and are negative to the soil at that point. There is a current of electricity flowing through it, sometimes reaching seventy-five and eighty amperes. I wish to ask if this current of electricity flowing through these pipes tends to assist the electrolytic action of corrosion on the surfaces from the chemical effect?"

Prof. Albert F. Ganz inquired if it it is necessary first to coat an underground pipe with a solution paint before applying the coating which will keep away the water. Mr. Toch explained that it would not be necessary to paint the pipe, although it is best to apply an insulating hydrocarbon paint, pouring half-neat cement around the pipe. This would be as cheap and better than pitch.

Allerton L. Cushman explained that the object of the inhibitor is to keep in contact with the surface of the steel a slightly soluble compound so that if any water gets through the excluding paint surface, upon reaching the steel the water must contain in solution some protecting derivative of iron. It was hoped, he said, that the scheme would work out practically, as theoretically the idea seemed to be all right.

Mr. Toch replied that in actual practice, when a beam or a billet is coated at the mill and transported, great chains being wrapped around it to hold and support it, besides the other surface injury to which it is subjected, no protective coating of .001 of an inch in thickness has been made that will withstand these attacks.

SATURDAY MORNING SESSION.

The Saturday morning session was held at the Chemists' Club on West Fifty-fifth street, and President Acheson, after calling the meeting to order, announced the paper on "The Lash Steel Process and the Electric Furnace," by F. A. J. FitzGerald, consulting chemist, Niagara Falls, N. Y.

Henry D. Hibbard spoke of the great advantage of the electric furnace in the production of heat without oxidation. When steel is made in the open hearth furnace, all the effects of oxygen are produced, the mingling of the carbon and silicon is carried out by oxygen, and in fact oxygen is the great servant used in produsing the results, but oxygen, while an excellent servant, always lies in wait to give all kinds of trouble, if one does not know how to handle it at the latter end. The oxygen must be fairly eliminated from the metal or the result is poor. In the electric furnace heat can be produced without oxygen, and from a steelmaker's point of view the process of making steel by such a furnace is simplified more than one can realize.

Prof. J. W. Richards said that there are two ways of making steel—one is simply to melt the ingredients together, and the other is to oxidize the pig iron so as to eliminate the impurities and get down to steel. These two processes require essentially different kinds of apparatus, for the reason that in the melting process it is simply a case of melting. In the oxidation process it is largely a case of having surface to oxidize the bath by means of the iron ore which is added. These two requirements are going to give rise to two different classes of furnace, each best adapted for its purpose. As to the question of losing iron in slag, that is not such a very serious one, because in ordinary open hearth processes there is considerable loss in slag. Electrochemists should not think that a process to be commercially successful must reduce the iron in the slag to a low point. There are open hearth furnaces running making steel successfully where they lose something like fifteen or twenty per cent of iron in the slag, but yet are commercially successful. The third point that Professor Richards made is that the electric furnace is being developed very largely by electricians and electrochemists, who in many cases are not experienced steel men, and the ideal combination is to get the experienced steel man with a first-class electrochemist to work on the proposition. Where a firm which is experienced in making steel secures the assistance of an electrochemist or an electrometallurgist to do the electrical work for them, the combination succeeds very nicely.

W. S. Landis contended that as he understood the Lash process, it is intended particularly for the reduction of iron ores and the final production of steel directly from them in the same operation, and it seemed, therefore, that the loss of iron in the slag is rather an important item.

At the request of W. H. Walker, Mr. FitzGerald described the Lash process as consisting in making an intimate mixture of the cast iron, oxide of iron and carbon. The cast iron is in the form of bars, or shelf pig iron, and is supposed to act as a carrier for the carbon and also some metalloids contained in it; it undoubtedly acts as a reducer. The process seems to be extremely simple and has been carried out on a very large scale, many hundreds of tons of steel having been made in the open hearth process, showing economies over the regular practice. In the Lash process a much larger percentage of ore can be used and in the open hearth furnace there is no difficulty in reaching a yield of ninety-four per cent, which means a loss of six per cent in the metallic contents. The method of working has been to have a blast in the furnace and then to add the Lash mixture. In the electric furnace, in the experiments made, there was about sixty per cent of ore, about twenty-three per cent of cast iron, and the remainder fluxes and carbons.

A paper, entitled "The Latent Heat of Vaporization of Zinc," by W. McA. Johnson, was then read. It was discussed briefly by Dr. Hering and Professor Richards.

Dr. Carl Hering next presented a paper on the subject, "Heat Conductance Through Walls of Furnaces." It related to methods for decreasing the loss of heat through the walls of electric furnaces.

P. M. N. Dennie spoke of the value of a gas envelope about a furnace in increasing its efficiency. C. F. Carrier, Jr., discussed Mr. Hering's constant K or coefficient of conductivity and regarded it rather as variable. J. W. Richards said that in studying recently the heat radiation from a certain sort of furnace it was shown by experiment that after a certain wall thickness was reached there was no more use in putting on protecting material outside, as the increased effect from the additional material was practically negligible. Others discussing the subject were H. D. Hibbard, J. C. Parker, F. A. Lidbury and W. S. Landis.

The next subject on the programme was an address on "Utilization of Power Stations for Electrochemical and Electrothermal Processes During Periods of Low Load," by E. A. Sperry of Cleveland. Mr. Graves, of the Brooklyn Edison Company, then read the paper on "Electrochemical Loads and the Central Station," written by John Meyer of Philadelphia.

The discussion on these topics was opened by President Acheson, who, speaking of the carborundum furnace, said the duration of its run is thirty-six hours, so that it would overlap all the high points and valleys, and it is not, therefore, available for central-station work, but there should be many industries that could be fitted in. Probably not so largely in the case of the electric furnace, because after the furnace is once fairly heated up it is not well to let it go out because the initial heat in warming up the work represents a large amount of energy.

Edward R. Taylor said that there are many electric furnaces capable of intermittent work in that respect, but of course not to as good advantage as though running continuously for twenty-four hours. It would not be advisable to shut the current entirely off during the peak load. For example, if the furnace were run twelve hours and then stopped twelve hours, it would barely get started again. On the other hand, on the peak load the furnace could be kept hot, and just below the point of production, and then when the valley load came an increase of power could be put on, and the production proceed for twelve hours. The current could probably be cut off best for the two or three hours of the peak load.

Dr. Carl Hering declared that the energy required for heating up a furnace is generally so great that it is doubtful whether it would pay to use furnace processes intermittently, unless the loss during the non-working period can be made very small. He thought, therefore, that the more probable field of usefulness for spare current would be for electrolytic processes, which can be more readily stopped.

W. E. Wells thought that if the electrochemical interests could get together with the central-station men, arrangements might be made whereby during the greater portion of the year current could be furnished continuously; during another portion of the year current could be furnished continuously except on Saturday nights, and during another and very short portion of the year, amounting to not more than forty-five days, current could be furnished continuously, excepting a one-hour peak, or a peak ranging from one and a half minutes to five minutes. It may not be generally known, but the last twenty-five per cent of the capacity of a large number of electric-light stations is used only one hundred hours per year. That twenty-five per cent of capacity could be used the other 8,000-odd hours to a very good advantage.

Lawrence Addicks said that for copper refining plants the price of current would have to be very low to be attractive, as the process is very sensitive to changes in conditions, an alteration of even ten per cent in current density at different times of the day disturbing seriously the silver and gold alloys.

C. F. Carrier, Jr., believed there is one factor that is apt to be overlooked in this question. He had found as the result of a complete calculation of a plant for making metallic sodium that was to be located near a central power station that, if the central power station made any money, he could not make any money, and, if he made any money, the central power station could not make any money.

G. M. Kibbe argued that while waterpower is cheaper in most instances than power from any other prime mover, a location at a remote waterpower may still make the production costs higher than a location near a central station at tidewater, for instance. Tidewater shipping facilities, cheap labor and a nearer market for finished products may more than offset the economy of waterpower.

Prof. J. W. Richards referred to an electric-furnace plant in Switzerland which runs one heat in the morning and one in the afternoon, and is then shut down for the rest of the day. Such plants could arrange to make another heat, so as to fit in with hours that would be satisfactory to the central-station managers. There are also some electrolytic processes which can be absolutely stopped for a certain number of hours, not run on light load, but more easily stopped entirely for four or five hours, and then started up again without practically any hindrance at all. It would be well for electrochemists, in considering different kinds of processes, to consider whether the process cannot be modified, or practically stopped, to fit in with the number of hours when current can be got at the cheap rate.

P. M. N. Bennie said the large generating companies at Niagara Falls are also acquainted with the load-factor problem, and they have been looking for the same solution right among these works, and they have not found it. He thought perhaps there has been a good deal of dreaming on this idea of getting an intermittent load and making it a success. There has been a great deal of work done on it, but there has not been any solution of it.

Lawrence Addicks believed that the relative importance of the power cost in the electrochemical industry to the total cost is not fully understood. There is an impression that it is a much larger item. From his experience in the copper-refining business the power runs at about twenty-five per cent of the cost, so that a saving in power may easily be outbalanced by other factors..

Others discussing the subject were Messrs. FitzGerald, Hibbard, Graves, Kohn, Wells, Breed, Sadtler and Sperry.

Edward R. Taylor was then called on to outline the objects of the appointment and the work of the national conservation committee.

On motion of Dr. Hering a vote of thanks was tendered to those who had participated in making the arrangements and promoting the success of the convention. The meeting then adjourned.

Among the entertainment features provided were a luncheon and organ recital on Friday noon at the College of the City of New York, a dinner at Reisenweber's on Friday evening and a smoker at the Chemists' Club on Saturday evening. On Saturday afternoon a visit was made to the Balbach Smelting and Refining Works at Newark, N. J., where the process of smelting and refining of lead, copper, silver and gold were inspected with much interest.

Electrical Ordinance for Atlanta, Ga.

What fire underwriters and electrical men in general regard as a model electrical ordinance, has just been adopted by the city council of Atlanta, Ga. The ordinance provides for a board of electrical control and regulates the construction and installation of electrical work and equipment. It goes further than almost any set of regulations previously framed anywhere for this purpose, and if properly observed should reduce to a minimum the hazard from improper wiring. A digest of the text of the ordinance is given here. The ordinance was framed by A. M. Schoen, chief engineer of the Southeastern Underwriters' Association, at the request of the city authorities.

The ordinance creates a board of electrical control, to consist of the chairman of the committee on electric lights, telegraph and telephones, the city engineer, the chief of the fire department and the chairman of the committee on electric and other railroads, the first named official to be the chairman of the board. It is the duty of the board of electrical control to have inspected all electrical construction, installations and equipments of any kind which it has the power to order removed, repaired or rebuilt, when, in the board's judgment, life or property will be better protected thereby. The board is charged with the duty of enforcing all laws relating to electrical energy and construction, and is empowered to pass upon the ability and responsibility of applicants to do electrical contracting in the city of Atlanta.

In January of each year the city council is to elect a competent man for the position of superintendent of electrical affairs, who is to receive a salary of $1,800 per annum and be subject to the orders of the board of electrical control. The superintendent of electrical affairs regulates and determines the placing of wires or other appliances for electric light, heat or power. In the discharge of his duties the superintendent is privileged to enter any building, manhole or subway, or to climb any pole, for the purpose of examining and testing electrical appliances. He has also authority to compel the removal of superfluous poles which may impede travel. The superintendent of electrical affairs inspects, approves and issues certificates of satisfactory inspection of all wiring. With the aid of the officers of the police department who report the operation of lights in the district, he has general supervision of city lights, requiring all concerns furnishing lights to the city to comply with the terms of their contract.

All electrical construction, material and appliances must conform to such special rules as may be adopted by the board of electrical control, and to the rules and requirements of the National Board of Fire Underwriters. No wiring or alteration in wiring for light, heat or power, or increase in the load carried is to be made without a written permit from the superintendent of electrical affairs.

The superintendent has authority to cut off the current in case of failure to comply with the ordinances. The use of metal conduits only is permitted for wiring buildings within the fire limits.

Failure to comply with the ordinances or an order or request made by the electrical superintendent by the authority of these ordinances is punishable by a fine of not less than $25 nor more than $100 for each offense, or thirty days' imprisonment. Before engaging in electrical construction it is first necessary to obtain a license, the fee for which is $25, although an establishment employing a man of electrical knowledge and experience may have the employe take the examination and be granted a license to do electrical work only in the establishment or building in which he is employed, upon payment of a fee of $5. Any person, firm or corporation found doing electrical work in the city of Atlanta without a license is subject to a fine of $100 or imprisonment for thirty days, or both. Licenses are for one year only and are not transferable.

Brooklyn Modern Science Club.

The Modern Science Club, 125 South Elliott Place, Brooklyn, N. Y., under whose auspices illustrated lectures on civil, electrical, hydraulic, mechanical and marine engineering subjects are held, announces the following forthcoming numbers on its fall programme:

November 10—L. J. Wing, of L. J. Wing Manufacturing Company, "Practical Results in Forced Draft Installation."

November 17—William T. Donnelly, M. E., "Transportation by Water."

November 24—C. J. Simeon, of the Avery Scale Company, "Automatic Scales in Modern Industries." With particular reference to the weighing and handling of coal.

Saturday, November 28, will be the date of a special lecture and general discussion upon the subject of "Patent Office Experiences."

Use of Electric Power for Safety in Mines.

The United States Geological Survey has issued a report on the prevention of mine explosions, submitted by three foreign experts, Victor Watteyne, inspector-general of mines, Belgium; Carl Meissner, councilor for mines, Germany, and Arthur Desborough, his majesty's inspector of explosives, England.

Among the recommendations of the report are these on the use of electricity:

"Electricity in mining operations offers so many advantages and has been so generally adopted that no reasonable objection can be made to its use under proper restrictions. The electrical equipment, however, should be installed, maintained and operated with great care, and so safeguarded as to minimize danger from fire or shock. The fact that the effectiveness of some insulating materials is soon destroyed in most mines should not be lost sight of.

"We recommend the following precautions: For distribution underground the voltage should not exceed 650 direct current or 500 alternating current, these voltages being intended for transmission to machinery operating at 500 volts direct current and 440 volts alternating current, respectively. Even lower voltages are preferable. The trolley wires should be installed in such manner as to render shocks least likely—that is, placed either high enough to be beyond easy reach or at one side of the track and properly protected.

"Where current at a potential of more than 650 volts is employed for transmission underground, it should be transmitted by means of a completely insulated cable; and where a lead or armored covering is used, such covering should be grounded.

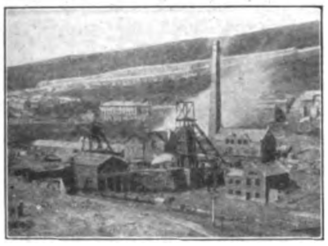
"In all mines having electric installation special precautions should be taken against the setting on fire of coal or timber. Inclosed fuses or cut-outs are recommended, and each branch heading should be so arranged that the current may be cut off when necessary.

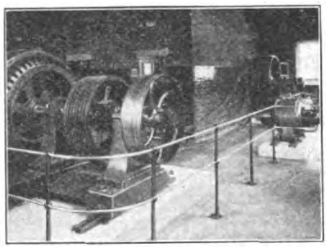
"No live electric wire should be permitted in that part of any mine in which gas is found to the amount of two per cent.

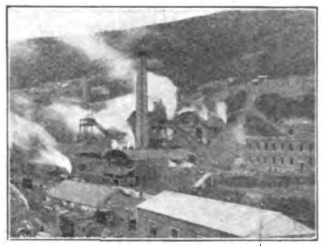
"In all mines producing gas in dangerous quantities, as indicated by a safety lamp which will detect two per cent of gas, the working places should be examined for gas by a qualified man using such a lamp immediately before any electric machine is taken or operated there."

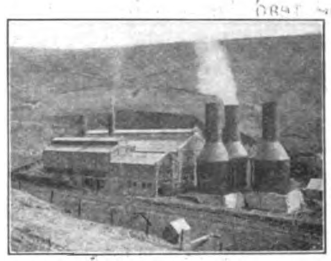
ELECTRIC POWER IN THE COLLIERIES OF SOUTH WALES

BY A. H. BRIDGE.


NOS. 8 AND 9 PITS, TYLORSTOWN.

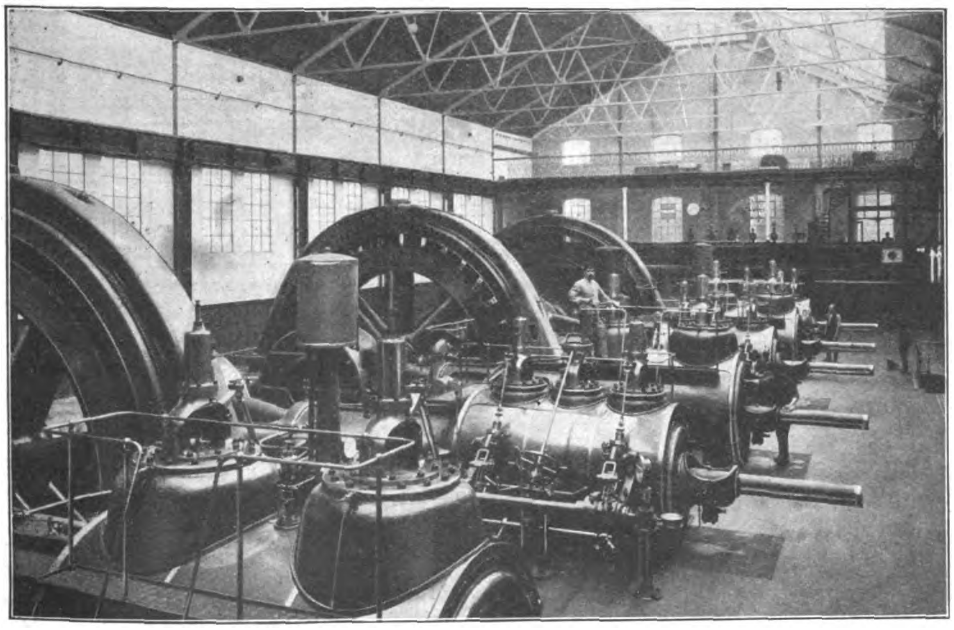

NO. 9—FAN HOUSE INTERIOR.


NOS. 1 AND 5 PITS, FERNDALE.


POWER STATION.

During the last few years the South Wales district has been the most fruitful one in the United Kingdom for the electric mining engineer, for in it quite a number of important installations have been put down for some of the principal colliery owners. It is reasonable to expect that the next few years will be even more satisfactory in this respect, both in the matter of new plants and in the extension of those already down. Two things of interest as leading to this anticipation are matters of general comment just now. One is the almost certain extension of electrical application in mines now that the demands for heavy output of coal which have been a remarkable feature of the last year or so, have lessened somewhat, giving a favorable opportunity for bringing the equipments of the mines up to date. The other is the greater application of electricity that is expected to follow as one result of the proposed, but at present deferred, legislation for a miners' eight-hour day.

It will be remembered that it was in the South Wales district that a large power company carried on extensive operations supplying large power users from several generating stations, but came to such a disastrous experience, ending in financial breakdown, loss to a number of firms in British electrical engineering industry, disfavor for electrical investments —indeed it was one of the severe blows that our electrical industry sustained a few years ago and has not recovered from yet. The company came to such a pass that the customers who were colliery and works owners dependent upon it for the supply of energy necessary for preventing an interruption of their industrial operations, had to step in and take the helm. The company, as has been recorded in these pages, has since passed through various other stages in which several smaller subsidiary companies have been formed to operate certain of the stations and supply energy in their neighborhood. Before the crash came, however, the company did excellent educational work among many of the mines, and there was promise of a most satisfactory development straightaway. Whether the course of colliery electrification in South Wales was greatly interfered with by reason of the Power Company's tribulations is one of those matters upon which a pretty safe guess might be made. However, things are now undoubtedly going ahead well, and nothing appears likely to stay the progress that has well begun. Three interesting undertakings, each of which has had its own electric generating station put down, may be mentioned in this article, namely: (1) The Aberdare collieries of the Powell-Duffryn Company; (2) the Cambrian collieries, in Clydach Vale; (3) the Ferndale collieries—the most recently completed system of the three.


FERNDALE COLLIERIES—POWER STATION ENGINE ROOM

THE ABERDARE COLLIERIES.

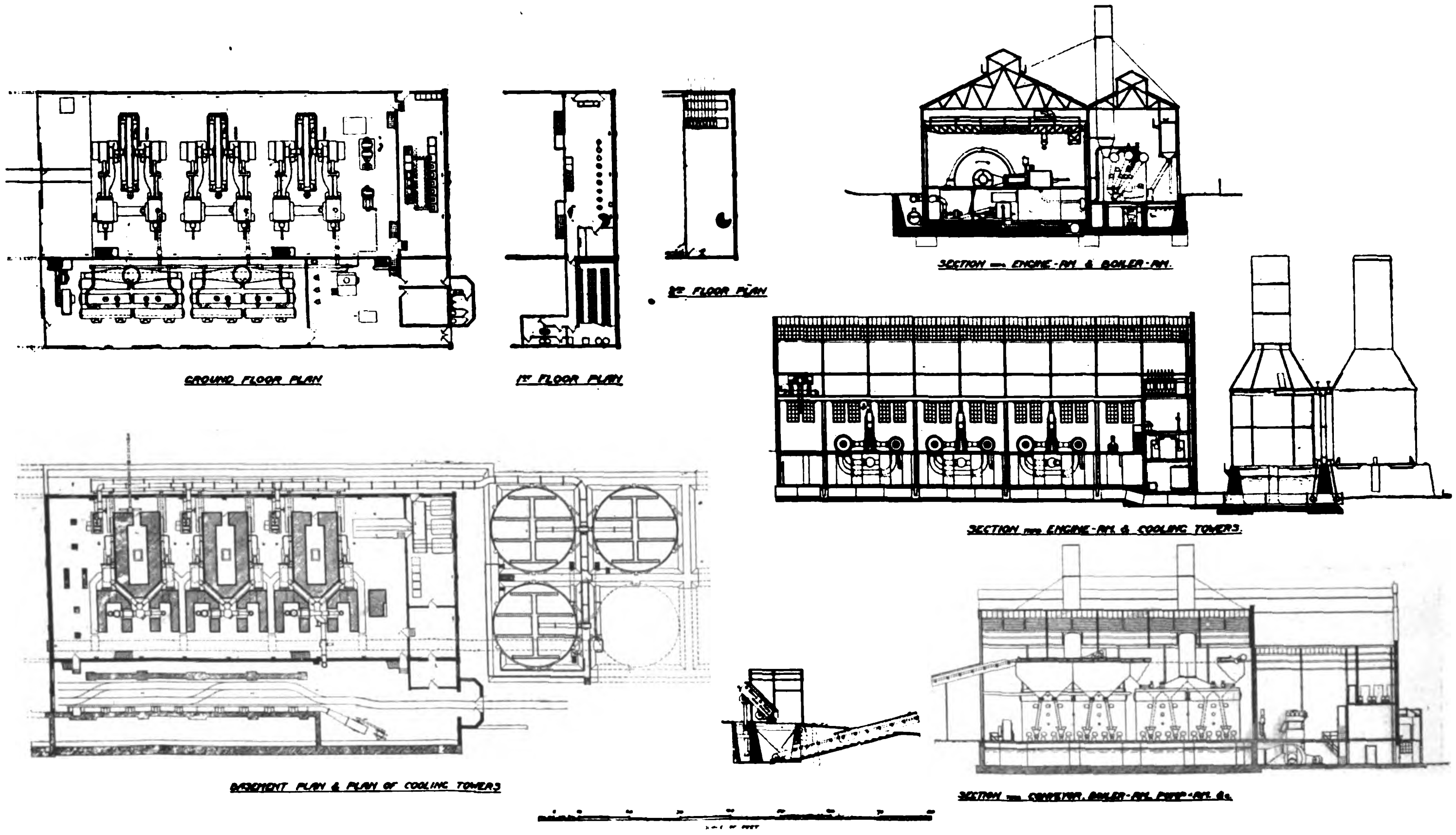
The equipment of the Aberdare collieries was put down to the designs of Charles P. Sparks, who acted as consulting engineer. He was responsible for the rearrangement of the electrical system under which a number of the pits had worked for several years, and for a great extension scheme. The Aberdare collieries, which are about twenty miles northwest of Cardiff, raise about half the annual output of the Powell-Duffryn Company, which was, a year or two ago, close upon three million tons. Six out of the nine pits were worked by isolated direct-current plants (200 and 400 volts), but these small plants gave way in the development scheme to one large power station for serving the entire pits in the valley, 3,000-volt, fifty-cycle, three-phase current being generated, and overhead transmission lines being employed. When this new power station commenced operations some three years ago 4,600 horsepower of motors were at work out of a total of 6,000 horsepower. The power-station plant comprised a number of 2,000 and 1,000 kilovolt-ampere, three-phase alternators, supplied by the Electrical Company, Limited (A. E. G.), each driven by Yates & Thom horizontal cross-compound, jet condensing type steam engines, which were served from Babcock & Wilcox water-tube boilers. A very detailed account of the plant, transmission lines, sub-stations, and the various operations performed in the mines was given by Mr. Sparks in a paper that he read before the Institution of Electrical Engineers in London.. A number of main and tail haulage machines driven by 150-horsepower, 3,000-volt, 290 revolutions per minute, variable-speed motors; fans driven by 180-horsepower motors of the same speed and pressure; screens rope-driven from sixty-horsepower, 3,000-volt, enclosed motors (485 revolutions per minute); an aerial ropeway driven by fifteen-horsepower motor; three-throw ram-pumps; winding machine with 100-horsepower motor (depth of pit ninety yards), giving an output of seventy tons of coal per hour, also a winder in a staple pit, driven by an eighty-horsepower motor—these are some of the representative examples.

THE CAMBRIAN COLLIERIES.

The Cambrian collieries, which are in Clydach Vale, produce in three pits about 1,000,000 tons per annum. Steam working gave way to electrical operation for working haulages, pumps, coal-cutting machines, the supply being first obtained from the Power company to which reference is made above. C. P. Sparks, who was the consulting engineer in this case, also persuaded the authorities to put down their own power plant. This consists of three 1,000-kilovolt-ampere Siemens, three-phase, rotating field type alternators, generating a 2,200-volt, twenty-five-cycle current. These alternators are driven by Belliss steam engines, and the speed of the sets is 250 revolutions per minute. The boilers are thirty feet by nine feet, Lancashire type, with Sugden superheaters. A small steam-driven set and two seventy-kilowatt motor-generators supply direct current for auxiliary purposes. Step-down transformers (2,200 to 400 volts) are fitted at one end of the switchboard for giving the supply to the surface and auxiliary motors. Some twenty-one induction motors aggregating 1,890 horsepower and ranging from 220 horsepower to three horsepower serve for the principal operations. The greater part of the supply is taken into the mine at from 2,000 to 2,200 volts and is received by the motors at that pressure.

THE FERNDALE COLLIERIES.

By the courtesy of W. H. Patchell we are enabled to give in fuller detail the particulars and illustrations of the last completed of the three undertakings named, i. e., the Ferndale collieries installation, for which he was consulting engineer. Here again a special power station has been put down. This is situated at Tylorstown, and the building is constructed on a steel frame which sustains the whole weight of the roof and upper floors, the brickwork serving merely to clothe the skeleton. The reason why this type of building was adopted was the ever present possibility of subsidence at the surface of a colliery. The north end of the station is temporary, so as to admit of future extensions. The building is served by a twenty-five-ton overhead traveling crane having a sixty-seven-foot span.



PLAN AND SECTIONAL VIEW, POWER STATION, FERNDALE COLLIERIES

Four water-tube boilers of the Stirling three-drum type are installed, each having 6,209 square feet of heating surface. Each boiler is provided with two underfeed mechanical stokers and a superheater of the McPhail type with 800 square feet of heating surface, and is capable of evaporating 30,000 pounds of water per hour at a pressure of 180 pounds per square inch and imparting a superheat of 150 degrees Fahrenheit.

The stokers are worked by a system of forced draught, which is supplied by two Musgrave fans, each being belt-driven from a motor.

The boilers are arranged in two batteries, each battery being connected by a breeched piece to a steel chimney seven feet in diameter and seventy-five feet high.

The coal used is run into Messrs. D. Davis & Sons' private siding from the Taff Vale Railway, where the wagons are

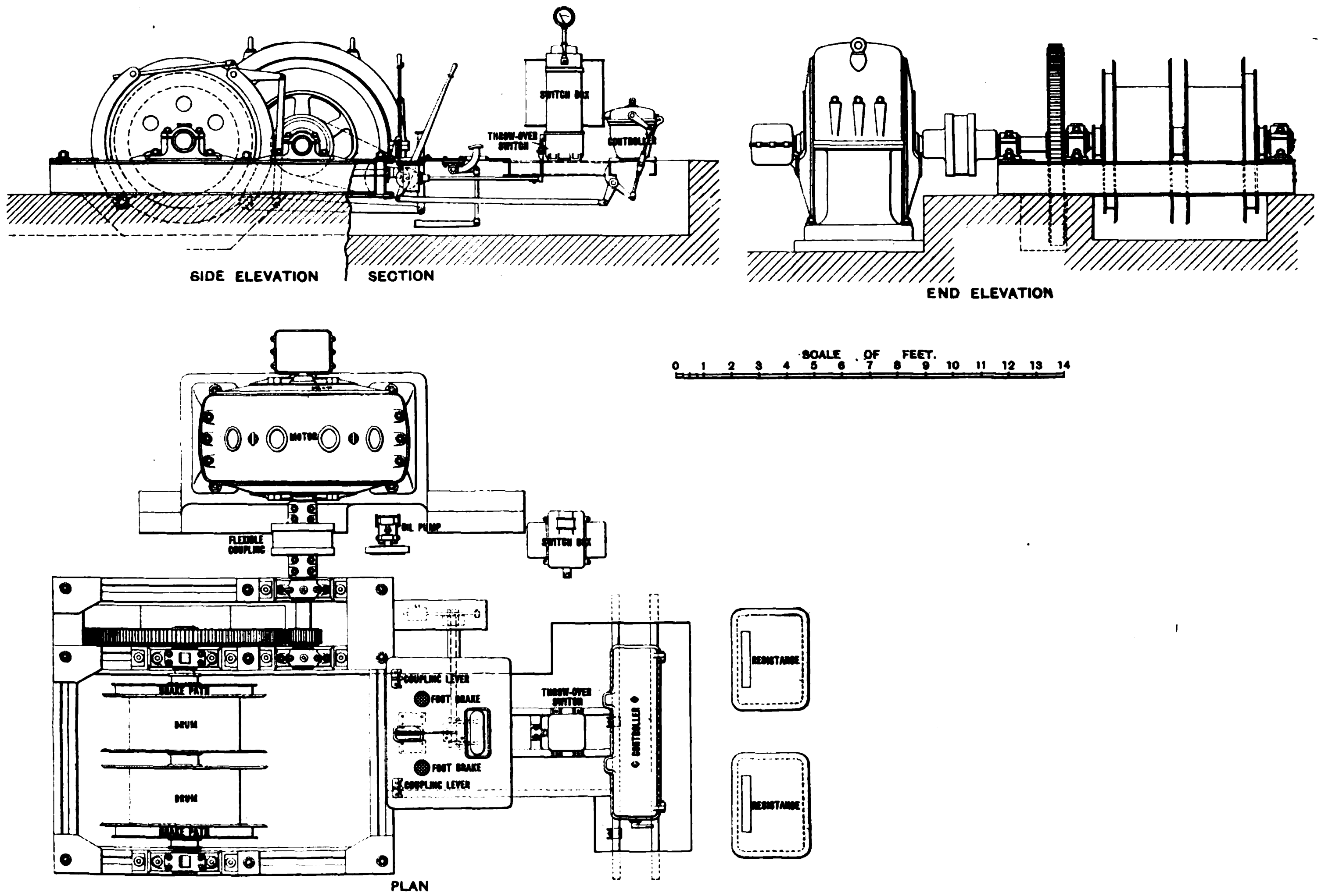
The ash from the stokers is removed by opening a sluice valve under the boilers, when the ash falls into narrow-gauge trucks in the boiler-room basement.

The water supply is pumped from Messrs. Davis's No. 8 pit, close by, and is stored in a large cast-iron tank outside the building. There is also storage in a large tank 100 feet long under the boilers.

The feed pumps, of which there are three, are of Messrs. Clarke, Chapman's make, tandem-compound, each capable of delivering 5,000 gallons of water per hour against the boiler pressure.

The exhaust steam from the pumps is

low-pressure, fifty-six inches; the stroke, fifty-five inches; speed, ninety-four revolutions per minute; working pressure, 170 pounds per square inch, with superheat of 150 degrees Fahrenheit at the stop valve. Each engine is supplied with two jet condensers and feed-water heaters. The injection water is taken from cooling tower concrete tanks through a main four feet in diameter buried in the engine basement floor, and after passing through the condensers is collected in a wrought-iron hot-well main. The circulating water is lifted to the cooling towers by centrifugal pumps connected to the hot-well



ARRANGEMENT OF THE 200-HORSEPOWER HAULAGE, FERNDALE COLLIERIES

tilted by hydraulic rams which are worked from the boiler feed pumps. The coal having been tilted into a hopper, it is then carried by a motor-driven inclined band conveyor into and along the boiler room, where by means of a throw-off carriage the coal is discharged into the bunkers above the boilers, which have a capacity of 150 tons, and is carried by chutes at the bottom of the bunkers to the stoker hoppers. The conveyor carries twenty tons of coal per hour and runs almost noiselessly.

taken to a Cochrane open-type exhaust steam heater, where it heats the feed water on the suction side of the pumps.

For use in emergency there is provided a Worthington tank pump, which draws from the river in the unlikely event of water from the mine failing.

The three main steam engines are of the cross-compound type made by Messrs. Sulzer Brothers, each capable of giving 2,500 horsepower at normal load. The dimensions of the cylinders are, high-pressure, thirty-three and one-half inches;

There are three natural draught wrought-iron cooling towers thirty-three feet in diameter and eighty-three feet high. The circulating water enters about thirty feet from base and is discharged into wooden troughs, which equally divide the water on cross timbers beneath, and so break it up into a fine rain; after cooling the water is collected in the concrete tanks under the towers.

The three-phase generators, coupled direct to Sulzer engines, are of the revolving-field, flywheel type, each having a normal continuous output of 1,600 kilowatts at a power factor of 0.85 and a potential of 2,200 volts, and having an overload capacity of twenty per cent for two hours, or thirty per cent for half an hour. The guaranteed temperature rise is not to exceed forty-five degrees centigrade after ten hours' full load run as measured by thermometer. These generators are of the Lahmeyer Electrical Company's make.

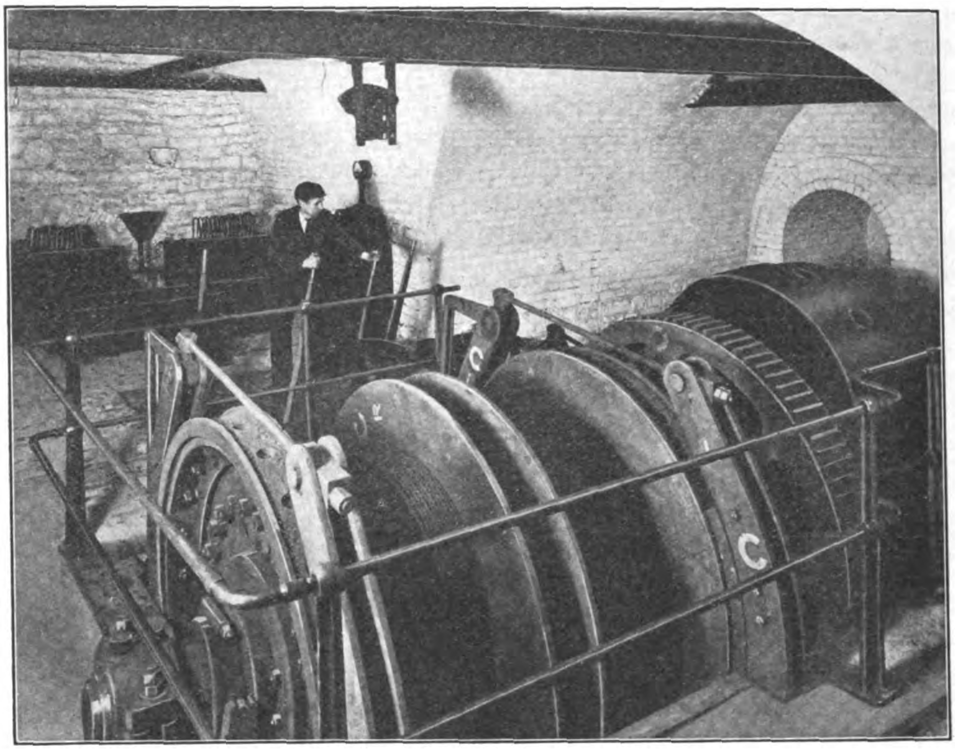
The total weight of each generator is 107 tons; of the revolving field, approximately seventy-five tons. The generators are separately excited at 200 volts from a seventy-five kilowatt Bellis-Lahmeyer exciter running at a speed of 525 revolutions per minute.

As a spare to the Bellis exciter there is a 100-120-kilowatt motor-generator booster set, consisting of a 180-horsepower, 2,200-volt, three-phase motor, coupled to a shunt-wound, 120-kilowatt generator. The booster is mounted at the end of the shaft and is capable of raising the voltage from 200 to 290 volts to charge the Tudor battery; the latter has a capacity of 380 ampere-hours when discharging at a thirty-eight-ampere rate and consists of 115 cells. The regulation is done by hand by a twenty-one-contact regulating switch. The battery can also be charged by the Bellis set, the generator of which is arranged so that its voltage can be increased to 290 volts in order to allow of its acting as a spare in case of a breakdown in the motor-generator set.

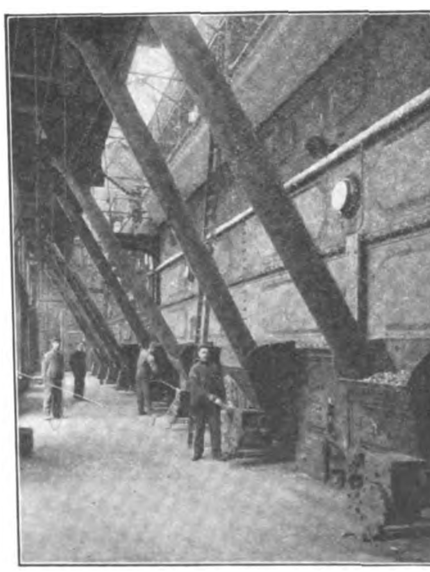
The electric current is taken from the generators to the main switchboard, which is situated at the south end of the building and is of the most modern type. The operating platform is occupied by a series of desks from which the main generators are controlled and switch pillars controlling the feeders. These desks and pillars merely carry switch-handles and low-tension instruments. The actual switches themselves are enclosed in a lower story. This has the advantage of giving ample room for the disposition of the high-tension gear in a chamber which need only be visited for the purposes of inspection and leaves the switchboard operators free to attend to their duties on the platform, which is claimed to be even safer than a switchboard of an ordinary low-tension station. These switches have been provided with Ferranti time-limit relays.

The current is taken from the power station by main feeders to distributing centers at the various pits. The motors are generally worked at 2,200 volts, but in certain places, in accordance with the Home Office rules, the current has to be stepped down by transformers to 400 volts.

Nos. 6 and 7 pits are only about 900 yards from the power station; the current, therefore, is taken direct to them at 2,200 volts. In the case of Nos. 1 and 5 pits, at Ferndale, which are 2,500 yards away, and Nos. 2 and 4 pits, which are some 2,000 yards further up the valley, the current is stepped up to 6,600 volts and transmitted by bare overhead wires which are run on duplicate poles. Step-down transformers are fixed at sub-stations convenient to the pits, where the pressure is again reduced to 2,200 volts, or 440 volts, as required.



200-HORSEPOWER HAULAGE IN NO. 1 PIT OF THE FERNDALE COLLIERIES



BOILER HOUSE IN POWER STATION OF FERNDALE COLLIERIES

Some twenty-two haulages are being installed, varying in size from 200 horsepower to fifty horsepower. The gears were made specially heavy, to Mr. Patchell's specification, by the Uskside Engineering Company. Slow-speed motors have generally been adopted and the electrical equipment is of massive construction supplied by the Lahmeyer Company. The controllers are of a new design arranged by the consulting engineer.

The haulages are generally of main and tail type and work at a speed of six miles an hour. They are principally of single reduction, but in some cases to suit the exigencies of the positions in which they had to be installed, double reduction type has been chosen. In all cases there is a flexible coupling between the motor and the gearing which to a very large extent takes the jar of the gear off the motor. These electrically driven gears are very popular with the drivers; and, owing to their reliability and ease of working, not only have great economies been effected over the old steam-driven haulage gears, but it has also been possible to obtain a greatly increased output, as there are no delays in starting up, the haulage gear commencing work immediately the driver manipulates the lever.

The underground pumping is now being handled electrically; in some cases by three-throw pumps made by the Uskside Company, and in other cases by high-lift Sulzer centrifugal pumps.

VENTILATION.

Ventilation is a most important part of the work, not only from the colliery manager's point of view, but also inasmuch as the continuous user makes it a most desirable load for the power station. At the new pit a "Sirocco" fan has been put down to handle 300,000 cubic feet of air per minute at a four-inch water gauge. This fan is driven electrically from either end of its shaft by two Lahmeyer motors working at 2,200 volts. One of the "Schiele" fans, which has been driven for several years by a steam engine and supplying 300,000 cubic feet of air per minute at 3.5-inch water gauge, has lately been converted to an electrical drive. Two other "Sirocco" fans are at present being installed.

The new pit is being entirely equipped with electrical machinery, including a winder, which is being manufactured by the Lahmeyer Electrical Company. It will work on what is known as the "Ilgner" system and is constructed to raise 1,800 tons of coal a day.

The consulting engineer, W. H. Patchell, of Caxton House, Westminster, has for many years been largely identified with the introduction of electricity for mines and was the electrical member of the Home Office Departmental Committee of Great Britain for the drafting of suitable rules for the use of electricity in mines. He has collaborated throughout with David Hannah, manager to the Ferndale collieries.

We understand that what is claimed to be the first large electric winding engine erected in the United Kingdom has just been put down at the Maritime pit of the Great Western Colliery, Pontypridd. In this case G. J. Hooghwinkel is consulting engineer.

Telephone Company Demands Portion of Telegraph Tolls.

The Cumberland Telephone Company has made a demand on the Western Union and Postal Telegraph companies, at New Orleans, for fifteen per cent of the tolls of messages which they transmit over the telephone instead of by messenger. The telegraph companies assert their right to use the telephones for any legitimate purpose, and refuse to pay the commission demanded, which makes it likely that they will order their instruments removed, for this was done under similar conditions in Chattanooga.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

MONTGOMERY LIGHT AND POWER.

The Montgomery (Ala.) Light and Power Company's report for the year ended June 30, 1908, is as follows: Gross, $320,375; expenses, $151,508; net, $168,867; interest, $103,194; surplus, $65,673; reconstruction reserve, $12,000; net profits, $53,673; equal to 2.6 per cent earned on the $2,000,000 capital stock. The net profits for the preceding year were $48,983.

PORTO RICO RAILWAYS.

The report of the Porto Rico Railways Company for the month of September and nine months ended September 30 shows as follows: September gross, $34,082; expenses, $19,649; September net, $14,433; nine months' gross, $277,233; expenses, $159,278; nine months' net, $117,955, as compared with $107,142 for the preceding year, an increase of $10,813.

TWIN CITY RAPID TRANSIT.

The report of the Twin City Rapid Transit Company for the month of September and nine months ended September 30 is as follows: September gross, $583,876; expenses, $276,588; September net, $307,288; charges, taxes and preferred dividends, $138,667; September surplus, $168,621; nine months' gross, $4,765,801; expenses, $2,372,024; nine months' net, $2,393,776; charges, taxes and preferred dividends, $1,145,122; nine months' surplus, $1,248,654, as compared with $1,323,094 for the same period of 1907.

DETROIT UNITED EARNINGS.

The report of the Detroit United Railway Company for the month of September and nine months ended September 30 shows as follows: September gross, $668,489; expenses and taxes, $423,136; net, $245,353; other income, $5,028; total income, $250,381; charges, $135,049; surplus, $115,332, comparing with $114,478 for September, 1907. January 1 to September 30: Gross, $5,324,855; expenses and taxes, $3,395,252; net, $1,929,603; other income, $45,055; total income, $1,974,658; charges, $1,218,860; surplus, $755,798, comparing with $888,241 for the corresponding period of last year.

LITTLE ROCK RAILWAY AND ELECTRIC.

Little Rock Railway and Electric's earnings for September and nine months ended September 30 are as follows: September gross, $54,655; expenses and taxes, $27,340; September net, $27,315; charges and sinking fund, $10,605; balance, $16,710; other deductions, $3,000; September surplus, $13,710, comparing with $21,592 for 1907. Nine months' gross, $495,817; expenses and taxes, $254,909; nine months' net, $240,908; charges and sinking fund, $90,796; balance, $150,112; reserve funds, $27,000; nine months' surplus, $123,112, which compares with $147,753 for the corresponding nine months of 1907.

TOLEDO RAILWAYS AND LIGHT.

The report of the Toledo Railways and Light Company for the month of September and nine months ended September 30 is as follows: Month of September: Gross, $222,891; expenses and taxes, $111,899; net, $110,992; other income, $61; total income, $111,053; charges, $71,976; surplus, $39,077. January 1 to September 30: Gross, $1,864,822; expenses and taxes, $1,019,823; net $844,999; other income, $3,072; total income, $848,071; charges, $635,743; surplus, $212,328. This is a decrease of $7,176 from the surplus for the corresponding months of the preceding year.

MEMPHIS STREET RAILWAY.

Memphis Street Railway's report for September and nine months ended September 30 is as follows: September gross, $143,044; expenses and taxes, $88,971; September net, $54,073; interest charges, $35,532; balance, $18,541; reserve fund, $2,500; September surplus, $16,041, compared with $20,304 for September, 1907. Nine months' gross, $1,199,765; expenses and taxes, $760,319; nine months' net, $439,446; interest charges, $314,970; balance, $124,476; reserve fund, $22,500; nine months' surplus, $101,976, as against $136,037 for the preceding year.

BIRMINGHAM RAILWAY AND LIGHT.

The Birmingham (Ala.) Railway, Light and Power Company's report for September and nine months is as follows: September gross, $177,891; expenses and taxes, $122,266; September net, $55,625; charges and sinking fund, $43,617; September surplus, $12,008, as against $29,363 in 1907. Nine months' gross, $1,586,026; expenses and taxes, $1,037,924; nine months' net, $548,102; charges and sinking fund, $394,772; nine months' surplus, $153,330, as against $190,013 for the corresponding quarters of 1907.

TWO-MOTOR-DRIVE WEB PRINTING PRESS, MANUAL CONTROL.

BY S. H. SHARPSTEEN.

A diversity of opinion exists among newspaper people as to which is the better, manual or automatic motor control. This is due in part to there being no data compiled to which the printer can refer and get the information that will enable him to review clearly all the questions involved.

The man in charge of the apparatus that drives the presses to print one of the large New York city dailies, when asked why he did not install automatic or push-button control on a web press, recently purchased, said, that he had just about press capacity sufficient to produce the editions in the allotted time, and that he was compelled to use apparatus with the least complication to permit of easy inspection.

In another press room of a metropolitan daily, where there is a recent installation of newspaper web presses, the electrician stated that the coils in the automatic devices sometimes burned out. On asking him what was done if a solenoid coil failed while a press was producing, he replied that in such an emergency the press was shut down until a coil could be taken from the control panel of an extra press equipment. The coil could be changed from one panel to another more quickly than the plates could be transferred from press to press.

It is now pretty generally understood in the newspaper world that where automatic or push-button control is used in the press room of a large daily, an extra press and electrical equipment is necessary to allow repairs when the control of an equipment goes out of commission. As a precaution an extra press would probably be installed regardless of the control in a new, large newspaper plant.

The business manager of a New York daily investigated web-press drive and control during eighteen months or more. Newspapers throughout the United States that were using electrical drive and control were consulted and the data thus received were carefully arranged by an electrical engineer. Manual control was chosen and installed; one man at the controller is responsible for the movement of the press. The only remote control used in this installation is the emergency stop, push-buttons being placed in positions of easy access about the press, to be used in case it is desired to stop the press quickly.

The men in a press room are often placed under a mental strain that tends to cause them to do foolish things. As an example: After the stock exchange closes there is a rush from the time the last news comes into the office of an evening publication, until the papers are being delivered. The newsboys are anxious to be first on the street with the Wall Street editions, and the delivery men have trains that should be met. As the last plates are securely fastened and the familiar roar of the presses goes out, there is a general stir among the people who take the papers. The business manager, possibly in a distant office, has been anxiously looking at the indicators, and as the presses are going on time he settles back in his chair with a contented expression on his face. Now let something happen in the press room that cuts short the product about the time the papers commence to pass out, and excitement seizes every man about the place. A short holdup is not important, but long delays at such time are serious, and each pressman is usually very eager to hurry things all he can to get the press running. With control stations located about the press room and possibly on a floor below, men will sometimes push the wrong button or one man pushes a button causing the press to do one thing, and another man at some other station pushes a button to perform a different movement, and serious trouble may follow. Much time and money have been spent to make automatic control devices interlocking to prevent trouble of this kind, but it seems impossible. With automatic control the service switch, through which current passes for all the devices of an equipment, is located, as a rule, on the controller panel in some remote place near a wall to which the panel can be fastened, and which also makes a fireproof back for the resistances. If the complicated devices for quick shutdown operated by a small switch or push-button and many feet of small wire gets out of working condition and some trouble with the press requires a quick stop, the pressman must hunt, possibly, on a long row of panel boards among many switches, for the one that will cut the equipment in distress from the line. If the motor did not respond to the emergency button, the slowdown and stop button would bring the equipment to rest, but might be too slow to save serious trouble. A second or duplicate quick-stop device could be installed to make an emergency stop more sure. In some cases a dynamic brake is used on large press equipments, in connection with an emergency stop, and these should be tried every day, while the press is out of use, to see if they are in good working condition. When a large web press is running at a high speed and is stopped quickly by the use of a dynamic brake there is excessive strain on press and motor, in many cases pitting the commutator; hence, the tests are seldom made, and defects not properly looked after.

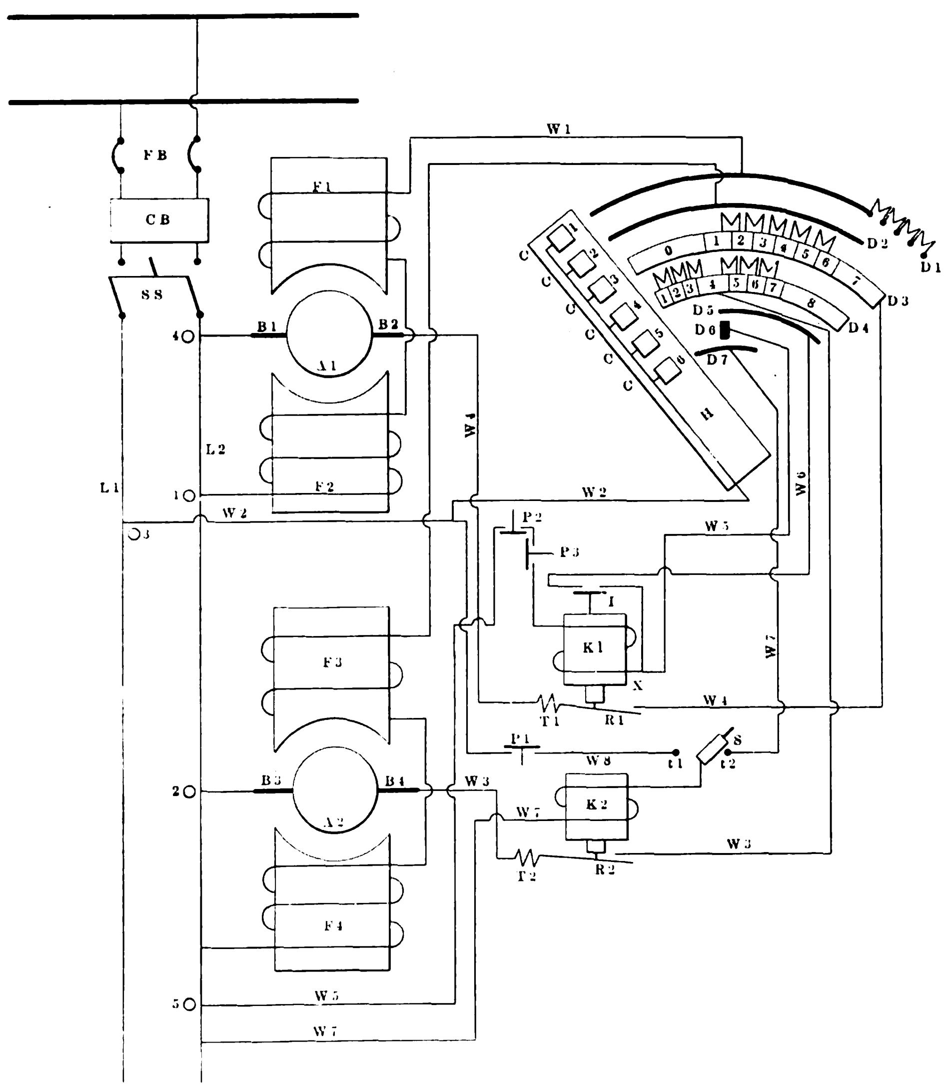
There is another side of this question. The home of a newspaper is of interest to the masses who read the paper. An imposing building, properly equipped inside, is important; a number of modern presses controlled as if by magic is no small factor in swaying the mind of the public.

Important dailies that have automatic control keep a good electrician constantly in attendance, especially when the presses are running. This is a reflection on the electrical industry. The proper electrical apparatus, when well installed, to drive a web printing press, should not demand as much attention to keep it going as a train of cars in the subway. The idea of having an electrician constantly on duty when a web press or presses are running is as unnecessary as it would be to have a high-priced electrician on every subway train. When running pastes are made on the floor below the press room and presses, it is convenient to have a press-control station near the paper supports, to enable an employe that is looking at the paste as it is made, to operate the press in a proper manner. In many cases the manual control could be located to allow the operator to see, through a hole in the floor, the pasting being done. A few signal lamps, a speaking tube, or a similar device, could be used.

The diagram herewith illustrates a simple form of two-motor drive and manual dial-type controller, F B being two cartridge fuses, one in each side of the circuit. If the ordinary bare fuses are used they should be enclosed in a fireproof box.

A web-press equipment should contain a substantial double-pole knife switch provided with a make-and-break device that will prevent arcing at the blades and jaws, especially if it opens and closes the field or fields of the motor or motors. The service switch S S ought not to be left to a contractor to buy in the market what is called standard goods. It should be a first-class article of a type that has proven by long and hard usage that it will stand printing-press work without requiring special attention. In many cases a switch of a certain amperage has been specified, the contractor selecting, from a catalogue, the cheapest one of the required capacity, that the fire underwriters will pass. With an ordinary stationary motor that is stopped and started but twice each day this switch might answer, but in web-press work, with manual control the switch is opened and closed many times each day, and constant use causes the pressman to handle it roughly. This switch ought to be placed on a substantial support near the controller, to enable the pressman operating the press to open it quickly in case of trouble that puts out of commission the other press-stopping devices, and since both polarities of the circuit come close together at the jaws and blades of the switch, it should be located between two slate or marble pieces to prevent wrenches or other tools being carelessly put across it, causing a bad burn. It is a familiar sight to see a careless employe use the hand that contains a wrench or oil can to open a switch on a printing press. In a rush a pressman might unintentionally do the same, causing a short-circuit, burning his arm or hand, and damaging a switch jaw or blade, making a delay in getting off an edition. These switches are sometimes placed in a small fireproof box and provided with lock and key to prevent the circuit being closed by some careless person when the pressmen are away.

When a web press is to be driven by an electric motor, if the current is to be taken from a large generator or from street service, it is well to understand that large quantities of electricity are ready to rush in and cause the motor to develop double its normal power or torque, or make a bad flash and burn if the insulation fails. It takes time for a fuse to blow, and since electricity is so quick, and there is such a large quantity to come, the sure way to protect a motor installation is by installing a double-pole circuit-breaker at C B, made by a responsible company, the breaker having a good record. In the press room of one of the Baltimore dailies a press, equipped with



TWO-MOTOR-DRIVE WEB PRINTING PRESS, MANUAL CONTROL.

motor drive, while standing still, the controller at the off position, was wrecked by the insulation breaking down between the frame of the motor and one of the series coils, allowing an excessive current to pass through the series winding and the armature with small or no resistance in circuit.

A good breaker, properly set, should have prevented the inrush of energy that stripped the press gears and put the equipment out of commission until new parts could be expressed from the press makers.

Consider that A 1 is the armature, F 1 and F 2 the field magnets of the main driving motor, A 2 the armature, and F 3 and F 4 the field magnets of the auxiliary motor for slow speeds.

When ready to move the press ahead, close the service switch S S on the line and the small switch S in the jaw J 2, and move the arm H slowly to the right. When brushes C 1 and C 2 touch on dials D 1 and D 2 the field magnets of both motors will be excited. The field circuit of the main motor connects with one side of the line L 2 at O 1 and is made up of field magnets F 2 and F 1, wire W 1, controller dial D 1, controller brush C 1 and wire W 2, which connects with the other side of the line L 1 at O 3. The field circuit of the small motor takes a similar course, but uses dial D 2 and controller brush C 2. Next, the small motor armature circuit closes in the controller as C 4 touches point 1 on dial D 4. Later, C 6 touches D 7, exciting contactor K 2, making the final close at R 2 in the armature circuit of the small motor, when it should turn slowly. The small armature circuit leaves line L 2 at O 2, and is formed of brush B 3, armature A 2, brush B 4, wire W 3, magnetic blowout coil T 2, contactor make and break R 2, a second portion of wire W 3, dial and part of resistance D 4, controller brush C 4, then by means of wire W 2, it is connected to line L 1 at O 3. When C 4 passes onto point 4, dial D 4, the resistance will be out of circuit with armature A 2, and the small motor will run at maximum speed, the press and large motor at a very low speed.

When ready for press production, continue to move arm H to the right, when C 3 should make good contact with point 1, dial D 3, closing the armature circuit of A 1 in the controller before brush C 5 touches D 5 and D 6. The instant that wire W 5 is closed at C 5, and D 6, the contactor is excited and makes the final close in the circuit of armature A 1 at R 1, when the large motor will develop torque, and drive the press at an increased speed, letting the small motor run free. During the travel of the arm H to the right, resistance will be cut in circuit with armature A 2 and out of circuit with A 1, the result being that the press will come to production speed and when C 6 leaves D 7 contactor K 2 will open at R 2; current will cease to pass through armature A 2, which, being connected to the press shaft or large motor shaft by a ratchet drive, will come to rest. The large motor armature circuit leaves line L 2 at O 4, passes through brush B 1, armature A 1, brush B 2, wire W 4, magnetic blowout coil T 1, contactor make and break at R 1, a second section of W 4, dial and resistance D 3, controller brush C 3 and wire W 2 to line L 1 at O 3.

The contactor is a type of automatic switch, which can be employed in a web printing-press equipment to advantage, especially where hand control is used.

If properly constructed and provided with magnetic blowout T 1, it will make and break the main current in a manner to prevent destructive arcing. It will provide a no-voltage release and can be operated by remote push-buttons to move the press slowly for make-ready and threading.

The exciting circuit W 5 of contactor K 1 leaves line L 2 at O 5, passes through push-button P 2 and P 3 coil of K 1, a second section of wire W 5 to D 6 and by means of C 5 and wire W 2 is connected with the line L 1 at O 3. This contactor provides a no-voltage release, and for this purpose is supplied with an auxiliary controller circuit leaving W 5 at X, and when the plunger is up in K 1, it passes through I, and by means of wire W 6 is connected with D 5.

As the controller arm H moves to the right, brush C 5 leaves D 6 before the motor comes to speed, and the arm is let rest, but the contactor K 1 is kept closed by its second controller circuit W 6. If the current should be cut off the line while running for production, the contactor K 1 would open both the main armature circuit at R 1 and the auxiliary contactor exciting circuit at I, as the plunger fell for want of excitation.

When the normal voltage of the system is returned, the main exciting circuit of K 1 will be open at D 6 and its auxiliary exciting circuit at I. Since no current can pass through the exciting coil it will not close the armature circuit of A 1 at R 1, and the arm H will have to be moved toward the left or off position until C 4 touches point 7, dial D 4, and C 6 touches D 7, starting the small motor, and later when C 5 touches D 6, the starting resistance of the large motor will again be in circuit to allow the large driver to commence furnishing torque under the proper conditions.

The press should be piped for four small wires and provided with outlets at convenient places for push-buttons. One circuit, placed in this pipe and supplied with push-buttons P 2 and P 3, and looped into the coil winding of K 1, will allow the exciting circuit of this contactor to be opened from convenient points by the pressman, and the press stopped while running for production. A second circuit, placed in the pipe and supplied with buttons like P 1, and looped into the coil circuit of K 2, will provide remote control for slowly moving the press.

During repairing or threading paper the press can be moved without a man stationed at the controller H. When the switch S is closed on jaw J 1, the contactor K 2 can be excited, independently of the controller arm, by the use of the button P 1 and the auxiliary circuit W 8, leaving W 7 at the switch S and passing to line L 1 by way of W 2 without going through D 7. When this remote control is desired, the controller arm is moved to the right until C 4 rests on point 1 or 2 of dial D 4 and S is closed on J 1; then, when the open-circuit push-button P 1 is held down, the exciting coil of K 2 is closed across the line, causing R 2 to close and pass current to start the small motor on a portion of its armature resistance.

When the plunger in K 1 falls and opens the armature circuit of the large motor at R 1 it could be made to close part of a dynamic or other brake device. If a dynamic brake were used, it would not be allowable to have this plunger, when it moved down, make the final close in the dynamic or brake circuit across the armature terminals of A 1. It would be necessary to add an automatic brake switch, controlled by push-buttons, about the press, to be used to make the final close in the dynamic-brake circuit. This plan allows the stop-button to be pushed and the press stopped by simply cutting off the current and letting the press come to rest without using a brake. If a very quick stop is needed, after the button for cutting off the current is pushed, the brake-button, if held down, will apply the brake. An automatic switch for this purpose will have to be of a type that will open when the push-button is released.

Water-Power Development at Great Falls, Mont.

Plans are being perfected by Chas. T. Main, engineer, Boston, Mass., for the immediate development of two powers near Great Falls, Mont.

The upper development is to be made at the falls known as Coulter's, Crooked and Rainbow, situated about three miles down the river from Great Falls. At this point the head will be about 105 feet high. A crib dam about twenty-five feet high will be built with masonry head gate, and waste-gate structures. A steel penstock twenty-two feet in diameter and about 2,500 feet long will extend from the intake to the power house. The latter will be of masonry construction, containing about 30,000 horsepower of wheels and electrical apparatus.

The lower development is about twelve miles below Great Falls. Here the fall is about the same as at the upper development. The dam will be of the same construction as at Rainbow Falls, the canal being 500 feet long, and directly below this, the power house. The equipment will be a duplicate of that at the upper development.

The engineering corps, already organized by Mr. Main, is now busily engaged in making surveys and in the preparation of plans. The work on the coffer dams is already begun, and it is expected to push the work of development to completion as fast as possible.

A considerable portion of the power developed will be used at the Boston & Montana Smelter, at Great Falls, Mont. The balance will be transmitted to more distant places.

Engineers' Society of Milwaukee.

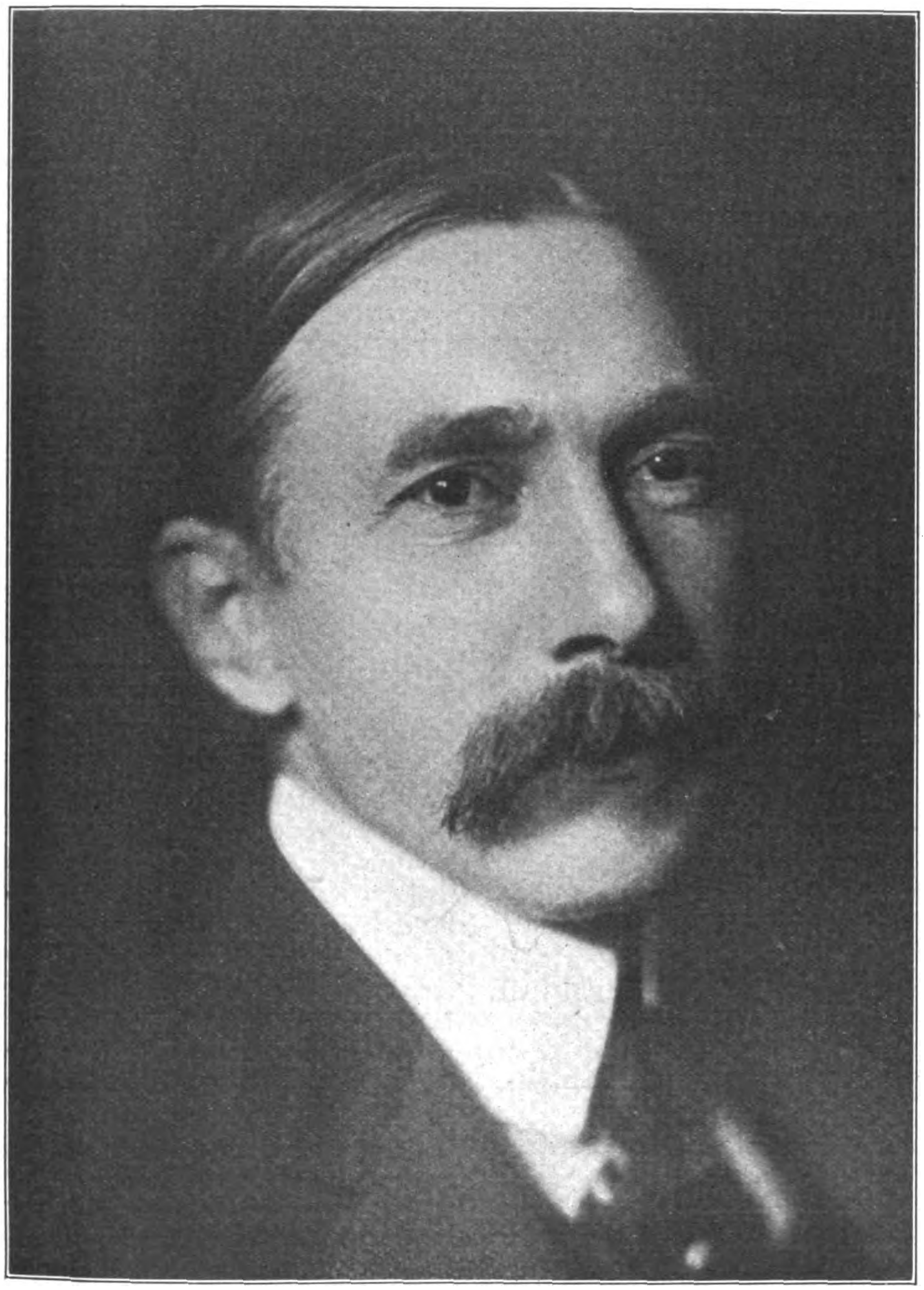
At the next monthly meeting of the Milwaukee Society of Engineers, which will be held on Wednesday evening, November 11, at the Builders' Club, 456 Broadway, Milwaukee, Wis., E. M. Griffith, state forester, will deliver an illustrated lecture upon "The Close Relation between the Forest Reserves and the Water Powers of Wisconsin." Besides discussing the general subjects of forestry and reforestation in their national and state aspects, the lecture will treat especially of the influence of forests in the regulation of stream flow, storage reservoirs, and waterpowers of Wisconsin. Invitations for the lecture may be obtained upon application to the secretary, W. Fay Martin, 456 Broadway, Milwaukee.

FREDERICK A. C. PERRINE.

BY RAY D. LILLIBRIDGE.

The death of Frederick A. C. Perrine, on October the twentieth at his home in Plainfield, N. J., after a protracted illness, has cut short one of the most promising careers in the engineering world, and one which is surpassed by few in actual accomplishment.

Dr. Perrine was of the highest type of young American engineer and man of affairs, and was a leader among the talented, earnest and well-trained men who have built up the standing of this country in applied science. He was born at Manalapan, N. J., in 1862, and received his education in that state, graduating from Princeton College in 1883, and receiving there subsequently the degrees of D. Sc. and A. M. A bent toward practical electricity resulted in his occupying positions of increasing responsibility in that field of engineering, then in the first stages of the wonderful expansion that it has undergone during the last three decades and to which Dr. Perrine contributed in an eminent degree. His distinguished career is, indeed, closely identified with the history of electrical engineering in this country. His work as chief engineer of the first great long-distance electric transmission line in this country—that of the Standard Electric Company of California—attracted attention the world over, and in recognition of this work he was awarded a gold medal by the Paris Exposition in 1900.



DR. FREDERICK A. C. PERRINE.

In addition to labors in important executive positions, like the presidency of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., which he held from 1900 to 1905, he gave much of his best strength to a number of scientific and engineering societies, of which he was a member and for which he wrote many papers. He also devoted himself to technical editorial work, and to education—to the latter notably as professor of electrical engineering at Leland Stanford, Jr., University, from 1893 to 1900. He was also the author of a standard work on "Conductors for Electrical Distribution." For the last three years he had been devoting himself to consulting engineering, with offices in New York city.

Some of the societies of which Dr. Perrine was a member are the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the Institution of Electrical Engineers, of England. He was also a member of the Lawyers' and Engineers' clubs of New York city. In 1892 Dr. Perrine married Margaret Roebling, daughter of Ferdinand W. Roebling of Trenton, N. J., who, with their three children, survives him.

Pennsylvania Terminal Electrification Contract Let to Westinghouse Company.

Plans for the electrification of the Pennsylvania Railroad terminals in New York city have been announced with the signing of a $5,000,000 contract for the work with the Westinghouse Electric and Manufacturing Company. This action followed a meeting of the Pennsylvania directory in Philadelphia.

The contract is for the electrification of the entire Pennsylvania system from Harrison, N. J., to Jamaica, L. I. While the initial amount of apparatus will aggregate $5,000,000, this is said by no means to represent the full amount.

The Westinghouse company installed the 11,000-volt, twenty-five-cycle, single-phase system of the New York, New Haven & Hartford Railroad Company from Woodlawn, twelve miles from the Grand Central Station, to Stamford, Ct., and the award of the Pennsylvania contract to this company is to be taken as evidence that a similar double-catenary, single-phase trolley system will be used in the New Jersey, New York & Long Island electrification.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER I. — (PART VI.) GENERAL PRINCIPLES. GRAPHICAL REPRESENTATION.

COMBINATION OF OHMIC RESISTANCE AND REACTION.

The ordinary or ohmic resistance of any of the coils just named cannot be added directly to the reactance to obtain the total opposition to the flow of current. The two can only be added as two forces are added that are acting on the same body at right angles to each other, as shown in Fig. 14.

Consider a body at A acted upon by two forces represented both in magnitude and direction by the lines A B and A D. The resultant, according to the parallelogram of forces, is represented both in magnitude and direction by the diagonal A C. Or, by geometry, the resultant A C can be expressed as follows:

$$AC = \sqrt{AB^2 + AD^2}$$

EXPRESSION FOR IMPEDANCE.

In a similar way the total opposition to the flow of an alternating current, that is, the impedance can be represented as the square root of the sum of the squares of the resistance and the reactance, thus:

$$Z = \sqrt{R^2 + X^2}$$

where Z represents the impedance, R the resistance and X the reactance; but since

$$X = 2\pi f L$$

on substituting,

$$Z = \sqrt{R^2 + (2\pi f L)^2}$$

or the current in such a circuit would equal

$$I = \frac{E}{\sqrt{R^2 + (2\pi f L)^2}}$$

It will be noticed from this expression that when L is zero the term $2\pi f L$ disappears and

$$I = \frac{E}{R}$$

which is the expression for the current in a direct-current circuit or in an alternating-current circuit when there is no inductance.

COMPONENTS OF ELECTRIC FORCE.

From the expression above it is evident that electromotive force E can be considered as made up of two components, thus:

$$E = I\sqrt{R^2 + (2\pi f L)^2}$$

or

$$E = \sqrt{R^2 I^2 + (2\pi f L)^2 I^2}$$

Note.—This serial was begun in the Western Electrician of October 3, 1908.

where R I is the ohmic potential drop and $(2\pi f L)$ I is the inductive drop. These two quantities can be represented graphically as two potential differences acting at right angles to each other just as the two forces were represented in Fig. 14. For example, in Fig. 15, let A C represent the ohmic drop I R, and B C represent the inductive drop $2\pi f L I$, then the line A B will represent E. As a concrete example, suppose I R equal 100 volts and $2\pi f L I$ equal 50 volts, then E would equal

$$\sqrt{100^2 + 50^2} = \text{about 112 volts.}$$

Or the result can be obtained graphically from Fig. 15. If A C be drawn to represent 100 units and B C to represent 50 units, then A B will represent 112 units nearly.

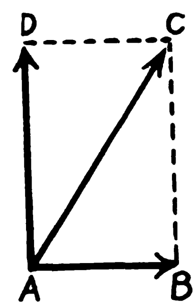


FIG. 14.—PARALLELOGRAM OF FORCES.

Suppose that under the above conditions a current of 10 amperes was flowing; then, since

$$I R = 100 \text{ volts},$$

R would equal 10 ohms, and since

$$2\pi f L I = 50 \text{ volts},$$

the reactance $2\pi f L$ would equal 5 ohms. If the frequency, f, is 60 cycles per second, then

$$L = \left[\frac{5}{2\pi 60}\right] = \left[\frac{5}{377.04}\right] = .0132 \text{ henry.}$$

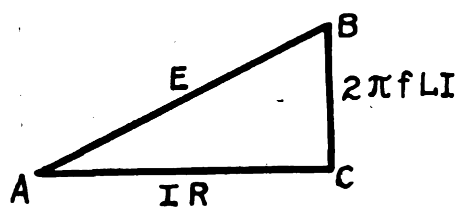


FIG. 15.—GRAPHIC REPRESENTATION OF ELECTROMOTIVE FORCES.

CALCULATION OF INDUCTANCE.

In other words, if an alternating current having an electromotive force of 112 volts and a frequency of 60 cycles per second be applied to a coil having a resistance of 10 ohms and an inductance of 0.0132 henry, a current of 10 amperes will flow.

It will be noticed that the inductance of a coil can be determined in a manner similar to the above calculation. On passing a direct current of 112 volts through the above coil a current of 11.2 amperes will be obtained, showing that the resistance R is equal to 10 ohms. With an alternating current, if the value of the current is 10 amperes, then the total expression is

$$I = \frac{E}{\sqrt{R^2 + (2\pi f L)^2}}$$

or

$$10 = \frac{112}{\sqrt{10^2 + (377\,L)^2}}$$

or

$$112^2 = 100 \quad 10^2 + (377\,L)^2$$

or

$$25.44 = (377\,L)^2$$

or

$$L = 0.0132 \text{ henry.}$$

It is to be understood that the above formula is used because it expresses the conditions that lead to a result corresponding to that obtained by experiment. It is similar in appearance to a formula expressing the resultant of two forces acting on the same body at right angles to each other, as already stated. Now the question arises as to how it is that the ohmic or non-inductive drop and the inductive drop can be considered as acting at right angles to each other?

CURVES OF COMPONENT ELECTROMOTIVE FORCES.

Suppose an alternating electromotive force is flowing through a straight conductor in the manner illustrated in Fig. 16 by the curve O B C D. There will then be no appreciable inductive effect. Let the straight conductor now be coiled and iron inserted in the coil, an induced electromotive force will appear in the coil itself, being that generated by the magnetic field when its energy reappears in the wire as an electric current as already explained. This induced electromotive force, as has been found by experiment, reaches a maximum when the current producing it is making its most sudden change, which is at the point when it is changing from a current in one direction to a current in the opposite direction.

The current curve is represented by the dotted line in Fig. 16. It passes through a zero value at the point C, and therefore this will be the point at which the induced electromotive force will reach a maximum, as shown on the curve M N P Q, which represents the curve of the induced electromotive force, or the inductive drop.

Let the curve O B C D represent the non-inductive drop or the electrical pressure that is forcing the current, represented by the dotted line, through the wire. The resultant of the inductive and the non-inductive drop is the electromotive force which must be applied to the coil to generate the current indicated by the dotted curve. It is found by adding the instantaneous values of the curves O B C D and M N P Q.

Subtracting the length 1-3 from the length 1-2, because they are in opposite directions, gives the point 1, which is on the O X axis, since the two are equal; likewise 4-5 added to 4-6 gives the point T, which is the maximum value of the new curve; 7-8 added to 7-8 gives the point W, and so on.

APPLIED ELECTROMOTIVE FORCE.

The curve 1 T S therefore represents the combined effects of O B C D and M N P Q, that is, the applied electromotive force, or, vice versa, if an electromotive force such as is represented by the curve 1 T S is applied to an inductive circuit such that the induced electromotive force is represented by the curve M N P Q, then, the active electromotive force will be represented by O B C D and the current by the dotted line.

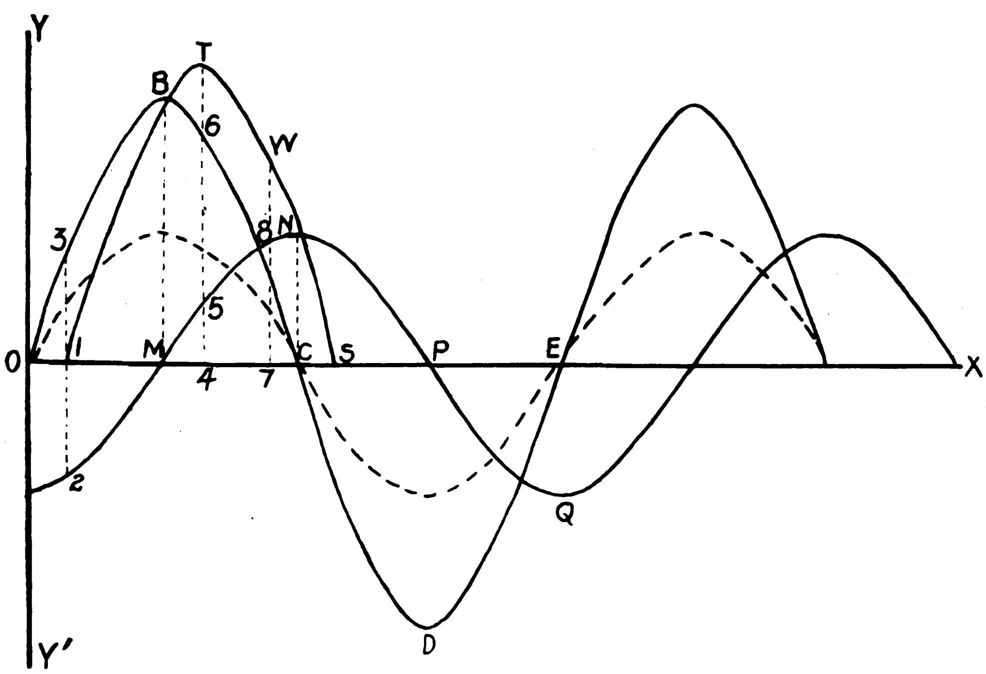


FIG. 16.—CURVES OF ELECTROMOTIVE FORCE AND CURRENT.

PHASE.

Three hundred and sixty degrees represent a complete cycle, so that the distance O E represents the time of a complete cycle, O C that of a half cycle, and O M or M C that of a quarter cycle, or 90°. The two electromotive forces O B C D and M N P Q reach a maximum one quarter of a cycle out of step with each other and are said to be 90° out of phase with each other. Representing the effective values of all of these curves by lines, a triangle similar to that of Fig. 15 is obtained. Since M N P Q is 90° out of phase with O B C D, the effective value of the latter will be represented by a line at right angles to that representing the former. It will be noticed that the applied electromotive force as represented by the curve 1 T S is out of phase with the current curve, which is represented by the dotted line. The distance 0 1 is about three-tenths of the distance O M, which represents a quarter cycle, or 90°. The two curves are therefore three-tenths of 90°, or 27 degrees out of phase with each other. The current and applied electromotive force are always out of phase in an inductive circuit.

There is a mechanical analogy to this: A pendulum may be oscillating to and fro and another oscillatory motion may be applied at right angles to the first, whereupon the pendulum will then execute a motion which is the resultant of the two.

[To be continued.]

Electricity Direct from Coal.

In a paper on "The Scientific Control of Fuel Consumption," read on September 29 before the Iron and Steel Institute, H. E. Armstrong, professor of chemistry in the City and Guilds of London Central Technical College, made some interesting observations concerning the direct conversion of the energy latent in fuel into electrical energy. He remarked that to say that this was impossible would be absurd; it was useless to exaggerate the difficulties. Hydrogen can be burned electrically in the Grove gas battery, but there is no economical process of preparing hydrogen; it can, however, be obtained by passing steam over red-hot coal, but only in admixture with carbonic oxide. "Why not burn such a mixture electrically?" it may be asked. Strange to say, not only are we unable to substitute carbonic oxide for hydrogen in a gas battery, but it puts a stop to hydrogen being used in one if mixed with it. Why this difference should obtain between the two gases, both being combustible, we scarcely know, although we may guess at the reason. Why carbonic oxide should hinder the electrolytic oxidation of hydrogen at present entirely passes comprehension. It is problems such as these, said Professor Armstrong, that we need to solve before any substantial advance can be made. No one, he continued, has yet succeeded in making a satisfactory voltaic battery with carbon, and before coal is burned electrically it will certainly be necessary to make it a conductor of electricity. "All these are tasks which we should aim at executing, whatever the difficulties in the way, the solution of such problems being of infinite importance to mankind."

Probable Earnings of the Hudson Tunnels.

In an estimate, submitted to W. G. Oakman, president of the Hudson Companies, by W. G. McAdoo, president of the Hudson & Manhattan Railroad Company, the probable earnings of the system are indicated as follows: Total net per annum, $3,810,000; fixed charges, $2,657,500; surplus, $1,152,000. Mr. McAdoo's figures are as follows:

77,000,000 passengers per annum (estimate of C. M. Jacobs, chief engineer, and Hugh Hazelton, electrical engineer) at 5 cents per passenger..................	$3,850,000
Cost of operation and taxes, at forty per cent (estimate of Hugh Hazelton, electrical engineer)	1,540,000
Net earnings from passenger traffic	$2,310,000
Net income from Terminal Buildings	1,200,000
Estimated income from baggage, advertising in cars and stations, news stands and other privileges, per annum.........	300,000
Total per annum..............	$3,810,000
Deductions from income:	
Interest on $53,500,000 Hudson & Manhattan Railroad first mortgage 4½'s (this amount estimated to be outstanding on completion of the lines) and $5,000,000 New York & Jersey Railroad 5's..................	2,657,500
Surplus	$1,152,500

ILLINOIS STATE ELECTRIC ASSOCIATION.

ANNUAL CONVENTION AT BLOOMINGTON, ILL., OCTOBER 27-28.

The Illinois State Electric Association held its annual convention at the Illinois Hotel at Bloomington, Ill., on October 27 and 28. In point of numbers of members attending and the character of papers presented, it was the best convention that has been held by the association. Special interest was shown in all the papers that were read because they had been printed before the convention met and then distributed to the members so that they were able to follow the speaker better. The weather the first day was disagreeable, but the second day turned out as fine as could be wished for. On the first day sixty-eight delegates had been registered.

President E. L. Brown of Elmwood called the convention to order on Tuesday morning, and in his address called attention to the loss of Senator John N. C. Shumway, former president of the association, who died during the past year. He also referred to the paper read before the National Electric Light Association by Mr. Doherty as to the advisability of the state organizations becoming part of the National Electric Light Association, by dropping their own name and becoming geographical parts of the national body. Speaking of governmental regulation of public utilities President Brown said: "It is easily apparent that regulation should come through the highest source possible, presumably a state board, as is in satisfactory operation in Massachusetts, Wisconsin and New York. Authority that would be removed from petty prejudice to the plane of the judicial, would have confidence of our customers, and be unlikely to place confiscatory regulations upon us. To be placed at the mercy of uninformed and transitory local officials would mean instability, endless friction and be a menace to growth and enterprise."

The first paper presented was that of J. J. Frey of Hillsboro, on "How to Finance a Small Electric Station." In this paper the methods of management that cause the failure of many small plants were briefly touched on. The author then considered the question of a new public service law and the good that would come through the appointment of a public service commission. The use of a uniform system of accounting was strongly urged so that costs could be compared in detail for similar plants.

Mr. Edwin O. Brown of Elmwood followed with a paper on "Extending Electric Service to Neighboring Towns." He described extensions of the plant at Elmwood, with which he is connected, to the nearby towns of Yates City, Brimfield, Douglas and Magnon. The longest transmission line is twelve miles, 6,600 volts being used. The entire system is laid out with great economy and is operating very successfully.

The afternoon session was opened by E. L. Smith, of Kewanee, who read his paper on "Elements of Cost of Service to the Consumer." He said that the subject was not given the attention that it deserved and that too many managers of small plants were in the habit of taking the coal cost as the cost of current. This was the case where the cost was given sometimes as only 1¼ cents per kilowatt-hour. He then gave a long list of items for both operation and maintenance that should be considered in making up the cost of the current, and the way that they might be classified so as to get the cost at the switchboard and the final cost to the consumer.

"The Advisability of Establishing a Day Circuit in the Small Town" was the subject of a paper by A. R. Manley of Mt. Carmel, who was unable to attend the convention. The paper was read by D. Davis of Litchfield. The paper was one of the best presented to the convention.

The author showed that the possibilities of the smaller localities are very frequently overlooked and neglected. While it is true that many electric light companies in the smaller towns have rather a precarious existence, this is due more to the companies themselves than to a lack of market for their product. Under anything like normal conditions, any town or city, large enough to have an electric light plant at all, can and will support a day circuit, if the opportunities for selling current are recognized and taken advantage of by the company. Most electric light plants, in towns having a population of 5,000 or under, operate either on a dark-to-midnight schedule, or, at the most on a dark-to-daylight basis. If a property remaining idle from twelve to eighteen hours of the day can be made to pay dividends, or even to meet its expenses, it would appear reasonable that, if an income could be obtained from the property during the full twenty-four hours, the profits would be much greater.

The fixed charges against the property and the depreciation are practically the same whether or not the day circuit is operated. The taxes, insurance, office expenses, etc., do not stop when the engines are shut down. The additional expenses of operating a day circuit are confined to the cost of fuel, supplies and an extra man or two. Briefly stated, all the income from the current sold in the daytime, over and above the cost of the extra fuel and supplies and the salary of the extra man or men, is profit.

All the conditions essential to the success of an electric-lighting plant are particularly so to one operating a day circuit. It is necessary to give continuous service, have a reasonable and fair rate and, most important of all, to have every service metered. It is advisable to give every patron on the lines the advantage of the day circuit—the opportunity to use current when he wants it. Under these conditions no flat-rate contract could be made that would be equitable to both consumer and central station, or that would not be abused.

Many helpful hints were given in the paper on how to bring the day service to the attention of the public and on how to conduct an aggressive campaign to further the introduction of motors, fans, signs, heating devices and all manner of electrical appliances for both industrial and household use. Reference was made to a plant whose load is practically the same summer and winter and after five years of constant advertising, constant solicitation, and which has brought the people to a point where electricity in the daytime has become a necessity and not a luxury. Every house that is built is wired and equipped, not only for lights, but for small heating appliances. The people are educated to a point where they apply for electricity for almost every purpose. The success of this plant is due largely to the fact that the service is absolutely dependable, the current not having been off the lines for more than four years. The rate is reasonable, averaging five cents for motor service and eight cents for lighting. The output has reached a point where the net profits from the day load are in excess of the profits from the night load.

During the discussion of Mr. Manley's paper the fact was brought out that, if it could be arranged so that the power user would take his maximum amount of power at a time when it would not interfere with the lighting load, or if he had what might be termed an off-peak load that could be handled without added cost as to equipment, he would be a great revenue producer, and an added benefit to all concerned.

The longest paper presented to the convention was read by George W. Burton, of Danville, on "The Legal Status of Transmission Lines in Illinois." The questions of law relating to this subject in Illinois are in many respects new. In the paper there were outlined the legal steps to be taken in the construction of a transmission line from one municipality to another, considering the situation within and without the municipal corporate limits, on highways and over private property, and with and without relation to individual and corporate property rights. These were discussed in connection with railway, telephone, telegraph and other electrical interests. A number of forms for frontage consents, pole line rights and municipal ordinances were appended to the paper. These were drawn so as to benefit the company by avoiding suits for damages.

In the discussion the matter of securing the whole of the right-of-way before commencing to build the line was shown to be a very important item as, if this is neglected and then the line is partly in operation, the expense of completion may easily become too great, for the property owners then have the company in their power and can demand too great a consideration for the small part that is needed to complete the line. The matter of using concrete poles came up during this discussion and Mr. Chubbuck called upon Mr. Miller, of Marseilles, who has been making them for a large system. He said they were made in molds in thirty, forty, forty-five and fifty-foot lengths. After being finished they were floated down the canal on a barge. As a pole thirty feet long weighed one and a half tons hauling them was a serious matter, and that the best way to do, where the conditions were not as favorable to their handling as they were there, was to haul the gravel and cement to the place where the pole was to be used and make it on the spot. The objection to this was the fact that it took twenty-one days for a pole to dry thoroughly, and during this time it would have to be lying there undisturbed and the conditions might make this impossible. After making the poles the holes were dug and the poles set by the use of a derrick wagon. Poles as made by him had six rods embedded in the concrete, one at each corner and the others nearer the center. Tests were made on the poles to determine how much they would stand. A pole was placed six feet in the ground, a rope attached to its top and the top deflected three feet with no cracks, the pole returning to the original position without a permanent deflection. When deflected four feet, it cracked at the bottom on the edges. Another test was made by attaching a rope to the top and fastening its other end to a tree, while between the two was hung a bag containing a mass of iron; this was jiggled up and down without any harm to the pole except a few small cracks on the edges.

At the request of the convention the subject of these tests and other information concerning concrete poles will be prepared into a paper for the use of the association. As to cross-arms for concrete poles some speakers advocated a concrete arm made integral with the pole while others suggested an iron arm, which was decided not to be as good on account of the rusting. The cost of these poles was given as double the cost of wooden poles; a thirty-foot pole costs $7.50 and a fifty-foot pole $12.50. These costs would vary as the cost of material and labor would vary in different localities.

The question of calling a line carrying high-tension wires a high-tension line was brought up, and it was agreed that in the future it would be better to call them long-distance transmission lines, and try to avoid the use of the term high tension, as enough opposition has been made to these lines already by the communities through which they pass or through which it is desired to erect lines.

On Wednesday morning Mr. McCollough, who was chairman of the committee to take action on the death of former President Shumway, read a set of resolutions at the opening of the meeting, and they were adopted and ordered to be placed upon the records and a copy sent to the family of the deceased. Senator Shumway was a charter member of the association, and much of the good accomplished by the association was through his untiring efforts. A report was received from the committee on the change in the by-laws calling for a fourth vice-president and an assistant secretary. It was adopted.

R. S. Wallace, of the Peoria Gas and Electric Company, then read a paper on "Rates and Their Relation to the Cost of Manufacture." This was believed by many to be the best paper read before the convention, but as it was not finished in time it was not in print before the session. The author had charts made and placed upon the wall to illustrate his remarks.

In this paper Mr. Wallace discussed the entire subject of rates and described the different systems of differential charging, giving examples of each. The fixed and variable costs were analyzed and their bearing on the equity of the rates made clear. Sliding scale or discount-for-quantity rates were condemned. Flat rates for sign and window lighting were approved, but in general meter rates are preferable for variable service. The author's general conclusions were: That the charge for service rendered should bear some relation to the cost of rendering it. Straight meter rates cannot possibly approximate the cost of service. Differential rates have been held equitable and legal in many decisions, and should be required where the difference in the cost of supply exists. As public servants, we must not favor one at the expense of another; that we must not sell to one at less than cost and make good our loss by excessive profits from another. While fully realizing the importance of acquiring and retaining the approval and confidence of the public, we must not, for the sake of popularity, sacrifice the basic principles which we know are essential to success, because there is public demand for something else.

During the discussion of the paper the fact was brought out that one rate could not possibly be fair to all consumers, as there are always different conditions governing the use of current as to the time when the maximum demand occurs and length of time when used. Various members gave their experience as to the rates they were charging and what success they had in securing the business and holding it. That it was an advantage to all concerned to have more electric power used, as someone in the electrical field was sure to benefit by it, a case was cited of several large stone quarries that were induced to use electric power, and while they were not served by a central station, they might some time be persuaded to be so served, and then someone would benefit by it, but at the same they were using the power now, and hence they were an addition to the electrical industry.

After this discussion the convention went into executive session and elected the following officers:

F. M. Sinsabaugh, Carrollton, president.

E. G. Schmidt, Springfield, first vice-president; W. G. Austin, Effingham, second vice-president; H. A. Foster, Fairbury, third vice-president; A. R. Manley, Mt. Carmel, fourth vice-president.

E. Macdonald, Lincoln, treasurer.

H. E. Chubbuck, Ottawa, secretary.

Chester A. Willoughby, Ottawa, assistant secretary.

Executive Committee: W. B. McKinley, E. G. Schmidt, J. F. Porter, F. J. Baker, E. L. Brown, and the president and secretary, ex officio.

The convention then adjourned. The location of the next convention will be determined by the executive committee at a meeting next June.

In the way of entertainment Tuesday evening was given over to social pleasures, various theater parties being made up and many old acquaintances renewed. On Wednesday afternoon the members and their friends took a car ride over the Illinois Traction Company's line to Peoria as the guests of that company.

There was present at the convention a small number of representatives of manufacturing and supply houses. Several members made the remark that as to the papers and the interest manifested it was the best convention they had attended, and also that they had been helped very much by attending, as all the papers were practical and helpful to their own properties.

Central Electric Railway Association.

A. L. Neereamer, secretary of the Central Electric Railway Association, announces that the next regular meeting of the association will be held at the Lima House, Lima, Ohio, November 19. The prospects for a large attendance and an interesting meeting are good. The Central Electric Traffic Association will hold its meeting at the same place the day preceding the regular meeting. On the latter occasion papers will be read on the following subjects: "Purification and Heating of Water for Feed for Boilers," by a representative of the Harrison Safety Boiler Works, Philadelphia, Pa. "Possibilities of Handling U. S. Mail and Compensation Paid by the Government," by G. M. Paxton, general manager Dayton & Troy Electric Railway Company, Tippecanoe City, Ohio. "The Claim Department," by Frank Talmadge, Columbus, Ohio. "Railroad Crossings," by W. C. Sparks, superintendent of tracks, Indiana Union Traction Company, Anderson, Ind.

Handling of Live Wires and Fire Streams.

On August 17, 1908, a meeting was held at Altoona, Pa., which was attended by officials and employes of the Pennsylvania Railroad to the number of about 200, at which instructions and demonstrations were given of (1) the method of, and the precautions to be exercised in, handling live wires, and (2) approved methods to be employed in resuscitation of those apparently dead from electric shock. In addition a series of tests was run to determine, for various voltages, the distance from live wires at which streams from fire hose and chemical extinguishers might be played on the same without injury to those handling the hose.

By reason of the increasing use of electricity along the lines of the Pennsylvania Railroad Company, it has become of great importance that employes have a better understanding of the personal hazard involved in the handling of live wires, so that the rescue and resuscitation of those suffering or who have suffered electric shock may not be delayed through ignorance or misconception. Lectures to employes on approved methods of resuscitation of those apparently dead from electric shock have been given in the past from time to time by the relief department, as a part of first-aid instruction. At such times brief instructions have been given on the recovery of bodies in contact with electric wires. It was decided, however, to go into more detail in this direction at the present time, before representatives of the various divisions, so that these representatives might in turn disseminate the information gained to employes under their charge.

A lecture and demonstrations on the methods to be used in resuscitation from electric shock was given in the forenoon on the above date by the local medical examiner, after which those present practiced the movements on each other to a considerable extent. In the afternoon, demonstrations of the proper methods of handling wires and playing of fire streams were carried out, suitable wires and apparatus having previously been erected for this purpose in a convenient location in the Altoona railroad yard.

HANDLING OF LIVE WIRES.

A pair of iron pliers, designed for use in cutting wires carrying high potential, was exhibited, and the essential features demanded were carefully pointed out. These consisted mainly in the insulation on the handles of the pliers, which is required so that no part of the hands or of the person manipulating them shall come in contact with any metal part of the pliers, which in turn comes into contact with the wire in the act of cutting. The insulated handles were of wood and were screwed securely onto the metal handles of the pliers, after which they were boiled in paraffine. The insulation was tested at 8,000 volts alternating, and successfully withstood this test. Equipped with these pliers, and standing upon a thin board, an operator cut several times a line which was lying on the ground carrying a potential of 2,300 volts—the other side of the wire being thoroughly grounded.

To illustrate methods which might be used to remove a wire from a body, in the event of pliers or other means of cutting the wire not being at hand, a coat was placed under the wire and held at either side by means of the sleeves; two persons are necessary for this maneuver. By this method the wire was raised from the ground, no effect being felt by the persons holding the coat, though the latter was somewhat damp.

EXPERIMENTS WITH FIRE STREAMS.

In order to determine definitely what hazard, if any, existed for firemen when they were compelled in line of duty to play water from fire streams on live wires at various potentials, arrangements were made so that circuits of 525, 2,300 and 4,600 volts, respectively, were available. The 525-volt line was a direct-current trolley wire connected to the lines of the Altoona & Logan Valley Electric Railway Company. The 2,300-volt and 4,600-volt lines were fed from alternating-current generators at the Altoona car shops. One side of each of these circuits was thoroughly grounded, and the fire stream played on the other side, which was suspended in the air and thoroughly insulated. A suitable voltmeter was connected between the nozzle and ground to enable the difference of potential between the nozzle and ground to be noted in each case. The following results were obtained, at the voltages specified below, in tests made the day previous to the general demonstration:

525-Volt Trolley Wire.
⅝-in. Nozzle.

Distance of Nozzle from Wire.	Potential between Nozzle and Ground.
7 ft. 5 in.	20 volts.
4 ft. 9 in.	38 volts.
3 ft. 7½ in.	60 volts.
2 ft. 2 in.	70 volts.
0 ft. 7½ in.	210 volts.

These results show that the nozzle may be handled without discomfort up to a point between three and four feet from the wire when those holding the nozzle are standing on the ground. It may be carried much nearer without harm, but would probably cause some discomfort. If those holding the nozzle were standing on a ladder or were otherwise insulated from the ground, it would be quite safe to bring the nozzle to within a few inches of the wire.

2,050-Volt Line.
⅝-in. Nozzle.

Distance of Nozzle from Wire.	Potential between Nozzle and Ground.
6 ft. 6½ in.	Static
3 ft. 5½ in.	Static

4,100-Volt Line.
⅝-in. Nozzle.

Distance of Nozzle from Wire.	Potential between Nozzle and Ground.
6 ft. 6½ in.	Static
3 ft. 5½ in.	Static

In each of the above tests no measurable deflection could be obtained on the voltmeter, but upon touching the nozzle with the hand when standing on the ground a slight effect due to static electricity was noted.

The above results were obtained in tests conducted a day previous to the general demonstration. In this demonstration, however, results were obtained which agreed with these. These results follow:

525-Volt Trolley Wire.
⅝-in. Nozzle.

Distance of Nozzle from Wire.	Effect at Nozzle.
3 ft. 0 in.	Slight Indication to hand.

2,300-Volt Wire.
1-in. Nozzle.

Distance of Nozzle from Wire.	Effect at Nozzle.
8 ft. 0 in.	Slight indication of static electricity to hand.

4,600-Volt Wire.
1-in. Nozzle.

Distance of Nozzle from Wire.	Effect at Nozzle.
10 ft. 0 in.	Slight indication of static electricity to hand.

In each case the nozzle was sufficiently near the wire so as to cause a solid stream to play on the latter. Just how far the results of a fire-hose test with salt water will differ from those above, which were made with fresh water, cannot be said at the present time.

Experiments were also made with streams from hand chemical extinguishers, and it was found that when a solid stream is played on a high-potential wire it becomes a source of danger to one holding the extinguisher. For instance, the nozzle of an extinguisher was held at a distance of nine inches on a grounded 2,050-volt alternating line. The difference of potential between nozzle and ground was 1,500 volts when the extinguisher was insulated from the ground.—*R. H. Newbern, superintendent insurance department, Pennsylvania Railroad Company, in the Quarterly of the National Fire Protection Association.*

International Conference on Electrical Units and Standards.[1]

On Thursday, October 15, the Technical Committee devoted the first part of the morning to the specification of the mercury ohm. The draft specification prepared by the Reichsanstalt was taken as the basis, and after alteration read as follows:

"*Specification A, relating to the Measurement of the Resistance of a Column of Mercury.*—The glass tubes used for mercury standards of resistance must be made of a glass which is as free as possible from elastic after-effects. They must be well annealed and straight. The tube must be of circular cross-section or nearly so of approximately one square millimeter. The mercury must have a resistance of approximately one ohm. The tubes must be carefully calibrated along their length by using threads of mercury of different lengths. The calibration factor must not exceed 1.0005. The mercury filling the tube at zero degrees centigrade must be considered as bounded by plane surfaces placed in contact with the flat ends of the tube. The length of the axis of the tube, the mass of mercury it contains, and the electrical resistance of the mercury, are to be determined at a temperature as near to zero degrees centigrade as possible. The measurements, when made, to be corrected to zero degrees centigrade. For the purpose of these electrical measurements end vessels carrying connections for the current and potential terminals are to be fitted onto the tube. These end vessels are to be spherical in shape (of diameter of about four centimeters) and should have a cylindrical piece attached to make connection with the tubes. The edge of the tube is to be coincident with the inner surface of the spherical end vessels. The leads are to be of thin platinum wire fused into glass. The point of entry of the current lead and the end of the tube are to be opposite ends of a diameter of the bulb; the potential lead shall be midway between these two points. The leads connected to the platinum wires must be so thin that no error in the resistance is introduced through conduction of heat. The filling of the tube with mercury for the purpose of the resistance measurements must be carried out under the same conditions as the filling for the determination of the weight. The resistance which has to be added to the resistance of the tube to allow for the effect of the end vessels is to be calculated by the formula

$$A = \frac{0.80}{1,063\,\pi}\left(\frac{1}{r_1}+\frac{1}{r_2}\right) \text{ ohm,}$$

where r_1 and r_2 are the radii in millimeters of the end sections of the bore of the tube. The mean of at least three fillings to be taken as the resistance of the tube. The mean result obtained from at least five tubes is to be taken as the mercury unit."

The final drafting of this specification was then referred to a drafting sub-committee, consisting of the chairman, Dr. Lindeck, Mr. Smith, and the secretary.

The committee then proceeded to consider Specification B for a standard silver voltameter. This was amended to read as follows:

"*Specification B, relating to the Deposition of Silver.*—The electrolyte should consist of from fifteen to twenty parts by weight of silver nitrate in 100 parts of distilled water. The solution may only be used once, and only for so long that not more than thirty per cent of the silver in the solution is deposited. The portion of the anode dipping into the liquid shall be of silver, and the cathode of platinum. The current density at the anode shall not exceed one-fifth of an ampere per square centimeter and at the cathode one-fiftieth of an ampere per square centimeter. Not less than 100 cubic centimeters of electrolyte shall be used in an experiment. Care must be taken that no particles which may become detached from the anode during electrolysis shall reach the cathode. Before weighing, any traces of solution adhering to the cathode should be removed, and the cathode itself dried."

This specification was then also referred to the drafting sub-committee, and the consideration of the specification of the Weston cell commenced. This was amended to read:

"*Specification C, relating to the Standard Cell.*—The cell to be taken as standard is the Weston normal cell, having an excess of stable cadmium sulphate ($CdSO_4 8/3H_2O$). The positive pole of the standard cell shall consist of mercury with mercurous sulphate as depolarizer;

[1] Electrical Engineer, London, October 23.

the negative pole to be of cadmium amalgam in the proportion of 12.5 parts by weight of cadmium to 100 parts amalgam. The electrolyte shall consist of an aqueous saturated solution of cadmium sulphate, neutral to congo red. The grains of mercurous sulphate must not be so small that an increase in the solubility and a consequent perceptible influence on the electromotive force may result; in addition, the solution from which the mercurous sulphate is precipitated must contain at least one-tenth gramme equivalent of strong acid; finally, the salt must be washed. The method to be employed must be one of those given in these notes, and the method must be closely followed. The depolarizer to consist of mercurous sulphate, mixed with powdered cadmium sulphate and a saturated, aqueous solution of this salt. For setting up the cell, the H form is the most suitable. The leads to the electrodes to be of platinum wire, which must not be allowed to come into contact with the electrolyte. The amalgam is placed into one limb after warming. The mercury is introduced into the other limb. The depolarizer is placed above the mercury, and a layer of cadmium sulphate crystals is introduced into each limb. The entire cell is filled with a saturated solution of cadmium sulphate, and then hermetically sealed. The following formula is recommended for the electromotive force of the cell in terms of the temperature:

$$Et = E_{20} - 0.0000406\ (t - 20^\circ) - 0.00000095\ (t - 20^\circ)^2 + 0.00000001\ (t - 20^\circ)^3.$$

The value of the standard cell to be the mean of at least twenty cells, which must be intercompared at least every three months, and which must be checked at least every year against the silver voltameter. Cells differing from the mean by more than 1.10^{-4} volt are to be replaced by normal cells."

In the afternoon the discussion turned on the value of the international ampere. It was eventually decided that "should the conference accept the figure 1.11820 milligram for the electrochemical equivalent of silver, then the electromotive force of the Weston cell at twenty degrees centigrade be provisionally accepted at 1.01820 volts."

On Friday, October 16, the conference met again, and considered the interim report of the Technical Committee. The length of the mercury column for the international ohm was confirmed as 106.300 centimeters. After further discussion Resolution VI was accepted by twenty-one votes to three. This reads: "The international ampere is the unvarying electric current which, when passed through a solution of nitrate of silver in water, in accordance with the specification attached to these resolutions, deposits silver at the rate of 0.00111800 of a gram per second."

Resolution II, amended as follows, was passed by the same majority: "As a system of units representing the above and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, the conference recommends the adoption of the international ohm, the international ampere, and the international volt defined according to the following definitions:"

An additional resolution, "That the ohm is the first primary unit," was passed unanimously.

The conference then proceeded to consider the steps necessary to secure uniformity of the standards in future.

Professor Warburg moved: "That the conference approves generally the draft scheme to establish a permanent commission to secure uniformity of administration in relation to electrical units and standards in the future. The conference refers the draft scheme to the Technical Committee to consider details and to nominate the first members of the commission." He then explained his views as to the ways for obtaining uniformity. He said that there were two courses open, one to form a central bureau like the Bureau des Poids et Mesures which kept the international meter, and the second was that given in the draft proposals.

Construction of Selenium Cells.

Selenium cells, which vary their resistance with the intensity of illumination to which they are subjected, may be constructed in a variety of ways. A common form, easily made, is to wrap two wires upon an insulating core, keeping them separated by a uniform short distance, and then coat over the wires with a thin film of molten selenium. Another plan is to cover the surface of some solid, usually glass, with a thin coating of selenium. A difficulty met with in doing this, especially with glass, is the liability of the selenium to form into drops, instead of adhering uniformly. A new method recently devised in Germany by W. S. Grippenberg, causes selenium vapor to condense on the cold surface of the glass. In this way very thin and uniform coatings which adhere well to the glass are obtainable. Two grooves are cut in the glass close together and of as great a length as possible, and these are coated inside with platinum to act as electrodes.

Changes in the Western Electric Company.

At a meeting of the board of directors of the Western Electric Company, held in Chicago, on October 30, the following changes among the officers were made: E. M. Barton retired as president and became chairman of the board of directors; H. B. Thayer was elected president; H. A. Halligan and F. R. Welles were elected vice-presidents; William P. Sidley was elected vice-president and general counsel; George C. Pratt was elected secretary.

Mr. Thayer has been vice-president for a number of years, and has been connected with the company for twenty-eight years. He was born at Northport, Vt., August 17, 1858, and was graduated from Dartmouth College with the A. B. degree in 1879. He is a director of the Tabulating Machine Company and the Mexican Telephone and Telegraph Company, a member of the New York Chamber of Commerce, the New England Society, and the University Club. Mr. Thayer has had his residence in New York city, and will continue to reside there, and some of the engineering and other administrative work of the company will be conducted at New York. This is for the purpose of avoiding duplication between the Chicago and New York offices and between the engineering department of the company and the telephone companies, its principal customers.

Mr. Halligan has been for a number of years secretary of the company and in charge of a large part of the American business. Mr. Welles has been connected with the company for more than thirty years, and has charge of the foreign business, residing in Paris. Mr. Sidley has been acting as counsel for the company, and will continue to so act. His office of vice-president will not involve severing his connection with the firm of Holt, Wheeler & Sidley, of which he has been a member for some years.

The Western Electric Company is engaged in consolidating its manufacturing business at its Hawthorne plant in Chicago. It is removing to that plant the manufacturing heretofore carried on at Clinton street, in Chicago, and the principal portion of that which has been conducted at its factory in New York city.

Recent Sources of Electric Light.

The ordinary carbon-filament incandescent lamp, says Dr. L. Block, in the *Journal fuer Gasbeleuchtung,* which has been greatly improved during the thirty years of its existence, consumes from three to three and one-half watts per candle-power. A considerable saving in current consumption is effected by the use of lamps with so-called metallized carbon filaments. By being subjected to a peculiar fusing process at high temperatures these filaments receive metallic properties, particularly that of increasing their resistance with rising temperatures. The saving in current is about thirty-three per cent as compared with ordinary incandescent lamps, as the metal-filament lamps consume only two to two and one-quarter watts per candlepower and have an equally long life. The methods of manufacturing these lamps were practically developed first in America and then by the Allgemeine Elektrizitäts Gesellschaft, of Berlin. Their cost is not appreciably higher than that of ordinary carbon-filament lamps. In historical sequence the Nernst lamp was the first of the new kinds of incandescent lamps. In this lamp a small rod, consisting principally of combinations of the metal zirconium, which does not conduct electricity when cold, is made conducting by the application of external heat, and then glows with an intense, almost pure white light as soon as the current flows through it. The Nernst lamp consumes from 1.5 to 1.7 watts per candlepower and has a life of about 400 hours. Its current consumption is fifty per cent less than that of the ordinary incandescent lamp. It is particularly suitable for higher tensions, about 220 volts. Competitors of the Nernst lamp are the more recent metallic-filament lamps, the first of which was the osmium lamp, invented by Auer von Welsbach. The filament consists of the metal osmium, which is very difficult to fuse, and is also very expensive. The lamps consume about 1.5 watts per candle, and their life is about 1,000 hours, without any diminution in lighting power during this time. However, the price of the lamps was very high. They could burn only in a vertical position and were made only for low tensions, so that on a 110-volt circuit at least three lamps had to be burned in series, and at least five on a 220-volt circuit. The later metallic-filament lamps have now taken the place of the osmium lamp. The next lamp of this kind was the tantalum lamp of the Siemens & Halske Company. The metal tantalum can be drawn into very thin and still strong filaments, those used in the lamps being over one-half meter in length and wound on a frame in the form of a cage. The energy consumption of this lamp is about 1.7 watts per candle and its life about 800 hours. At present it is made for pressures up to 120 volts and is particularly suitable for direct current. The latest successes in incandescent-lamp manufacture are the lamps with filaments made of wolfram and similar metals. They are now manufactured for the usual tensions up to 130 volts, in units of twenty-five to 100 candlepower, and are put on the market by various concerns under many names, such as osram, osmium, colloid, sirius, Just-wolfram, colloid-wolfram lamps, etc. Their principal advantage is the small consumption of energy of only about one watt per candle, which means a saving of seventy per cent over ordinary incandescent lamps and of forty per cent over Nernst and tantalum lamps. At the same time the lamps have a life of about 1,000 hours without showing any appreciable decrease in light intensity. They are equally well suited for direct and alternating current. The first lamps of this kind could be used only in a vertical position, but they are now able to burn in any position. Their price is at the present time still about three marks (seventy-five cents), but in view of the great saving in current this higher cost is scarcely to be considered. In the arc-lamp field a greater light intensity and economy were attained by the so-called flaming arc lamps. The carbons used in these lamps contain, inside of a coat of ordinary carbon, a core consisting chiefly of fluor in combination with various metals. The vapors of these metals glow in the electric arc with an intensely luminous flame of 1,000 to 2,000 candlepower. The energy consumption of these flaming arc lamps is only 0.2 to 0.25 watt per candle, and the carbons last from ten to twelve hours. The gases are removed from the lamps by natural circulation of the air, and for this reason they are not suitable for illuminating small or badly ventilated interior rooms. A still lower consumption of energy, 0.15 to 0.2 watt per candlepower, and an almost pure white light are obtained in ordinary arc lamps by the use of the new "Alba" carbons of Siemens Brothers. In conclusion, mention must be made of the peculiar mercury light, which was introduced first in America by Cooper Hewitt. This is an arc of unusual length produced in a vacuum tube between surfaces of mercury. It has a remarkable green color, its efficiency is about the same as that of ordinary arc lamps, but the life of the lamps is about 1,000 hours. The quartz lamp seems likely to find the most extensive application among this type of lamps. The arc is here produced in a tube of quartz, which is capable of withstanding very high temperatures, and consequently the arc may be confined to a much smaller space and the light efficiency increased about twice that of the ordinary arc lamp. It is used directly on 220-volt circuits and can be operated only by direct current, like others of this type. A quartz lamp of 3,000 candle-power was exhibited. In appearance it resembles the flaming arc lamp. It is suitable for all purposes where the color of the light, which is a greenish yellow, is immaterial, and where a strong and economical light is required. On account of its long life, which is about 1,000 hours, the attention is reduced to a minimum, and so far the quartz lamp must be considered the only long-lived illuminant of great intensity.

The Alternating-Current Railway Motors of the Oerlikon Company and Their Effects on Telephone Circuits.

A lecture, delivered by Dr. Hans Behn on this subject before the Physical Society, of Zurich, is reprinted in the *Elektrotechnische Zeitschrift* for September 24. The opening of the first alternating-current electric railway in Switzerland, that between Seebach and Wettingen, was subjected to a protracted delay on account of serious disturbances caused in the nearby telephone lines. The experiences and the means which led to the removal of the difficulty are reviewed in detail. A theory of special upper vibrations of the electromotive force produced in commutator motors was established, as well as also a theory and calculation of the effects of these vibrations on telephone circuits. Other favorable experiences made with this line are discussed, and principles for the construction of larger alternating-current motors on the Oerlikon system developed. A complete calculation for an electric locomotive of 3,600-horsepower capacity, with four motors, is given. The disturbing influences on the telephone lines disappeared with the employment of a current of fifteen periods per second, and motors operating under this frequency were adopted and are generally recommended for railroad operation.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

THE GRISSON RECTIFIER.

An improved type of this alternating-current rectifier, with aluminium electrodes, which was first brought out in 1903, is here described. The former glass cell has been replaced by an iron cell in order to permit air cooling in place of the original method of cooling by water, which proved impracticable. It has also been found of advantage to give the aluminium electrodes an inclined position, so as to permit an easy escape of the hydrogen bubbles. The electrolyte consists of a solution of specially prepared bicarbonate of soda in pure water in proportions of one to sixteen parts. The rectifiers are furnished with electrodes already formed, but they have to be "polarized" before being put in operation, that is, the aluminium electrodes have to be provided with a coating of oxygen bubbles. Tables of the operation of a rectifier on a 110-volt alternating-current circuit of fifty periods per second under varying loads indicate a maximum efficiency of seventy-five per cent, and of seventy per cent on a 120-volt, fifty-period, polyphase circuit. By connecting the cells in series or multiple they may be used for any tension or current intensity and adapted to any purpose.—*Abstracted and translated from Elektrotechnische Zeitschrift (Berlin), October* 1, 1908.

NEW ANTI-INDUCTIVE SYSTEM OF CROSSING AERIAL TELEPHONE CIRCUITS.

With the introduction of the first long-distance electric transmission lines, disturbing influences on telephone circuits in their proximity were observed. They manifested themselves by rattling noises in the telephone receiver, and were at first ascribed to electromagnetic induction, but it was soon ascertained that they were due rather to electrostatic induction. This can be easily demonstrated by entirely suppressing the current in the energy transmitting line and leaving it only under tension. But whatever the cause may be, the most effective way of preventing these noises consists in reducing the coefficient of mutual induction between the disturbing and disturbed nets to a minimum. This result is attained by twisting the wires of one of the two nets, preferably the telephone wires. With the insulated conductors of an underground cable this twisting presents no difficulty, but it is different with bare aerial wires supported on insulators. The efficacy of the method has been thoroughly demonstrated in practice, but the various ways of applying it had numerous defects. A new system has been adopted by the Northern Railway of

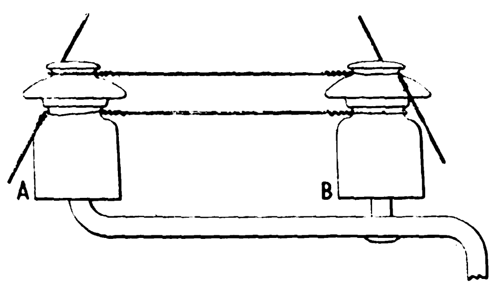


FIG. 1.—METHOD OF USING INSULATORS FOR TRANSPOSITION OF CONDUCTORS.

France, which was devised by its chief electrical engineer. In this system all the poles are uniformly provided with brackets carrying two insulators, as shown in Fig. 1. The insulators are of glass with a double bell and two recesses separated by a hood, the object of which is to insure perfect insulation between the two recesses. Fig. 2 shows the manner of put-

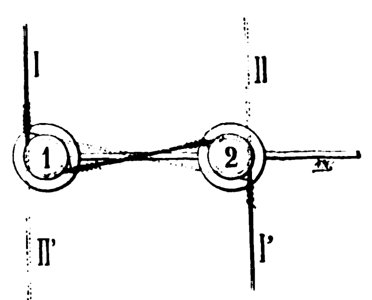


FIG. 2. METHOD OF USING INSULATORS FOR TRANSPOSITION OF CONDUCTORS.

ting the wires in place. Wire I makes a quarter turn in the lower recess of insulator No. 1, then goes to the corresponding recess of insulator No. 2 and passes on in the direction of I'. Wire II, represented by dotted lines, passes around insulator 1 and 2 in the same manner as wire I, but in the upper recesses. When the line has been put up, the conductors are held in place by binding wires. The effectiveness of this new crossing arrangement is evident, since it is only an artifice permitting a return to the original method. Double wire lines installed in this manner occupy space only in width and allow a utilization of the poles to their maximum capacity. The system has been tested for over a year on several long-distance telephone lines belonging to the Northern Railway Company of France, which frequently run parallel to high-tension transmission lines, and the results have been satisfactory in every way. The article concludes with a table indicating the number of crossings per kilometer which it has been found best to employ with different tensions and distances of the disturbing line.—*Abstracted and translated from L'Electricien (Paris), October* 10.

A RAILWAY ACCUMULATOR CAR.

Louis Dubois describes a new type of storage-battery car which has recently been put in operation upon the system of suburban lines around Mayence, under the direction of the Prussian Railroad Administration. A few cars of this design have been installed, and a favorable impression made. It is expected that a larger number will be called for in the near future. There are three suburban lines which branch out from Mayence and run as far as the towns of Oppenheim, eleven miles; Russelheim, seven and one-half miles, and Ingelheim, eleven miles, making a total of twenty-nine and one-half miles for the entire system. The present railroad is operated at speeds which vary between twenty and thirty miles an hour, and there are a number of intermediate stations on the route. The car is of the side-opening compartment type, and contains six compartments with seats on each side. The compartments are designed to hold ten persons each, and in general construction the car resembles the type which is used at present on the Berlin subways. The car is mounted on three axles of the ordinary kind without the use of bogies, and the over-all length between buffers is forty feet. The motorman's cab is raised considerably above the floor level, and there is a cab at each end of the car. The accumulators are stowed under the seats of the car in each of the compartments. The batteries are of an improved type brought out by the Accumulatoren Fabrik of Hagen. Under each seat there are permanently placed two large boxes, which are protected by the front board of the seat, this being fixed by screws. The top of the seat is hinged and can be easily raised and held in this position by a catch when it is desired to inspect the battery connections. The two boxes contain seven and eight cells, respectively, making thirty in each compartment. The entire car holds 180 cells, which is found to be amply sufficient to run it under the present conditions of speed and gradient. The cells have a capacity of 2,300 ampere-hours at the 100-ampere discharge rate. With a single charge the 180-cell battery can cover a distance of thirty-six miles when running at a speed of twenty-four miles an hour, which is about the maximum speed used on the Mayence lines. With this capacity the car can make two trips to the suburbs and return without recharging. Upon returning to Mayence after the second trip the battery is charged in place by means of a flexible cable which is fitted into a charging plug at one end of the car. The battery is not removed except for making repairs. Each cell weighs 100 pounds complete. The positive and negative plates measure twelve by twelve inches, and have a thickness of about three-tenths of an inch. There are four positive plates per cell. The plates are separated by wood and gutta-percha strips, and are hung upon glass by lugs, leaving a space of about two and one-half inches under the plates. The cell boxes are of wood, which is specially treated and given an outer coating of acid-proof varnish. Connection is made to the terminals of each cell by means of a copper strip, which is, in turn, protected by a coating of lead. In order to keep the fumes out of the car, the top of the seat is provided with a rubber gasket, and the space under the seat is ventilated by a tube which projects from the car and gives a good supply of air to the interior. The 180 cells represent a total weight of about ten tons. They are able to furnish 68.5 kilowatts on a single discharge, as shown by official tests. Their energy capacity is 6.85 watt-hours per kilogram. The life of the positive plate is estimated at 62,500 car-miles, and that of the negative plate at 37,000 car-miles. On the front and rear axle twenty-five-horsepower motors are arranged for series-parallel control, with a gear ratio of one to 4.3. Eighty-four per cent efficiency is claimed with a total weight per motor of 2,600 pounds, including the gears and casing. The batteries may be charged in a single series of 180 cells, or in two groups of ninety cells coupled in parallel. The car, when fully loaded, weighs twenty-two tons. The motors weigh 2.4 tons, and the battery ten tons, making about thirty-five tons for the entire weight. The cost of the battery is $3,250, and that of the electric outfit $2,750. The car costs $750, making the total cost of the present outfit $6,750.—*Abstracted from the Electrician (London), October 16.*

AN ELECTRIC COLLIERY RAILWAY.

The electric railway at the Consett Iron Company's Chopwell colliery is interesting chiefly as being the first installation of its kind in the north of England. The innovation reflects great credit upon the company's mining engineer, F. O. Kirkup. The line connects the Chopwell colliery with a new winning at Whittonstall, about two and one-quarter miles distant. The coal at Whittonstall is loaded into tubs, which are made up into a train of thirty-six, and hauled by means of an electric locomotive to the screening plant at the Chopwell colliery. In this way the installation of a large amount of new and expensive stationary plant is avoided, and it is possible to work new isolated seams economically. The line is two and one-quarter miles long, with a maximum gradient against the load of one in twenty-four. The length of the maximum gradient is about 720 yards, and the average gradient against the load is about one in forty-seven. The load to be hauled, exclusive of the locomotive, is twenty-five tons; the time allowed for each journey ten and three-quarter minutes, and two double trips per hour are expected. The track is of twenty-six-inch gauge. For these conditions a powerful locomotive is necessary, and the narrowness of the gauge imposes severe restrictions on the motors. The body of the locomotive is supported on two bogie trucks, each equipped with a single fifty-six-horsepower, 500-volt Siemens railway motor. The aggregate capacity is 112 horsepower. The two axles of each bogie are connected together by side rods, in order to utilize the whole weight of the locomotive for adhesion. One of the axles is driven through spur gearing by the motor. This gear consists of two equal gear wheels and one pinion, the pinion being fixed on the motor axle, one gear wheel on an intermediate shaft, and one on the driven axle. The locomotive body is built up on two main longitudinal steel girders, which are themselves supported by cross beams from the bogie centers. The space between the bogies is utilized for the lower part of the driver's compartment. In this way the height of the locomotive is reduced, so that the line can be taken under a roadway without excessive excavation. Current is collected by two Siemens bow collectors of such a length as to allow of a considerable range in the height of the trolley wires. The track consists of fifty-pound Vignole rail. Each rail is thirty feet long, and they are bonded by means of a single bond at each joint. Power is supplied to the locomotive from a 200-kilowatt, direct-current, compound Siemens generator, coupled direct to a Belliss engine. The power house is situated about 600 yards from the railway, near the Chopwell end, and is connected to the overhead line by means of two positive and one negative insulated feeders running through earthenware pipes in a trench.—*Abstracted from Electrical Engineering (London), October 22.*

Civil Service Examination for Electrical Engineers and Draftsmen.—Office of Supervising Architect.

The United States Civil Service Commission announces an examination November 23 to 25, at the usual cities to fill a position of electrical engineer and draftsman in the office of the supervising architect, Treasury Department, Washington, D. C., at $1,200 per annum, and similar vacancies as they occur. The examination will be weighted as indicated: Mathematics to plane trigonometry, 10; theoretical and practical questions in electrical science (special reference to lighting and elevator work in public buildings), 20; drawing and design, 40; training and experience, 30. Three days of seven hours each will be allowed for the examination. Applicants should at once apply to the United States Civil Service Commission, Washington, D. C., for application form 1312.

Report of Earnings of the Northern Ohio Traction and Light Company.

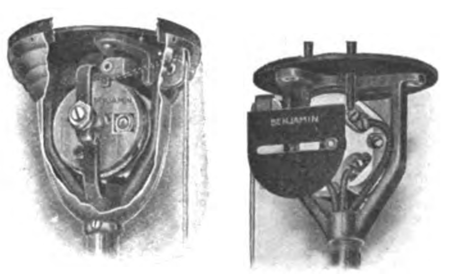
The report of the Northern Ohio Traction and Light Company for the nine months ended September 30 shows gross earnings of $1,421,549, against $1,459,-782, net of $598,506, against $627,197 and surplus of $206,502, against $244,-036. The earnings for October are estimated to be about the same as last year, and for the balance of the year will be able to show increases.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Some New Benjamin Specialties.

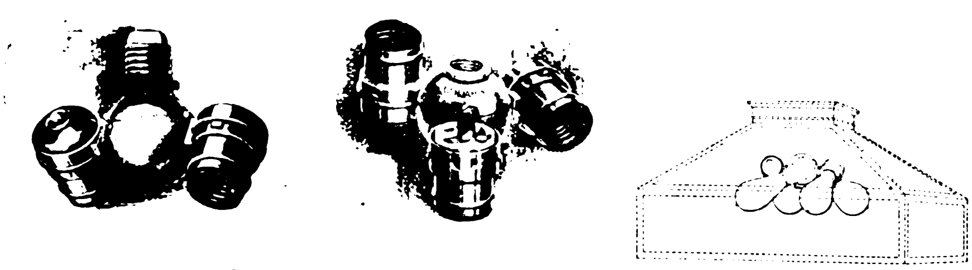
The Benjamin Electric Manufacturing Company, 42 West Jackson boulevard, Chicago, Ill., is placing on the market several new National Electrical Code Standard lighting specialties. The illustrations herewith show two grouping canopy switches with auxiliary pulleys. The Benjamin grouping canopy switch is



BENJAMIN GROUPING CANOPY SWITCHES.

adapted for conveniently and economically locating the control of any lighting fixture or bracket in which a plurality of lamps is to be operated in two groups. Two or three degrees of illumination may thus be secured without the necessity of running the usual three wires to the switches on the side walls or using two pendant switches. The controlling pendant cord or chain is dropped directly from the canopy, or it may be carried to any desired point by the use of an auxiliary pulley. Binding posts are provided in the switch for the two leading-in wires and the three other wires extending through the stem to the fixture body. The mechanism is substantial in character and is entirely enclosed. The canopy is provided with a fiber insulating ring. It has a margin of one-half-inch play to allow for projecting outlet boxes.

The illustrations herewith also show some uew Benjamin adjustable plug and socket clusters designed for use with ceiling or pendant dome fixtures, stand lamps in dining rooms, reading rooms, or other installations, where it is desirable to adjust and fix the lights in special relation to the sides of the dome or reflector. The socket may be turned to any position between two points, 180 degrees apart, and locked by means of a screw. By removing the socket cap, easy access is gained to the binding screws. These clusters are easily wired, and are finished ordinarily in polished brass.



BENJAMIN ADJUSTABLE SOCKET CLUSTERS.

Curve-Drawing Instruments for Alternating and Direct-Current Circuits.

Curve-drawing instruments which will indicate the load conditions of central stations are a necessary addition to the modern switchboard. The General Electric Company has produced for this service a complete line of voltmeters, ammeters, single and polyphase wattmeters and power-factor indicators for alternating current, and ammeters, voltmeters and wattmeters for direct-current circuits.

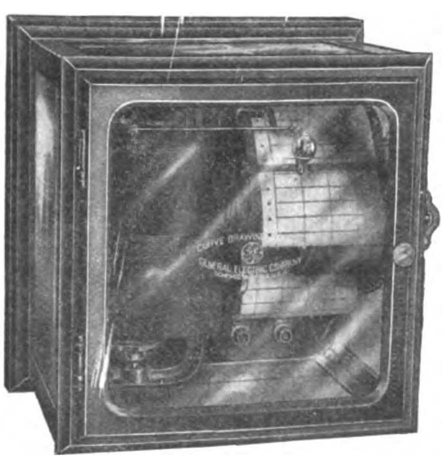
As in all instruments for measurement, continued accuracy is the principal requirement, and its importance has been kept in view in the design of these instruments. Friction is almost entirely reduced to that of the recording pen on the paper. The moving element is entirely suspended by a steel piano wire, the lower end being accurately centered by a small hardened steel pivot passing through a ring-stone sapphire jewel. A device is also provided for holding the moving element and pen arm firmly in place during shipment.

The pen depends for its action upon the principle of capillary attraction. It has an iridium point sealed into a very small glass tube, which in turn is placed inside of a larger tube, the latter terminating in a bulb which holds sufficient ink to operate the pen seven days without refilling. The record is made on a band of specially prepared paper sixty feet in length. On this paper are ruled lines corresponding to the time and to the instrument calibration; ordinates across the paper indicating time and those ruled lengthwise representing volts, amperes, watts, power factor, or other quantity indicated by the instrument. This form of chart has the advantage of permitting the use of time divisions of equal length throughout the entire range of the recording pen. The recording pen is attached to the moving element in such a manner that its motion is transmitted in a straight line parallel to the time divisions on the chart, and the record or diagram thus produced is much easier of interpolation than that produced by instruments that have lines which are curved or of unequal length.

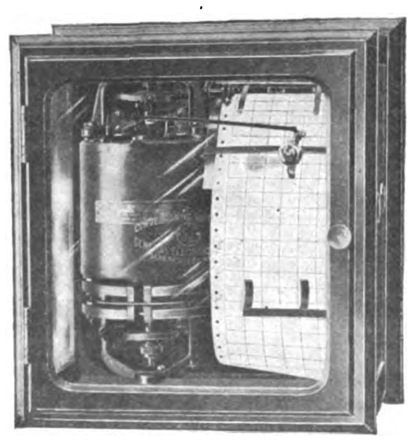
As the paper is unwound and passed under the recording pen, it is paid into a space at the bottom of the instrument case. The instrument case is provided with a cutter which enables the paper to be torn off evenly and without damage. When a roll of paper is exhausted the empty wooden holder can be easily removed by withdrawing it from the spring-supporting trunnions. A new roll can then be placed in position on the supporting trunnions, and the end of the paper carried over the idler roll at the back of the case. The pen arm is moved back from the paper by simply lifting it, which at the same time locks it into position, where it remains until loosened.

The standard rate of chart feed is three inches per hour, although a feed of one inch or six inches per hour can be furnished if desired. The rapid feeding of recording instrument charts is of great importance, as it insures a clear, accurate record that cannot be obtained with slow-moving charts. For driving the chart an eight-day clock, of simple and rigid construction, is used. It is self-contained, easily regulated and an accurate timekeeper. By means of suitable gearing, the clock drives a drum having peg teeth which engage the holes located near the edge of the chart. These teeth not only feed the paper under the recording pen, but also give it a definite and accurate position along the axis of the drum. The feeding drum is driven by a friction clutch which can be operated either forward or backward. This enables the paper to be accurately located in regard to the time graduations without difficulty or without strain to the driving gears and clock. If desired, a re-roll attachment can be furnished with these instruments. By means of this device, the chart is rewound as it passes from the drum after the record has been made. The re-roll is revolved by means of a separate spring attachment, releasing the clock from any extra strain.

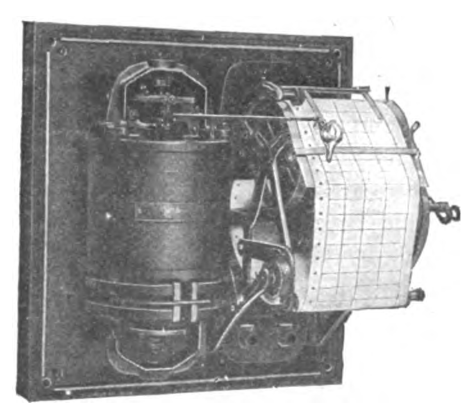
The electrical characteristics of these instruments are also excellent. The torque or directive force is very high, thus insuring long life with continued accuracy. The pen arm fluctuations are magnetically damped by means of a disk of aluminum passing between the poles of permanent magnets. This method of damping is very effective, introduces no friction, and is free from the objectionable features common to air or liquid damping systems. The instruments are thoroughly shielded from the influence of external magnetic



DIRECT-CURRENT CURVE-DRAWING AMMETER.



ALTERNATING-CURRENT CURVE-DRAWING WATTMETER.



ALTERNATING-CURRENT CURVE-DRAWING WATTMETER WITH RE-ROLL ATTACHMENT.

fields. This desirable feature is accomplished by the use of a laminated soft-iron shell which completely surrounds the measuring coils. These instruments are free from heating errors and may be used on circuits of any wave form or power factor.

Ammeters, power-factor indicators and single-phase wattmeters are made in capacities up to and including 200 amperes and 650 volts, for use without current or potential transformers. For circuits in excess of the above, current and potential transformers must be used. Voltmeters are made in capacities up to and including 750 volts without potential transformers, which are required, however, above this limit. Polyphase wattmeters with current capacities up to and including sixty amperes and with potential capacities up to and incluuding 650 volts, are made for use without current and potential transformers. On circuits where the voltage and current exceed the above limits, current and potential transformers must be used.

Direct-current curve-drawing ammeters are constructed upon the astatic principle, and are of the electromagnet type. The moving element consists of two rectangular-shaped coils connected together with two soft sheet-steel astatic control pieces fastened between them. The current to be measured, or a shunted portion of it, is passed through the coils, which are free to move in the field set up by two astatically arranged electromagnets. These magnets are wound standard for 125-250 and 550 volts, and the instruments are so designed that a twenty-five per cent variation above or below normal will cause no appreciable error in the instrument indications. The movement of the coils is opposed by the counter-torque of the astatic control pieces, and also by the control springs.

Direct-current ammeters are made self-contained in capacities up to and including sixty amperes. Instruments with capacities from eighty to 3,000 amperes are provided with external shunts and can be furnished of higher capacities if desired. All of the shunts used with these instruments have a uniform drop of sixty millivolts, and capacities in excess of 800 amperes are provided with a special thermo-electric attachment, which is designed to eliminate errors due to thermo-electric currents. Both the alternating and direct current instruments are finished in dull black, and are enclosed in glass cases and fitted with felt guards or cushions to make them dust-proof.

Feed-in and Strain Support for Feeder Cables.

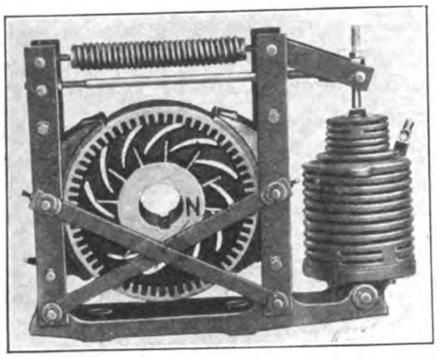
A new and improved combined feed-in and strain support for trolley feeder cables has been brought out by Dossert & Co., Incorporated, 242 West 41st street, New York. The device, as shown in the accompanying illustration, comprises a combination of the Dossert solderless cable

FEED-IN AND STRAIN SUPPORT FOR FEEDER CABLES.

tap with a regular soldered ear of the cap and cone type. The feed-in tap is made with a standard threaded stud which screws into the ear. A jamb-nut and lock-washer holds the feed-in tap securely in place against the boss of the ear. The advantages claimed for the Dossert feed-in are that it eliminates the process of soldering the feeder cable or fastening it with screws, gives contact throughout its entire length instead of at three points, as in case of a yoke, does away with bending and "checking" of the feeder by receiving it in a perfectly straight line, acts as a strain support, is strong and compact, and cannot work loose. The tap is bored to take up to No. 0000 round wire or stranded cable, and can be furnished with five-eighths-inch or three-fourths-inch stud.

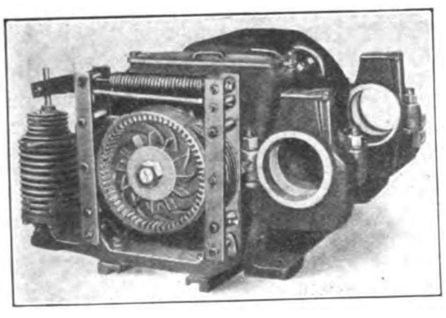
Electric-Motor Friction Brakes.

The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has developed several types of electric-motor friction brakes for the many applications of motor drive where it is necessary to



REAR VIEW. TYPE SP BRAKE.

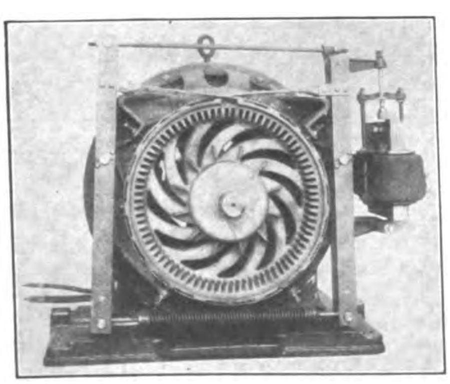
make quick and accurate stops. In rolling mills, blooming mills and similar installations, where frequent stops and reversals are necessary, brakes are needed to save time in bringing the motors to



TYPE SP BRAKE ATTACHED TO WESTINGHOUSE TYPE MD MILL MOTOR

rest before reversing, and to assist in the accuracy of control.

These brakes are built for both alternating and direct-current motors, and are operated by electromagnets, the coils of



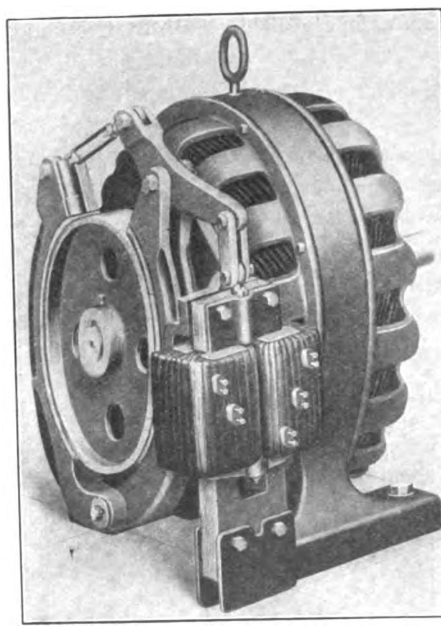
TYPE PB ALTERNATING-CURRENT MOTOR BRAKE.

which are connected in series or in shunt with the motor circuit. Series coils are used almost entirely with direct-current motors, and give more satisfactory service than shunt coils, although the latter can be supplied if desired. Alternating-current brakes are equipped with shunt coils only. These are connected across one phase of the motor circuit.

The type QK brakes are used on Westinghouse type K direct-current motors operating cranes, hoists, etc. These brakes are attached to the motors by means of special bearing housings carrying brake pads.

The type QBK brakes are similar to the type QK brakes in all respects, except that the former are mechanically operated, and are particularly adapted for use with the bridge travel motors of traveling cranes. These brakes are connected to the crane cage by suitable rods, and the braking force is applied by the crane operator.

The type SP brake has been designed primarily for steel-mill work, but can be



TYPE FS BRAKE ATTACHED TO WESTINGHOUSE TYPE HF MOTOR.

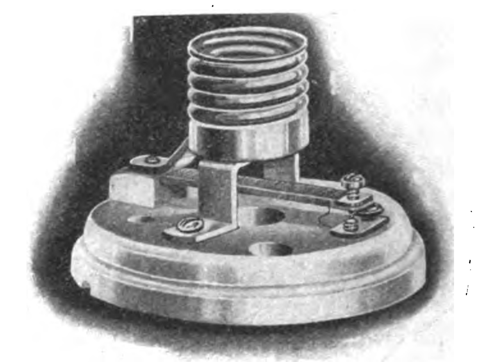
used in any service where a strong, rigid construction is desired. All parts are liberally proportioned, having a factor of safety large enough to meet the severest operating conditions. The brake is designed for mounting on the Westinghouse type MD mill motor, but can be used with other motors if desired.

The type FS alternating-current motor brake is adapted for twenty-five and sixty cycles, two and three-phase motor circuits.

Type PB alternating-current motor brakes are made for Westinghouse two and three-phase induction motors of from five to 100 horsepower, twenty-five, forty and sixty cycles. The braking action depends on the contraction of a coiled spring, and the brake will operate equally well with the motor tilted at a considerable angle from the horizontal position, as on roller lift drawbridges. This brake is attached to the motor in the same manner as the type FS, requiring a special bearing bracket and shaft.

A New Flashing Socket—the "Firefly."

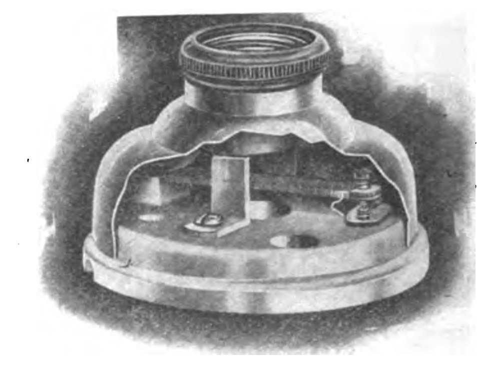
The reliability and usefulness of small thermostatic flashers, operating upon the principle invented by Dr. C. O. Schneider, of Chicago, about five years ago, has been



"FIREFLY" SOCKET FLASHER, SHOWING ARRANGEMENT OF PARTS.

amply demonstrated by the constantly increasing sales of the "Firefly" flasher, and also by the many cheap imitations of this simple little instrument that have appeared on the market at different times.

Realizing the desirability of a compact unit, containing both the flashing mechanism and a receptacle for the lamp, C. O. Schneider & Company have now devised



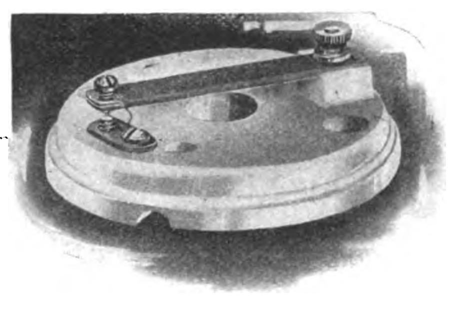
"FIREFLY" SOCKET FLASHER, WITH RING REMOVED.

the "Firefly" flashing socket, which is illustrated herewith.

The flashing mechanism in the socket is the same as the regular "Firefly" only much reduced in size, and it operates equally as well as the larger instrument. The iridio-platinum contacts will be the same size as are being used in the original flasher, therefore they anticipate the same satisfactory long-lasting qualities of the new flashing sockets.

The flashing socket may be connected with the same facility as an ordinary socket, it being merely necessary to unscrew the insulating ring, to lift off the cover, insert the wires through the porcelain base, fasten them to the binding screws and replace the cover and ring. Any lamp may be screwed into the socket, even up to a 100-candlepower tungsten. After waiting a minute until slightly warm, it will begin to flash the light on and off automatically from twenty to thirty times a minute, for a year or two.

Thermostatic flashers are now very extensively used to operate lamps in small electric signs, for attractive window-trimming effects, for displaying new types of lamp, decorative lighting, Christmas tree lamps, etc. In some forms of small signs made of all glass and metal, the flashing socket can be used without the ring and cover, as shown in the illustration. Another illustration shows the same flashing mechanism without the lamp socket; this will be known as the "Midget" flasher.



"FIREFLY" FLASHER USED WITHOUT RING AND SOCKET.

The great majority of thermostatic flashers in use at the present time are required to operate only a single lamp, and for this reason the flashing socket should meet an already existing large demand.

Schureman Alternating-current Elevator Controllers.

The J. L. Schureman Company, of Chicago, which for the past fourteen years has specialized in the design and construction of self-starters and elevator controllers, and whose direct-current apparatus is in general use throughout the country, has recently perfected a complete alternating-current line which is distinctive in that it conforms to the best principles in self-starter design, as developed in direct-current practice, by employing solenoids to perform all the functions of connecting the motor to the line and bringing it up to speed.

The line is complete in every respect and includes remote-control switches, self-starters for all classes of pump and compressor work, and elevator controllers for all services. Only one type, the reversing controller for slow-speed freight elevators, will be described at this time.

To obtain the best results and to avoid injury to the motor or controller through ignorance of the operator, the controller should be positive in action. After the rope has been pulled to start the elevator, the acceleration of the motor should be regulated entirely by the controller and should not be subject to the will of the operator. Also, in case of a failure in voltage through an interrupted circuit of any kind, it is unsafe to rely upon the judgment of the operator to return the controlling rope to the off position. To guard against accident in such a case the controller should be provided with a no-voltage release, which insures the return of the controller to starting position on failure of voltage.

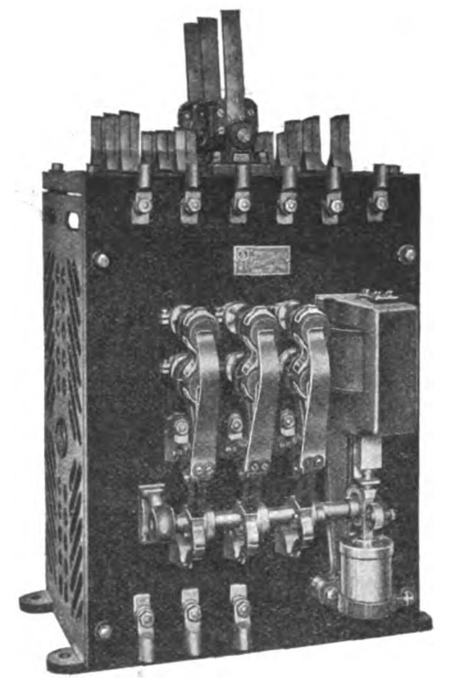
These controllers employ the resistance method of starting, and are especially adapted to slip-ring two or three-phase motors, such as are generally used for elevator service, on account of the high starting torque required. They have been successfully used, however, with squirrel-cage motors with high-resistance windings and comparatively high-torque characteristics.

The construction and operation of the controller is very nearly the same for either class of motor, the essential difference being in the rheostat. In the slip-ring type the starting resistance is of course inserted in the rotor circuit, is star-connected for three-phase motors and is inserted in all three phases. In the squirrel-cage type the resistance is inserted in two phases of the stator circuit and is cut out by the rheostat switches operating in pairs.

Fig. 1 shows a fifteen-horsepower, 220-volt, three-phase type "ASF" controller for a motor of this type. It is constructed along the same general lines as the "Schureman" direct-current freight elevator controller and consists of a solenoid-operated rheostat for accelerating the motor, and a knife-type reversing switch.

The method of operation is extremely simple. The shaft of the reversing switch is geared suitably to the operating mechanism of the elevator. A movement of the shipper rope sufficient to produce a throw of ninety degrees on the switch shaft closes the reversing switch and starts the motor in the direction for either up or down movement of the car, as desired, depending on the direction of pull on the rope, and the consequent direction of rotation of the switch shaft. This switch not only closes the stator circuit of the motor and connects the latter directly to the line, but also acts as a pole changer and controls the direction of rotation by reversing two legs of the stator circuit. It also controls the circuit of the rheostat solenoid, and when closed this solenoid is instantly energized and completes the operation of the controller by cutting out the starting resistance in the rotor circuit and bringing the motor to speed.

The construction of the controller is simple and rugged throughout, all parts being made interchangeable for easy replacement. The rheostat consists of a series of short-circuiting switches, a solenoid and dashpot. As the plunger of



FIFTEEN-HORSEPOWER, 220-VOLT TYPE ASF CONTROLLER.

the solenoid is raised, it revolves a horizontal shaft through the medium of a rack and pinion. A series of cranks placed at fixed positions on the shaft operate the switches, closing them in succession, and short-circuiting the starting resistance. The switches are three-point, and each short-circuits one step of resistance in each phase. In this way the resistance in each phase is equal at all times and the circuit is never unbalanced. This insures uniform torque and maximum efficiency. A vacuum dashpot retards the movement of the solenoid plunger and can be adjusted to give the desired rate of acceleration.

The solenoid is of special construction, the pull being practically constant throughout the stroke, and is practically noiseless in operation. It is designed to withstand severe service without undue heating.

Electrodeposition of Brass.

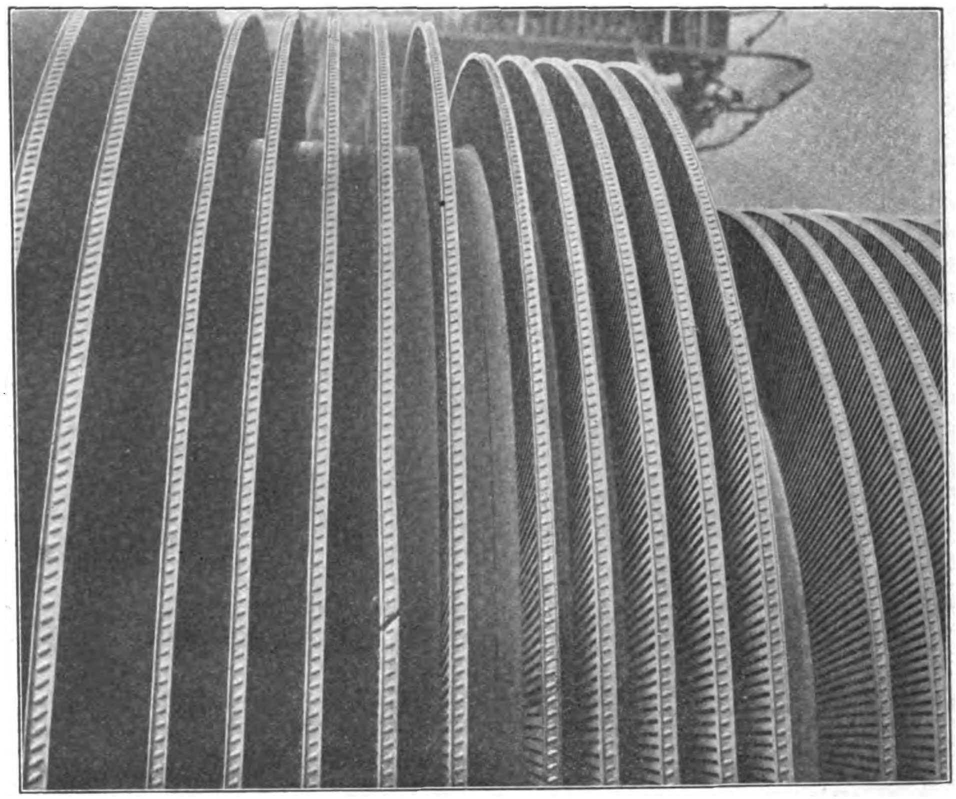
In the electrodeposition of brass and similar alloys the chief difficulty which has heretofore been experienced in practice is to obtain for any length of time an alloy of the desired composition. The composition of the alloy can be regulated within certain limits by varying the relative percentages of the metals in solution through the adjustment of the temperature of the electrolyte and the current density with the corresponding increase or decrease in voltage and moving the cathode, but this regulation is not sufficient in cases where it is desired to deposit an alloy of any thickness, for instance, to produce brass sheets or tubes.

As the result of an invention that was recently patented Mr. Sherard O. Cowper-Coles, of London, England, provides means whereby the composition of the alloy deposited can be more effectually controlled. His process consists in employing, in addition to an anode of the alloy to be deposited, say brass, anodes of copper and zinc which can be connected to the circuit which supplies the current passed through the brass anode. Furthermore, resistances are inserted in the conductors which convey the current to the zinc and copper anodes, whereby the amount of current flowing through these anodes, and as a consequence, the amount of metal that goes into the solution, can be regulated.

The inventor has found that good results can be obtained in practice with such an arrangement of anodes by employing an electrolyte composed of double cyanides of copper and zinc and potassium. He has obtained excellent results with an electrolyte prepared as follows: A ten per cent solution of cyanide of potassium is brought to the point of saturation by passing an electric current through a brass anode, the cathode being protected by a porous pot, and the electrolyte being then worked under the condition already mentioned, small quantities of cyanide of potassium being added from time to time to maintain the strength of the solution.

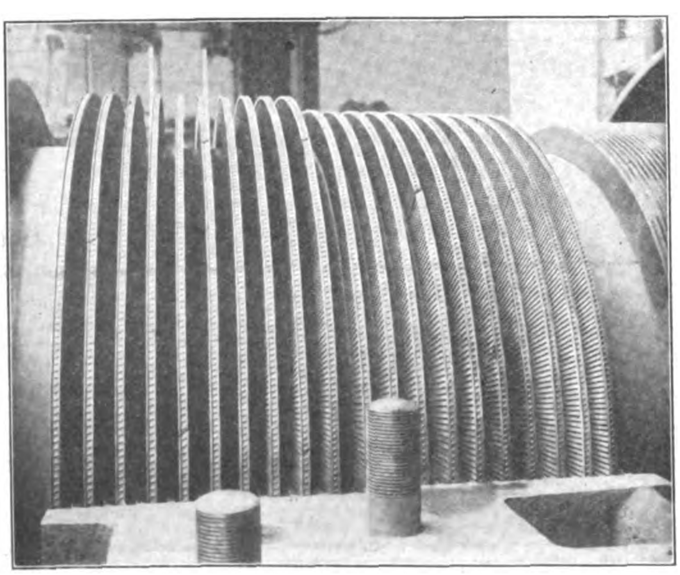
Remarkable Performance of Allis-Chalmers Steam Turbine.

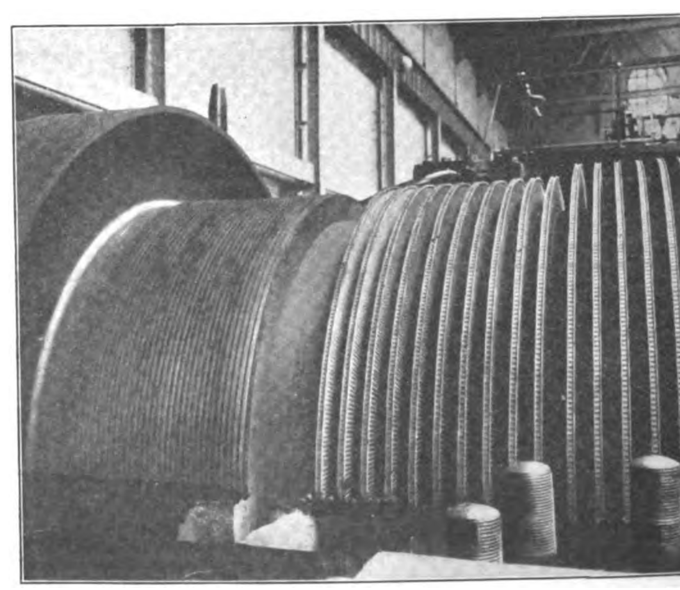
The accompanying illustrations have been made from photographs which were taken of a 5,000-kilowatt Allis-Chalmers



A NEAR VIEW OF THE BLADING OF ALLIS-CHALMERS STEAM TURBINE AFTER TWENTY-SEVEN MONTHS' CONTINUOUS SERVICE.

steam turbine which was opened up recently at the power house of the Brooklyn Edison Company, in Brooklyn, N. Y.,

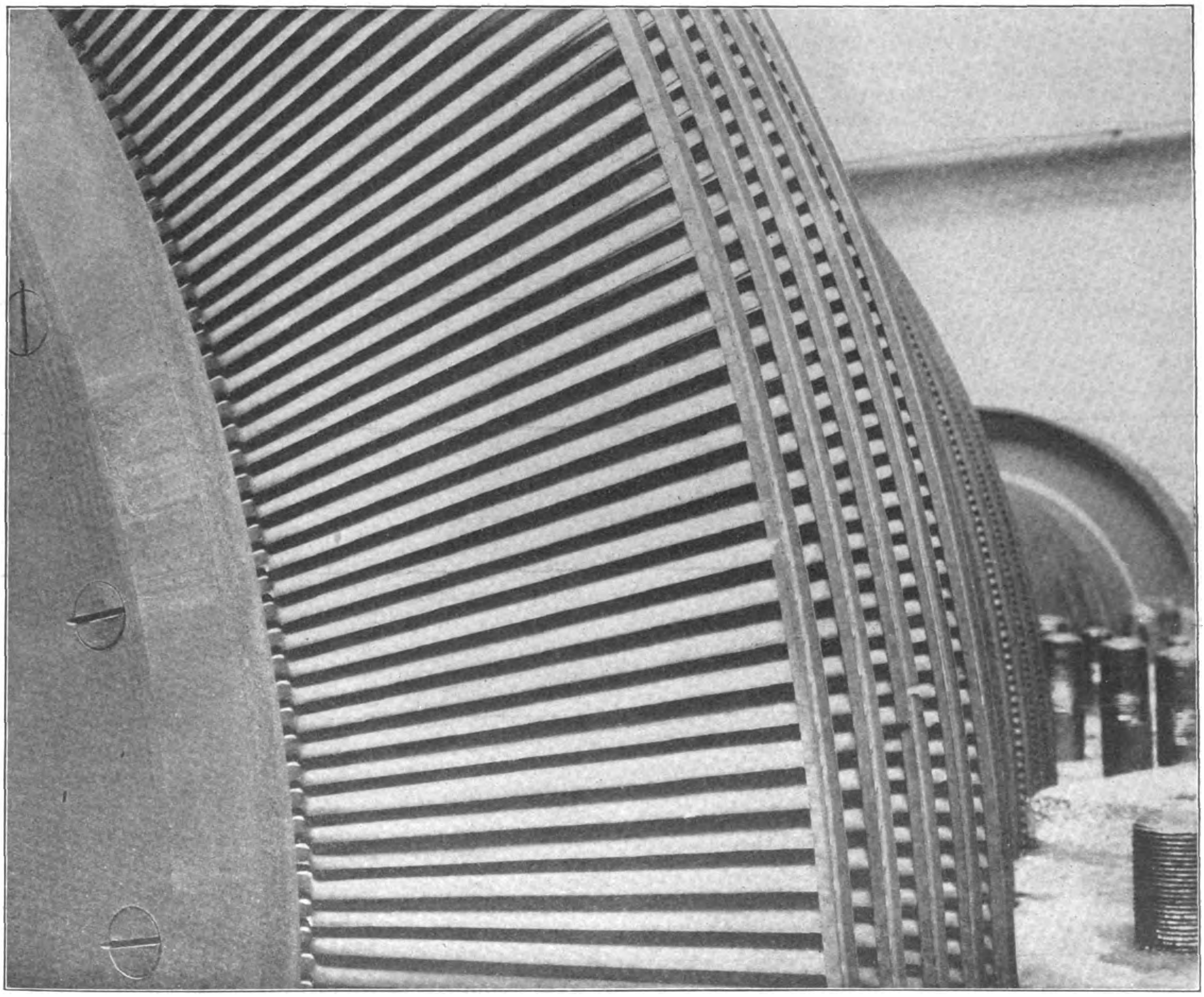




A 5,000-KILOWATT ALLIS-CHALMERS STEAM TURBINE AFTER TWENTY-SEVEN MONTHS' CONTINUOUS SERVICE IN THE POWER HOUSE OF THE BROOKLYN EDISON COMPANY, BROOKLYN, N. Y.

after twenty-seven months' continuous service. The camera was brought as close to the machinery as practicable, in order to secure the greatest detail possible. The photographic results show that there was absolutely no deterioration after this long period of service. Notwithstanding the high initial rating given the machine, it has frequently carried a load of 9,000 kilowatts for long periods continuously.

The constructional features of the Allis-Chalmers steam turbine are well known, and they will be referred to here only briefly. The turbine as manufactured today is the result of practical experience and systematic experiment extending over the period since 1884, when the first commercial "Parsons" turbine was produced. The turbine consists essentially of a fixed casing or cylinder and a revolving spindle or drum. The ends of the spindle are extended in the form of a shaft carried in two bearings, and excepting the small parts of the governing mechanism and the oil pump, these bearings are the only rubbing parts in the entire turbine. Steam enters through a main throttle or regulating valve, and passes into the cylinder at the high-prssure end, passing alternately through stationary and revolving rows of blades, finally emerging at the lowest stage and passing to the condenser or to the atmosphere. Each row of blades, stationary and revolving, extends completely around the turbine, the steam flowing through the full annulus between the spindle and the cylinder. The blades in each step are arranged in groups of increasing length. At the beginning of each of the larger steps the blades are usually shorter than at the end of the preceding smaller step, the change being made in such a way that the correct relation of blade length to spindle diameter is secured.



BLADING AND SHROUD RING OF 5,000-KILOWATT ALLIS-CHALMERS STEAM TURBINE AFTER TWENTY-SEVEN MONTHS' CONTINUOUS SERVICE IN THE POWER HOUSE OF THE BROOKLYN EDISON COMPANY, BROOKLYN, N. Y.

Each blade is individually formed by special machine tools, and the roots of the blades are held firmly in the foundation ring. To protect and, in a substantial manner, bind together the tips of the blades, a shroud ring is used. Holes are punched in this shroud ring to receive projections on the tips of the blades, these holes being accurately spaced by special machinery to match the slots in the foundation ring. The finished rings themselves are of dovetailed shape in cross-section, and are inserted in dovetailed grooves in the turbine cylinder and spindle, respectively, in which they are firmly held by key pieces. The latter, after being driven into place, are upset into under-cut grooves, positively locking the whole structure together and making it wholly impossible for a blade to get out of place.

The flanges of the channel-shaped shroud rings are made thin, so that in case of contact from any accidental cause, no dangerous heating will take place, nor will the rubbing rip out the blades.

SILICO-VANADIUM TRANSFORMER STEEL.

BY H. W. YOUNG.

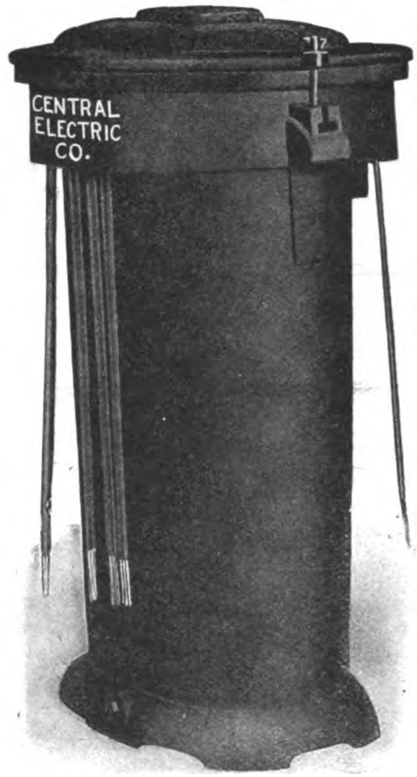
The remarkable magnetic qualities of the new silico-vanadium steel as used in recent designs of transformers has aroused so much inquiry that a brief discussion of the physical appearance of this alloy steel will be of interest.

Silico-vanadium steel is strongly crystalline in structure, looking very much like a sheet of zinc or tin, although the appearance of different samples will vary on account of the different thicknesses of scale arising from the annealing process. When held so that the light is reflected from its surface this crystalline structure is most pronounced. Occasionally, samples will be found which are coated with a dark blue scale covering the surface of the metal, but when this is removed the characteristic crystalline structure is plainly discernible.

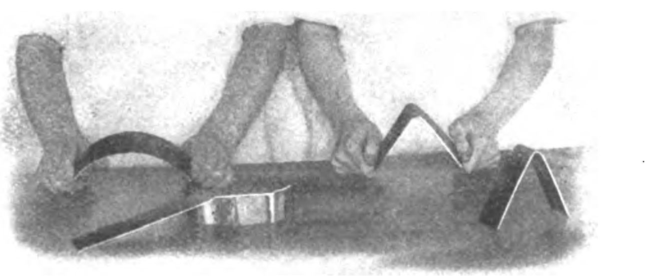
The susceptibility of silico-vanadium steel to oxidation during the annealing process is a very valuable commercial feature, for the reason that the exceedingly thin scale or film of oxide which forms on the surface is an insulator to the extent of rendering unnecessary the usual practice of painting or japanning the transformer laminations made from this steel. Insulating the laminations by paint or japan is not only expensive, but undesirable, for the reason that the japan or paint occupies some space, so that as much steel cannot be placed in a given section as would otherwise be employed.

In the accompanying illustration is shown a piece of silico-vanadium steel being bent into the form of a half circle, and also a piece of ordinary alloy steel, or silicon steel, which will not readily bend into the form of a half circle, but rather tends to form a V-shaped fold. The piece of silico-vanadium steel shown standing on edge has been bent sharply a number of times and shows how the dark blue scale has been loosened by the operation.

Anyone who is interested can thus readily compare the various alloy steels at present on the market by an examination of their physical appearance and also by the bending test, as shown in the illustration. A further peculiar characteristic of silico-vanadium steel is the manner in which it breaks and the appearance of the fracture. While there is a slight variation in the hardness of this steel, some pieces breaking instantly like glass upon the first attempt at bending, other samples may be bent very sharply several times before snapping. The fracture is irregular and the crystals may be easily seen without the aid of a magnifying glass.



COMPLETE SILICO-VANADIUM STEEL TRANSFORMER.



BENDING SILICO-VANADIUM STEEL.

As this subject is of such widespread interest at the present time, manufacturers have prepared small samples of the alloy steels which they are using, and are usually glad to send these on request.

The improved magnetic quality of silico-vanadium steel is now fully recognized as of great importance in decreasing transformer core losses, and improvements in efficiencies resulting are of material value to central stations. While the use of this new alloy has necessitated more or less redesigning the standard transformer, the general appearance has not been greatly changed, as will be noted from the illustration showing a complete transformer mounted in the case.

Texas Independent Telephone Convention.

Seventy-five representatives of Texas independent telephone companies attended the convention of the Texas Independent Telephone Association, held at Dallas, October 25 and 26. J. B. Earle of Waco, the retiring president of the association, delivered an interesting address in which he pointed out the benefits to be obtained by the members of the association through organized and concerted effort. C. A. Shock of Sherman, retiring secretary-treasurer, spoke of the value of a state association. The effect of anti-trust and anti-pass laws on telephone development was discussed by T. P. Stilwell of Lone Oak, who took the position that this character of legislation had encouraged telephone development in Texas. "Financing Telephone Properties" was the subject of a paper by W. A. Walker, president and general manager of the San Antonio Telephone Company. C. W. Emmer of Beaumont discussed the matter of "Relation of the Exchange Owner to the Supply Dealer and Manufacturer." Addresses were also delivered on the subjects: "How to Increase Income and Curtail Expenses," by E. M. Chamberlain of Greenville; "Rural Lines and Connections," by W. P. Johnson of Corsicana, and "Value of Tact in the Telephone Field," by Floyd R. Brown of Dallas.

The following officers were elected for the coming year: President, D. A. Walker of San Antonio; vice-presidents, E. M. Chamberlain of Greenville, R. A. Renfro of Hillsboro, and I. W. Parks of Giddings; secretary-treasurer, T. A. Gould of Ennis. D. A. Walker was elected delegate to the international convention, with J. B. Earle as alternate.

Current Electrical News

CONTINENTAL EUROPE.

BASEL, OCTOBER 17.—The city of Sofia, Bulgaria, whose population is estimated at 100,000, is well provided with electric lighting and tramways. To furnish the current for both purposes there have been erected two electric plants of some size. The first of these stations is a hydro-electric plant, about ten miles from the city, near the village of Pantcharevo, on the Isker River. The remainder of the power is supplied from a steam plant located within the city limits. The hydraulic plant uses a 170-foot head of water and has a capacity of about 1,600 kilowatts at present. Oerlikon alternators of the three-phase type are used in the station, and are direct-coupled to Piccard-Pictet wheels, manufactured at Geneva. In the second plant, within the city, are installed three units of 400 kilowatts each, arranged to be worked in parallel with the hydraulic plant, for both lighting and tramways. Owing to the extension of the tramway lines a new 1,000-horsepower group will be especially installed for this purpose. The lighting mains of the town are 3,400 volts on the primary and 150 volts on the secondary.

At the electrical exposition of Marseilles the section relating to traction contains some interesting electric railway exhibits. The Marseilles tramway company, which now operates one of the most extensive systems in Europe, shows a number of models of its city and suburban cars and motors. The Schneider Company of Creusot (France) has a complete exhibit of track material and rolling stock, together with many samples of fittings. Underground conduits for electric tramways are exhibited by the East Parisian Company. The Bordeaux Tramways Company has a large exhibit, which includes a train of three cars, two motor cars and a trailer, of the most recent type. A similar exhibit is made by the traction company of Nice, showing its multiple-unit cars. The Genoa company has two narrow-gauge traction cars, in which the electric outfit was furnished by the Allgemeine Elektrizitäts Gesellschaft of Berlin.

At Budweis, Austria, there is a project in consideration for a new system of narrow-gauge electric traction lines for the city. The International Electric Company is one of the promoters, and it is intended to run several different sections of line in the town and the suburbs. A new suburban tramway line, which was opened not long ago at Berlin, runs to the locality of Altstadt. Passengers and freight are carried on this line. The city of Basle, Switzerland, besides having extensive tramway lines within the town, is now the terminus of two suburban lines. One of these lines (the Birseck road) uses a type of motor car and trailer. The extensive electrical works of the Abott Company, one of the largest in Switzerland, are located on the present line at Münchenstein. The second suburban system, known as the Birgstal road, uses motor car trains.

At St. Petersburg not long since there was held a congress of the leading railroad officials of the county to discuss the question of adopting electric traction upon parts of the principal railroads of Russia. This move is an important one, as it is proposed to use the electric system upon the St. Petersburg-Moscow, Kharkoff-Sebastopol, St. Petersburg-Warsaw and Kieff-Odessa lines.

A. DE C.

GREAT BRITAIN.

LONDON, OCTOBER 16.—Just as there seemed to be a possibility of the London electric power bills being allowed to come before a committee of the House of Commons and being considered on their merits, the opposition of the London municipal authorities has assumed a most virulent form, and every effort is to be made to prevent the companies' bills going forward. Considerable strong feeling has been shown at the action of many members of Parliament for London assenting to the second reading of the bills, their reason being that they were convinced of the necessity for some bulk supply arrangements being made, and that as the London County Council had expressed its intention of not entering the field with a scheme, they voted for the companies' bills as the only alternative.

The delegates to the International Conference on Electrical Units and Standards are not lacking entertainment. Luncheons and dinners have been given by the government, and also by the Royal Society and the lord mayor of London, and visits are being made every day to numerous institutions, both scientific and popular.

Trolley omnibuses appear to be creating an impression among municipal tramway authorities. The latest giving consideration to their adoption are the Liverpool and Falmouth local authorities. Similarly, the London Electrobus Company continues to make applications to numerous provincial authorities for permission to run electric omnibuses in parts not touched by tramways.

Rumors are afloat in London of the formation of a new electric power company, with the sole object of supplying the Rand (South African) mines. Of interest in the same connection is the report of the Victoria Falls Power Company, which has just been issued. From this it is clear that the utilization of the waterpower at the Victoria Falls is not at all an immediate possibility. In fact, a new steam station is about completed, at Brakfran, while a second similar station at Germiston is under construction. The first has a capacity of 8,000 horsepower and the latter 16,000 horsepower.

G.

EASTERN CANADA.

OTTAWA, OCTOBER 24.—The new electric line, the Montreal & Southern Counties Railway, which some time ago secured an entrance into Montreal from the South Shore, has started construction work.

The proposal to lease the properties of the Mexican Light & Power Company to the Mexico Tramways Company meets with such adverse criticism from shareholders of the former company that the project has practically been shelved. Sir George Drummond's recent resignation from the presidency of this company is understood to have been by way of a protest against the sacrifice of its interests to the aggrandizement of the Tramways concern.

The Ontario Hydro-Electric Power Commission has announced that the engineers have adjusted the details of the construction of the Niagara Falls transmission lines with the contractors and work will commence at once.

In spite of the depression in business during the past year, the financial statement of the Montreal Street Railway shows that the road received an increase in gross and net earnings for the year ended September 30. The gross earnings are given at $3,677,432, and the operating expenses amounted to $2,158,394. The net income is placed at $1,136,411, and after dividend payments a surplus of $235,686 is left.

Much Canadian capital is invested in the West India Electric Company, which owns and operates the tram service at Kingston, Jamaica, James Hutchinson, of Montreal, being the president. This company operates about twenty-five miles of road, all of which is of first-class construction. The natives are employed as motormen and conductors and have been found fully competent for their respective duties.

W.

WESTERN CANADA.

WINNIPEG, OCTOBER 31.—Timely rains in Victoria, B. C., have put an end to the power famine in that city, and it is expected that there will be no more trouble before next summer, when it is intended that the British Columbia Electric Railroad Company will have a new power plant in operation. This company will erect a huge concrete dam at Coquitlam Lake, near New Westminster, B. C., for the purpose of increasing its power. This dam will be seventy-five feet high, ranging in width from forty feet at the base to the width of a wagon road at the apex.

The municipal electric street railway system at Edmonton, Alberta, was put in operation on October 26.

The city of Port Arthur, Ontario, has made a contract for the supply of 400 electrical horsepower, at $25 per horsepower, from the Kaministiquia Power Company of Fort William, Ont. The company will build a sub-station in Port Arthur, with a capacity of 2,000 horsepower, and will distribute power to manufacturing concerns in Port Arthur and Fort William.

The telephone line between South Pender and Pender Island, B. C., has been completed by the Dominion government, and arrangements are now being completed for the extension of the line to Mayne Island, giving through communication with Victoria, B. C. R.

IMPORTANT DEVELOPMENTS.

NEW PLANS FOR MOJAVE RIVER POWER SCHEME—A new company has been organized for the purpose of taking over the Westwater interests in the Victor dam project, and the great scheme of impounding the waters of the Mojave River by filling up the natural dam site at Victorville may soon be accomplished. The company has filed articles of incorporation under the name of the Mojave Water and Power Company, with an authorized capital of $2,000,000.

HUGE WATERPOWER DEVELOPMENT TO MANUFACTURE PAPER—The Minnesota & Ontario Power Company has been incorporated, with a capitalization of $7,000,000. The corporation plans to develop idle waterpower, establish a paper manufacturing center and conduct lumbering operations over a territory of 150,000 square miles. The board of directors is as follows: Edward W. Backus, William E. Brooks, Warrens Curtis, John A. Davis, of New York; W. A. S. Peabody, Alexander Smith, of Chicago, and Warren Curtis, Jr., formerly of Corinth, N. Y.

RECEIVERS FOR HUDSON RIVER COMPANIES—Receivers have been appointed for the Hudson River Electric Power Company, which was organized in 1903, and controls the Hudson River Water Power Company, Hudson River Electric Company, and Hudson River Power Transmission Company, together with various sub-companies owned by the last two named, supplying central and eastern New York state with power. The authorized capital stock was $10,000,000, of which $5,390,000 was issued. The total funded debt of the corporation, according to its last statement, was $9,683,500. Net earnings for 1907 were $486,200.

POWER DEVELOPMENTS AT NECAXA, MEX.—Contracts have been let by the Mexican Light and Power Company for the construction of the three tunnels and a canal to divert water to the reservoirs of the company at Necaxa. The tunnels will be, respectively, one of 1,400 meters and two of 350 meters in length, and the canal will be two or three kilometers in length. Two additional dams are to be built at Necaxa for the storage of this additional water supply. One of these dams will contain 800,000 cubic meters of material and the other 250,000 cubic meters. The power house at Nacaxa is also to be increased by two large concentrators, of 16,000 horsepower capacity. The Laguna reservoir dam has been completed and the reservoir is now about half full of water. This reservoir has a capacity of 44,000,000 cubic meters. The Los Reyes reservoir dam has also been completed and is practically full of water. This reservoir has a capacity of 12,000,000 cubic meters. Shareholders of the Mexican Light and Power Company will hold a special meeting in Montreal, Canada, on December 3, for the purpose of ratifying an increase of $3,800,000 in the preferred stock issue of that company.

PROMOTES $24,000,000 TROLLEYLESS STREET-RAILWAY SYSTEM FOR SAN FRANCISCO—John J. Egan, a promoter, concerning whom little appears to be known, is seeking a 25-year franchise in San Francisco for a street car system, to traverse 244 miles of streets, and to be established at an expenditure of $24,000,000. He says he has recently received a patent for a new type of electric street car system, the conductor rail being carried on the roof of the cars, projecting 25 feet ahead and the same distance behind. The ends are to touch poles set at regular intervals, thus keeping the car at all times connected with the source of current.

UNION TRACTION COMPANY, OF PHILADELPHIA, VOTES IN FAVOR OF $5,000,000 LOAN—Stockholders of the Union Traction Company, of Philadelphia, Pa., voted in favor of the $5,000,000 loan to the Philadelphia Rapid Transit Company, the holding company, 506,757 shares voting in favor and 3,435 against. After the announcement that the loan proposition was carried the following resigned: John B. Parsons, as president and director; George D. Widener, as vice-president and director; P. A. B. Widener, W. H. Shelmerdine, George H. Earle and J. J. Sullivan, as directors. E. A. Ballard then nominated the following, who were elected to the vacancies: John H. Chestnut, William P. Katz, Jacob S. Disston, Henry Fernberger, Edward M. Story and J. J. Sullivan. After the Union Traction meeting the stockholders of the Philadelphia Rapid Transit Company held a special meeting ratifying the Union Traction Company $5,000,000 loan.

INDEPENDENT INTERESTS PLAN NATIONAL LONG-DISTANCE SYSTEM—The reported combination of independent long-distance telephone interests to form a national long-distance system was confirmed at Buffalo, N. Y., on October 29, by B. G. Hubbell. "Contracts are now being closed," said Mr. Hubbell, "with twelve of the principal independent long-distance companies for the use of rights-of-way, poles and connections, and there is every prospect of early incorporation and the beginning of construction. The plan is to fill in the gaps between existing long-distance systems to form a single group, with Poughkeepsie, N. Y., as the eastern terminus, Kansas City as the western, and Mobile, Ala., as the southernmost point. Within this area will be united Chicago, Detroit and Michigan points, with Cleveland, Buffalo and Rochester to the east and St. Louis, Indianapolis, Louisville, Pittsburg, Scranton and Philadelphia, besides intermediate points."

PROPOSALS.

VACUUM CLEANING SYSTEM FOR FEDERAL BUILDING, CLEVELAND—The office of the supervising architect will receive sealed proposals until November 21 for the installation of a vacuum-cleaning system for the Federal building at Cleveland, Ohio, in accordance with specifications, which may be had at the above office or the office of the architect, Arnold W. Brunner, 33 Union square, West, New York city.

POSTOFFICE, GAINESVILLE, GA.—The office of the supervising architect, Treasury Department, Washington, D. C., will receive sealed proposals until December 8 for the construction (complete) of the U. S. postoffice at Gainesville, Ga., in accordance with the drawings and specifications, copies of which may be had at the above office or at the office of the postmaster at Gainesville.

ENGINEERING SOCIETIES.

BOSTON BRANCH, A. I. E. E.—The first monthly meeting of the Boston section of the American Institute of Electrical Engineers was addressed by Professor Charles M. Allen, of the Worcester Polytechnic Institute, on the subject, "Testing by Dynamometers."

WORCESTER POLYTECHNIC BRANCH, A. I. E. E.—The meeting of the Worchester Polytechnic Branch of the Institute, at Worcester, was given over to a discussion of the proceedings of the American Street and Interurban Railway convention at Atlantic City last month.

ELECTRIC LIGHTING.

TOPEKA, KAN.—The Great Bend Water & Electrical Company, with a capital stock of $80,000, has been granted a charter.

NASHVILLE, TENN.—The Tennessee Electric Company has been incorporated for $5,000 by I. L. Canoway, J. H. Rudisell and T. S. Sinson.

ANTLERS, OKLA.—An engineer has been employed to make estimates of cost of an electric-light plant which the city contemplates installing.

STOCKBRIDGE, MASS.—The Stockbridge Lighting Company seeks authority to issue $15,000 additional capital stock, making the total $40,000.

ALBANY, KY.—Five citizens have formed a stock company and Albany is to have an electric light plant. The plant will be installed at once.

BASTROP, TEX.—T. A. Orgain, city secretary, has charge of a project for the city to issue bonds for the purchase of an electric-light plant.

SPOONER, MINN.—Building on the Shevlin-Mathieu power house has been commenced. The structure throughout will be of concrete and steel.

BUFFALO, N. Y.—The Republic Electric Company has been incorporated for $5,000 by a number of incorporators, headed by William E. Robertson of Buffalo.

WARREN, OHIO—Mayor Kilpatrick has vetoed the ordinance passed in council in favor of the Hydro Electric Company and the Warren Water & Light Company.

STOYESTOWN, PA.—The Stoyestown Light, Heat & Power Company is to be organized, with a capital stock of $7,500. D. E. Long heads the list of incorporators.

COLUMBUS, OHIO—The East End Electric Company of Cleveland has been incorporated with a capital stock of $10,000. C. R. Foster heads the stockholders.

ROOSEVELT, N. Y.—The Roosevelt Waterpower and Light Company has been incorporated, with a capital stock of $40,000. Edward Uhe heads the incorporators.

MONTGOMERY, ALA.—The Choctawhatchie River Light and Power Company has been incorporated for $1,000,000, of which $500,000 is paid in. W. C. Fritter heads the incorporators.

SCHENECTADY, N. Y.—According to newspaper reports the Schenectady Illuminating Company is to erect an eight-story building at State and Barrett streets, on the site of the Park House.

JACKSONVILLE, FLA.—An ordinance before the city council provides for granting a franchise for an electric light and street railway system to M. M. Smith, W. D. Holden and A. Johnson.

HARRISBURG, PA.—Plans for a permanent decorative illumination of Market street and Market square have been made by the Harrisburg Light, Heat and Power Company. Several blocks are now thus illuminated.

FAIRFIELD, CONN.—A report on the cost of installing an electric lighting plant to light the villages of Fairfield and Southport, made at a meeting of the Fairfield Village Improvement Society, is now before the people of the town.

ELWOOD, IND.—The plant of the Citizens' Heat and Light Company, of Elwood, was sold at receiver's sale at the Anderson courthouse for $50,000, the purchase being made by E. R. Ester, a member of a committee representing the stockholders. The plant was appraised at $375,000. The Central Indiana Electric Company is expected to take over the Elwood plant as soon as it secures a franchise in Elwood. The bonded indebtedness of the Elwood company is $364,000.

FRANKFORT, IND.—The municipal electric light plant was wrecked October 27, sustaining $25,000 damage, by the explosion of a fourteen-ton flywheel. The governor on the 500-horsepower engine stuck, it is said, and pieces of the flywheel were hurled 300 feet.

ATLANTIC CITY, N. J.—Chairman Donnelly, of the council's lighting committee, has been authorized to secure bids for the lighting and illumination of the "boardwalk" next year. The present contract expires in a few weeks. Bids are to be received until November 9.

CARL JUNCTION, KAN.—Business men are urging a lighting system from the lines of the Joplin-Pittsburg Electric Railway, which passes through Carl Junction. It is understood that the company can furnish all power necessary and would wire the city at a reasonable rate.

BUENA VISTA, VA.—The Rockbridge Power Company has secured a franchise to furnish the city with electric light and power. The company proposes to develop waterpower on North River and furnish electricity to Buena Vista, Glasgow, Buchanan and possibly Lexington, Va., locating sub-stations in each city.

PLATTEVILLE, WIS.—O. M. Fox and M. F. Fox are considering extending electric light and power lines to Platteville, having already decided to build from Galena to Benton and Cuba City. The company which they head is erecting an electric power plant at Galena, to furnish light and power to the vicinity.

NAPA, CAL.—The board of supervisors has granted E. D. Lehe of Dixon a franchise to construct electric power lines over the roads of Napa County north from the city to the Lake County line, passing through St. Helena and Calistoga. Mr. Lehe plans to re-establish the electric lighting system at Calistoga.

BEDFORD CITY, VA.—A 1,000-horsepower hydro-electric plant is planned for a power site on the James River, 25 miles from Bedford City. There is a fall of seventeen feet at this point, and it is estimated that the present dam will generate 1,200 horsepower. The power would be transmitted and used to light the city.

LINDSAY, OKLA.—The board of trustees has called for an election on the proposal to appropriate $40,000 for a water and electric light system for Lindsay. The town is situated in a prosperous and growing country and apparently there is little opposition to the movement, and it is predicted that the election will carry by a large majority.

CHICAGO, ILL.—The Commonwealth Edison Company has obtained control of the property at the southeast corner of Quarry street and the Chicago River through a lease from Northwestern University. The tract contains 118,356 square feet, or almost three acres. The present lease is for ninety-five years from November 1 of the present year, the total rental being $308,750.

ST. LOUIS, MO.—Property owners of the district bounded by Fourth, Twelfth, Washington and Market streets, are discussing a uniform system of lighting for the downtown streets. A committee has presented figures on the cost of carrying out the plan in the district named, and interesting data from other cities, which have adopted the electrolier system, were furnished the property owners.

TERRE HAUTE, IND.—The directors of the Pleasant Shades Power Company, which was incorporated under the laws of Indiana September 1, for $100,000, have decided to locate the home offices in Terre Haute. M. H. Ewers, president of the company, heads the list of Terre Haute men who comprise the incorporators. The new company was organized to build a waterpower generating station and summer resort on Rocky River, or Sugar Creek, near Waveland, thirty-two miles from Terre Haute. The company owns about 400 acres of land. A dam 350 feet long and twenty feet high will be built to supply waterpower for generating 500 kilowatts of electric power, to be used in lighting the resort and operating an electric railway.

PROVIDENCE, R. I.—The stockholders of the Narragansett Electric Company will shortly be called upon to consider the advisability of an issue of $500,000 in 4 per cent debentures. The purpose of the issue is to retire a portion of the floating indebtedness of the company. This issue, if approved by the stockholders, will make the total of outstanding securities of the company of all classes $4,500,000.

BLUE ISLAND, ILL.—The Sanitary District of Chicago has entered into a contract to supply the town of Blue Island with light and power. Compensation was fixed on a basis of estimated returns to the District of $14,000 the first year and increases each year thereafter. The District is to take over the commercial lighting system and supply current to the residents of the town at a rate of 10 cents per kilowatt hour.

PUGET SOUND, WASH.—Work is progressing on the construction of the new $450,000 central power plant, which is being built at the Navy Yard. The Westinghouse Electric and Manufacturing Company has secured the contract for supplying a 1,000-kilowatt generator and a 500-kilowatt generator. These, in addition to the 500-kilowatt generator previously contracted for, will give the plant a generating capacity of 2,000 kilowatts.

CHATTANOOGA, TENN.—The Chattanooga-Tennessee River Power Company awarded a contract to Guild & Company of Chattanooga, to furnish material and construct a transmission line fifteen miles long from Hale's Bar to Chattanooga. Steel towers resting on concrete foundations will be erected along the right-of-way. The contract involves the expenditure of about $150,000. The company is constructing a hydro-electric plant at Hales Bar to secure an ultimate development of 56,000 horsepower.

OBITUARIES.

MR. HENRY A. BUTTERS, president of the Northern Electric Railway Company, died in Berkeley, Cal., last week. He was widely known as a mining man and capitalist.

DR. DANIEL C. GILMAN, first president of the Johns Hopkins University, Baltimore, Md., and afterward head of the Carnegie Institute, Washington, died on October 14 at Norwich, Ct., at seventy-seven years of age. Educated first at Yale and then at Cambridge and Berlin, he became president of the University of California in 1872. Five years later he went in the same capacity to the Johns Hopkins University. His work there, which lasted until 1901, secured him a place among the foremost American educators. In 1891 Dr. Gilman left Baltimore for Washington, where he spent three years organizing the Carnegie Institute. In addition to the work of his various university appointments, Dr. Gilman was appointed by President Cleveland to act as commissioner in the Venezuela and British Guiana boundary dispute. He was president of the American Oriental Society, and a prominent member of various learned societies and institutions.

NEW PUBLICATIONS.

NATIONAL BOARD OF FIRE UNDERWRITERS—Among recent publications of the National Board of Fire Underwriters are two leaflets giving rules and requirements for the construction, installation and use of coal gas producers on both the pressure and suction system, and rules for the construction and installation of incubators and brooders. Devices heated by coal, gas or electricity are regarded as much less hazardous than those heated by oil flames.

THE ARMOUR ENGINEER—During the coming year there will be published Volume I of the Armour Engineer, the new semi-annual technical publication of the student body of the Armour Institute of Technology, Chicago. This is an engineering magazine issuing two large numbers each year, one for each semester. The Armour Engineer is to contain technical articles by prominent Armour graduates, results of research in the Armour testing laboratories, the best papers presented before the engineering societies, editorials, book reviews, engineering notes and comments.

TELEPHONE AND TELEGRAPH.

WILKES-BARRE, PA.—The Bell Telephone Company has been given permission to start the work of laying its wires in the central part of the city under ground.

SPOTTSYLVANIA, PA.—The Caroline Telephone Company is extending its line to the town of Bagby, in that county, and will run it from there to Port Royal, on the Rappahannock River.

NASHVILLE, TENN.—The Limestone Telephone Company has been incorporated to operate in Washington County, with a capital stock of $3,000. S. B. Moreloch heads the incorporators.

READING, PA.—The Mt. Zion Rural Telephone Company has been organized by farmers and business men of Mt. Zion. The line will cover a territory of twenty miles, including Mt. Ætna, Frystown and Lebanon.

BIRD ISLAND, MINN.—The village council has granted a franchise to A. C. Bowe, of Merriam Park, for the installation of a telephone system. Mr. Bowe will put in a modern plant, using the common battery system.

GROTON, VT.—The Groton Telephone Company has been organized, with a capital stock of $10,000, for the purpose of maintaining telephone lines in the towns of Groton, Bradford, Topsham, Barnet, Corinth, Newbury, Peacham and Ryegate.

BOYDS, MD.—The Boyd Telephone Company, supplying Montgomery, Frederick and Carroll counties, later controlled by the American Union Company, has been sold, with all franchises, to the recently organized Montgomery Telephone Company, which plans to build an independent line, with metallic circuit.

CORDOVA, ALASKA—Mummy Island, about eight miles from Cordova, has been selected as the site for the navy wireless station, to be established on the Alaskan coast to close communication between the coastal wireless station of the navy and the military Alaskan telegraph system. Work on the new station already has begun.

NEW BRUNSWICK, N. J.—The Middlesex Telephone Company, of Monmouth Junction, is capitalized at $10,000, of which $1,000 is subscribed. The incorporators are: Clarence S. Groves, of Dayton; D. C. Mershon, Prospect Plains; Andrew Ely, Dayton; A. V. Stout, Monmouth Junction; W. J. Rowland, Monmouth Junction; George W. Waite, Deans.

BOYDS, MD.—A meeting attended by residents of Poolesville, Dickersons, Boyds, Dawsonville, Barnesville and other points was held at Poolesville recently for the purpose of organizing a telephone company. A metallic system will be installed. Howard G. Spurrier, of Poolesville, was elected president of the company, A. D. Trundle vice-president and Reginald J. Darby secretary-treasurer.

PHILADELPHIA, PA.—The Keystone Telephone Company has taken no action upon the proposed plan to form the Keystone and other independent telephone companies into a concern to handle long-distance telephone and telegraph business all over the country. It is stated, however, that the new company will be incorporated with a capitalization of between $10,000,000 and $20,000,000.

DELHI, LA.—The West Carroll Telephone and Improvement Company has been formed, with a capital of $10,000, to build and maintain a telephone system covering the territory embracing Richland parish and other parts of the state. It will be a subsidiary of the Cumberland Telephone and Telegraph Company. The president is W. B. Redmond. Local exchanges will be maintained at Delhi, Floyd, Kilborn, Calvert and Pioneer.

HARRISBURG, PA.—The Bear Gap & Numidia Telephone Company, the line of which touches towns in Northumberland, Columbia, Mountour and Schuylkill counties, has been incorporated with a capital stock of $5,000. Adam W. Dimmick, of Paxinos, is treasurer. Lavelle Telephone and Telegraph Company, touching towns in Schuylkill, Columbia and Northumberland counties, has been incorporated for $5,000; H. O. Lenker, Lavelle, is treasurer.

PERSONAL MENTION.

MR. PAUL W. HORBACH will succeed Mr. E. J. Sullivan as manager of the Nebraska Electrical Company at Omaha, Neb., of which he is president.

M. HENRI POINCARE has succeeded the late Henri Becquerel as president of the French technical commission on radiotelegraphy appointed March 5, 1907.

MR. BION J. ARNOLD of Chicago has been elected an honorary member of the engineering fraternity, Tau Beta Pi. He was initiated into this honorary society on October 30.

MR. C. O. BAKER, of New York city, the head of the well-known platinum house of Baker & Company, who had been dangerously ill for six weeks past, is again in good health and active service.

MR. MARK LOUD of Dallas, Tex., who is associated with Stone & Webster, was a New York visitor last week. While in the city he was tendered a luncheon at the Machinery Club by Capt. Willard L. Candee.

MR. L. H. VAN ALLEN, at one time general superintendent of the New York Central, has been appointed general manager of the Buffalo, Genesee & Rochester Traction Company, with headquarters in Buffalo, N. Y.

MR. E. W. GOLDSCHMIDT, New York manager of the Wagner Electric Manufacturing Company, was to sail November 6 on the White Star liner Cretic for Naples, expecting to remain abroad until the first of the year.

MR. JAMES RAYMOND DEANE was married on October 15 to Miss Cornelia Mercedes Donovan at St. Vincent's Church, Chicago, the Rev. P. V. Byrne officiating. Mr. Deane is associated with the Guarantee Electric Company.

MR. GEORGE R. DENEHIE, formerly of the Tampa Electric Company, Tampa, Fla., will succeed George F. Morse as master mechanic of the Terre Haute, Indianapolis & Eastern Traction Company at Terre Haute, Ind. Mr. Morse becomes master mechanic of the Tampa Electric Company.

DR. A. RAPP and MESSRS. G. GRABBE, C. F. BAUMANN and S. HEISEY of Berlin, Germany, are visiting automatic telephone plants throughout the country on a trip of inspection, escorted by Dr. Frank of New York and Dr. Sulsberger and Messrs. W. E. Cook and Russell of Chicago. The party has visited the automatic plants at Columbus, O., and Grand Rapids, Mich.

DR. JOHN W. HAYFORD, member of the international boundary commission of the United States and Mexico, and well-known as an engineer, has been appointed dean of the new school of engineering of Northwestern University, Evanston, Ill., and will take up his duties September 1, 1909. The new dean is a graduate of Cornell University, class of 1889, and is 40 years of age.

MR. ARTHUR WILLIAMS, recently made president and general manager of the Union Electric Light & Power Company of St. Louis, has resigned this position, which he had occupied but two months, succeeding Mr. V. N. Powelson. Mr. Williams went to St. Louis from the New York Edison Company, where he had built up a unique position as general inspector. It is rumored that Mr. Richard McCulloch of St. Louis will succeed Mr. Williams as the local executive head of the Union Electric Light and Power Company.

MR. VAN RENSSELAER LANSINGH, illuminating engineer, of New York, delivered an address before the electrical section of the Canadian Civil Engineers' Society at Montreal, October 22, emphasizing the necessity of engineers and architects working together to secure proper natural and artificial lighting of buildings. On November 5 a similar address was delivered before the Dayton (Ohio) Electrical Club, including representatives and engineers of the Dayton Lighting Company, local electrical contractors and jobbers, and a number of the owners and managers of large buildings.

MR. G. HENNING YOUNGREN, for some time past western advertising manager of the Manhattan Electrical Supply Company, will engage in the preparation of technical copy for advertisers and institute follow-up systems and publicity campaigns, particularly among the members of the electrical industry. Mr. Youngren's headquarters are at 630 North Humphrey avenue, Oak Park, Ill.

MR. HERBERT H. EVANS, of Chicago, a collaborator on the report of electrification of railway terminals and the Illinois Central, made under the auspices of the committee on local trans portation, city council, has received an appointment as secretary of the committee, a position created by the council in view of the volume of important business to be considered during the next two years. Mr. Evans is a mechanical engineer and a brother of Dr. W. A. Evans, city health commissioner, a joint author of the electrification report with Alderman Foreman and Messrs. Paul P. Bird and Gilbert E. Ryder, of the city smoke inspection department.

ELECTRICAL SECURITIES.

Last week was marking time in the stock markets generally, biding the result of the election. The very obvious improvement steadily going on in business conditions all over the country has discounted to a considerable degree the apprehension which has been felt as to the turn affairs might take in national politics. Some convincing signs of betterment are seen in the reports of increased earnings of railroads, particularly those roads operating in western territory. The statement of the United States Steel Corporation of its September quarter's earnings is also very favorable. The gross traffic returns for the month of September of the Rock Island system, the Omaha, and the Minneapolis & St. Louis, were all above those of September, 1907. The Union Pacific gained $464,000, and the Northern Pacific $209,000. Eastern roads, while failing to show the same improvement, are recovering slowly.

ELECTRICAL SECURITIES FOR THE WEEK ENDED OCTOBER 31.

New York:	*Closing.*
Allis-Chalmers common	11⅝
Allis-Chalmers preferred	39½
Brooklyn Rapid Transit	48¼
Consolidated Gas	144½
General Electric	142¾
Interborough-Metropolitan common	9¾
Interborough-Metropolitan preferred	28¾
Kings County Electric	125
Mackay Companies (Postal Telegraph and Cables (common)	73
Mackay Companies (Postal Telegraph and Cables (preferred)	69⅞
Manhattan Elevated	135
Metropolitan Street Railway	24
New York & New Jersey Telephone	114
Western Union	59¼
Westinghouse Mfg. Company	82
Boston:	*Closing.*
American Telephone and Telegraph	126⅝
Edison Electric Illuminating	232
Massachusetts Electric	54
New England Telephone	120
Western Telephone and Telegraph preferred	70
Philadelphia:	*Closing.*
Electric Company of America	9¾
Electric Storage Battery common	35
Electric Storage Battery preferred	35
Philadelphia Electric	11⅜
Philadelphia Rapid Transit	22¾
United Gas Improvement	86¼
Chicago:	*Closing.*
Chicago Telephone	123½
Commonwealth Edison	108
Metropolitan Elevated preferred	42
National Carbon common	68
National Carbon preferred	111

NEW MANUFACTURING COMPANIES.

THE AMERICAN ELECTRICAL MANUFACTURING COMPANY, Orange, N. J., has been incorporated, with a capital stock of $350,000. John C. Ireland, Everett Frohman and T. Wesley Wright are the incorporators. The company will manufacture electrical and mechanical goods.

ELECTRIC RAILWAYS.

SUSQUEHANNA, PA.—A new interurban line is projected between Factoryville and Susquehanna.

PITTSBURG, PA.—Pay-as-you-enter cars have been put into service on the principal lines of the Pittsburg Railways Company.

DETROIT, MICH.—The Detroit United Railways Company has put into service a handsome new funeral car which cost $8,000.

WHEELING, W. VA.—The Union Traction Company's line now operating between Sistersville and New Martinsville will be extended to Hannibal.

GLEN ROSE, TEX.—J. Mercer Carter, who is engaged in promoting an interurban road into Glen Rose, announces that $50,000 worth of stock has been subscribed.

WILMINGTON, DEL.—The Wilmington & West Chester Electric railway has secured its right-of-way through Delaware and the greater part of the Pennsylvania section.

EUGENE, ORE.—The Mackenzie River Power & Railway Company, which is incorporated with a capital stock of $100,000, plans an electric road from Eugene to Belknap.

NORTH FORK, W. VA.—Capital has been secured for building an electric road from North Fork to Elkhorn, a distance of four miles. Work is to commence as soon as a franchise is secured.

JOLIET, ILL.—The Joliet & Southern Traction Company has begun running its cars on the New Lenox line. When the line from Joliet to Chicago Heights is completed, a half-hour schedule will be inaugurated.

WINONA LAKE, IND.—$300,000 will be expended by the Winona Interurban Railway Company to rush completion of the Warsaw-Peru division, giving through service from Benton Harbor, Mich., to Louisville, Ky.

LOWELL, MASS.—The Lowell, Acton & Maynard Street Railway Company has applied to the State Railroad Commission for permission to increase its capital stock by $25,000 at par, the amount to be used for extensions.

PUEBLO, COLO.—The Kansas-Colorado Railroad is in possession of the entire right-of-way from Turkey creek to the city limits and will ask the council for privileges on the city streets, promising that cars will be running within a year.

LA CROSSE, WIS.—Officers of the Sparta-Melrose Electric Railroad Company expect to begin operations in 1909 on the construction of a line between those two cities via Cataract, Angelo and Trout Falls, the road to be twenty-eight miles long.

NEW YORK, N. Y.—The New York & Queens Railroad Company has been granted by the Board of Estimate and Apportionment the franchise which has been pending for some time to construct extensions of its lines to Whitestone and Bayside.

JACKSON, MICH.—Work on the Jackson-Lansing electric line of the Michigan United Railways is to be rushed to completion, the contract for construction having been let to A. L. Drum & Company of Chicago. Cars are promised to be running by March of next year.

ALLENTOWN, PA.—The service of the Electric Express Company over the lines of the Lehigh Valley Transit Company has proved successful beyond all expectations. Goods are carried directly to the doors of farmers along the route, and the service is to be extended.

MODESTO, CAL.—The surveying corps of the Stockton-Modesto trolley line reached Modesto, having completed the survey between the two cities. Applications for franchises in both Modesto and Stockton will be made this week, and construction work will begin within a month. Private right-of-way has been obtained for the entire distance between the two cities, and the promoters expect to have the road finished by next July. It will later be extended to Turlock and other points down the valley, giving the producer direct communication with tidewater at Stockton.

EL PASO, TEX.—The organization of the El Paso & Fort Hancock Railroad Company has been projected. Charles N. Bassett is president of the company. The capital stock defined in the charter to be applied for is $100,000. The road will be built from El Paso to Fabens and later to Ft. Hancock.

PIERRE, S. D.—Articles of incorporation have been filed for the Dakota Southern Railway Company, with headquarters at Lemmon, S. D. It is organized by local men and proposes to construct a line from Rapid City to Williston, N. D., by way of Lemmon, and, as set forth, is capitalized at $90,000,000.

SEATTLE, WASH.—The Seattle & Issaquah Electric Railway Company has been chartered, with a capital stock of $2,000,000, by Edwin S. Gill and John McQuade, with the purpose to acquire, construct, equip, lease, own and operate steam or electric roads between points in King and Snohomish counties.

EVANSVILLE, IND.—Directors of the Evansville & Southern Indiana Railway Company, which includes interurban lines from Princeton to Evansville and the Evansville street railway system, have voted to extend the line, which will eventually connect Evansville and Terre Haute, northward from Patoka in the early spring.

AUGUSTA, GA.—An electric trolley line is projected from Augusta to Edgefield, one of South Carolina's most historic county seats. A contract for the survey work has been awarded, and prospects seem good for completion of the road within a short time.

GARY, IND.—A new interurban road, to be known as the Valparaiso, Hobart & Gary railway, is said to have the support of ample capital and to be built as soon as certain franchises are obtained. Among those interested is James Hopkins, son of Senator Hopkins of Illinois.

UVALDE, TEX.—The driving of the first spike in the Uvalde city railway lines was performed with much ceremony on October 20. Mayor Mat Burney of Uvalde and Mayor W. L. Rawlinson of Sansom wielded the hammers. M. M. McFarlane, who is the promoter of the enterprise, says the line will be in operation by December 1.

LEAVENWORTH, KAN.—In preparing to operate trains by electricity through the Cascade tunnel, the Great Northern Railroad is building a low concrete dam in the Wenatchee River, together with 11,000 lineal feet of nine-foot wooden flume and 1,000 feet of steel flume, to convey water to its power house. It is expected that the plant will be in operation by January 1.

ALTOONA, PA.—An electric trolley line from Altoona to Bedford Springs, by way of Morrison's Cove, has been definitely planned. The road will be fifty miles in length and will pass through Duncansville, Hollidaysburg, Roaring Spring, Martinsburg, New Enterprise and Woodbury. The estimated cost of the construction of the road, power plants and rolling stock is $1,500,000.

WEST NEWTON, PA.—Work will start next week on rival street railway lines between West Newton and Herminie, ultimately to be extended to form a short-cut line between the Youghiogheny and Monongahela valleys. The Jeannette, West Newton and Monongahela Valley Street Railway Company is placing grade stakes on its route, and the Pittsburgh & Westmoreland Company has a line partly constructed through the town and work will be resumed next week.

BUFFALO, N. Y.—A report favorable to the Buffalo & Lackawanna Traction Company has been filed by Michael Danahy, Michael F. Schelling and William B. Cutter, the commission appointed by the Appellate Division. The Buffalo & Lackawanna is in reality the Buffalo & Lake Erie Traction Company. The commission found that the route is the shortest possible between West Seneca and the business heart of Buffalo and that the distance can be traveled in thirty minutes less time than by the present route of the International Railway.

WASHINGTON, D. C.—Plans are being matured for the construction of a second trolley line between Washington and Baltimore. The plan is to close the gap between Ellicott City, Md., and Sligo, by the construction of new tracks, making use of the trackage of the Washington Railway & Electric Company, on the Brightwood line, and the Seventh street line of the Capital Traction Company for entrance to the district, and the tracks of the United Railways of Baltimore over the Ellicott City branch for entrance to Baltimore.

DATES AHEAD.

Association of Car-Lighting Engineers. First annual meeting, Chicago, Ill., November 18.

National Society for the Promotion of Industrial Education. Annual meeting, Atlanta, Ga., November 19-21.

International Independent Telephone Association. Annual convention, Chicago, Ill., December 1-3.

American Society of Mechanical Engineers. Annual meeting, New York city, December 1-4.

American Roentgen Ray Society. Annual meeting, New York city, December 28-30.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

American Association for the Advancement of Science. Annual meeting, Baltimore, Md., January, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

INDUSTRIAL ITEMS.

THE WESTERN ELECTRIC COMPANY, Chicago, in booklet No. 1150, explains the advantages of lead-covered telephone cable for aerial and underground purposes. Several pages of general instructive matter on the subject of cables are followed by a detailed description of the cable products of the company.

THE UNDERWRITERS' LABORATORIES, INCORPORATED, 382 East Ohio street, Chicago, has issued a thirty-six-page booklet descriptive of the nature of its work and the terms and conditions under which it conducts tests of fire-resisting appliances and materials. The laboratories are under the control of the National Board of Fire Underwriters.

ROSSITER, MACGOVERN & COMPANY, dealers in electrical machinery, Whitehall Building, 17 Battery place, New York city, have purchased the Charles E. Dustin Company, dealer in electrical, steam and miscellaneous machinery, formerly at 11 Broadway, New York city, and the offices of the latter company have been moved to those of the former.

THE EXCELLO ARC LAMP COMPANY, New York and Chicago, has published a new catalogue describing the Excello flaming arc lamp and its advantages for various kinds of lighting and giving full data on the various types of this lamp made. In a pamphlet entitled "Seen Everywhere" the company gives nearly thirty views showing installations of Excello lamps.

THE BAY STATE INSULATED WIRE AND CABLE COMPANY, Hyde Park, Mass., announces that it has no further business connection with the Western Wire Sales Company of Chicago, Ill., as the latter company has ceased to be its agent. Hereafter Mr. Richard Wick, 356 Dearborn street, Chicago, will represent the Bay State Insulated Wire and Cable Company in the Chicago district.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has issued a new bulletin relating to Ward Leonard load boxes, a loading device for replacing lamp banks. Different capacities are made, from 10 amperes to 23½ amperes on 120-volt circuits, and from 5 to 12 amperes on 240-volt circuits. A combination or double-voltage rheostat giving 24 amperes on 110 volts and 12 amperes on 220 volts, is listed. The bulletin declares that many of these rheostats are in daily use by the leading electric light companies of America, among the more prominent users being the Edison companies of New York, Detroit, Chicago and Brooklyn, and the Public Service Corporation of New Jersey.

THE CENTRAL ELECTRIC COMPANY, Chicago, has completed arrangements to sell and carry a Chicago stock of Ward Leonard meter-testing rheostats. A catalogue will shortly be issued describing these rheostats, together with full illustrations indicating the methods of applying them to testing of commercial meters of both alternating-current and direct-current circuits. A copy of this catalogue will be sent upon request.

THE HOLOPHANE COMPANY, New York, has published bulletin No. 11, devoted to high-efficiency reflectors. These have been particularly designed for use with Gem, tantalum and tungsten lamps, and are built on the new equal prism principle. The reflectors are made in three different types, extensive, intensive and focusing. In the bulletin there is also included a mass of data valuable in designing illumination with the new reflectors.

DOSSERT & COMPANY, 242 West Forty-first street, New York, reports the receipt of the following orders during the current week: 350 cable taps for feeder cable, from the Chicago City Railway Company; 1,750 two-ways, three-ways and fuse box plugs from the Edison Electric Illuminating Company of Brooklyn, and 800 connectors of various sizes and styles from the Western Electric Company of New York, for export to South Africa and the Klondike.

THE L. E. KNOTT APPARATUS COMPANY AND THE ARTHUR W. HALL SCIENTIFIC COMPANY announce that they will combine their respective assets and business experience, with a view to rendering the best possible service. Arthur W. Hall is to be actively connected with the new management. E. Cate, after more than a year's absence, partly abroad, resumes his connection. L. E. Knott retires. The business address continues to be 16 Harcourt street, Boston, Mass.

THE FOOS GAS ENGINE COMPANY, Springfield, O., announces that the United Cigarette Machine Company, of Lynchburg, Va., which has used several Foos engines in its power plant for eight or ten years, has recently placed an order for one of the Foos Company's 100-horsepower, multiple-cylinder vertical engines and producer gas plants complete. The engine will be direct connected to a General Electric generator, which is to supply current for the operation of the new plant nearing completion.

THE RAIL JOINT COMPANY, Troy, N. Y., at the annual meeting of its stockholders, held on October 28, chose directors as follows: George G. Frelinghuysen, Frederick T. Fearey, E. Y. Weber, C. P. Wheeler, Mark T. Cox, Marcus L. Ward, F. C. Runyon, L. F. Braine, Percy Holbrook, Benjamin Y. Wolhaupter and George A. Weber. The directors of the company organized with these officers: Chairman of the board, George G. Frelinghuysen; president, Frederick T. Fearey; vice-presidents, L. F. Braine and Percy Holbrook; secretary, Benjamin Y. Wolhaupter; treasurer, F. C. Runyon.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, Chicago, has issued a handsome catalogue, B-18, describing and listing Benjamin wireless clusters and lighting specialties. Conveniently indexed are complete lists of cluster bodies and ceiling, pendant, special and weatherproof fixtures and miscellaneous materials. Many special and ingenious forms of fittings are described. The extensive lists give code word, catalogue number, description, list price and weight of package for each article mentioned. In its typographical and mechanical make-up the catalogue is unique and very convenient.

THE MASCHINENFABRIK OERLIKON, near Zurich, Switzerland, has distributed recently a number of publications of special interest. A well-illustrated bulletin of thirty-six pages describes the power plant and transmission system of the Societa Mineraria ed Elettrica del Valdarno in Italy. A seventy-two-page bulletin gives a full description of the single-phase railway from Seebach to Wittingen, Germany. Other publications are devoted to the 52,000-volt power transmission system from Gaucin to Seville, electric installations driven by wind power, high-speed motor generator sets and automatic limit devices for electrically driven cranes.

THE WHEELER CONDENSER AND ENGINEERING COMPANY, Carteret, N. J., has published a 24-page booklet entitled "Surface Condensers." The subject matter includes chapters on the economy of running condensing, the advantages of different types of condensers, and a description of Wheeler surface condensers. The Volz combined feed-water heater and condenser, in which some of the tubes serve as a primary heater, is described, and there is a section on turbine condenser outfits. The final part of the catalogue is devoted to notes and suggestions on the installation and operation of surface condensers. The illustrations show the various types of Wheeler Admiralty and Wheeler-Volz surface condensers and waterworks condensers, and a number of the large steam power plants of the country. This booklet is one of a series of engineering treatises which the Wheeler Condenser and Engineering Company is distributing, and will be of interest and value to any engineer who is called upon to design, construct or manage steam plants.

THE PETTINGELL-ANDREWS COMPANY, Boston, is marketing a number of devices designed to prevent the theft of current. In the forthcoming issue of the company's new publication, Juice, the "O. K." fuse block cover and "O. K." meter connection block are to be described. The former is a device for covering branch blocks so as to prevent illegal connections or the refusing of blocks on discontinued services. The meter connection block makes it possible to carry the service wires in conduit from entrance to meter, leaving no exposed wires in the customers' premises. This block is designed to facilitate the testing or replacement of meters, without interrupting the customers' service, or the necessity of opening tap joints or cutting wires. These two devices are being extensively used by some of the larger central stations, and the knowledge of their merits will undoubtedly be of interest to every central-station man.

RECORD OF ELECTRICAL PATENTS.

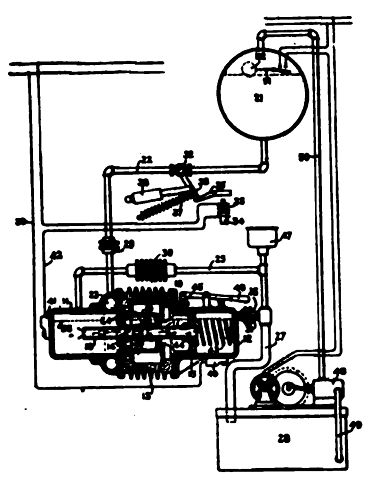
Issued (United States Patent Office) October 27, 1908.

901,939. CUT-OUT BOX. Thomas Q. Andrazyk, Chicago, Ill. Filed July 29, 1907. An asbestos-lined cut-out box.

901,942. WAVE-RESPONSIVE DEVICE. Clifford D. Babcock, New York, N. Y., assignor to United Wireless Telegraph Company, New York, N. Y. Filed August 27, 1906. The device has an adjustable contact engaging a spring contact arm.

901,944. CAR TRUCK. Asa F. Batchelder, Schenectady, N. Y., assignor to General Electric Company. Filed January 29, 1908. The motor armature is mounted on one axle and a combined bolster and motor field is supported on the side frame.

901,957. TELEGRAPHIC CODE CONDENSER. Matthew B. Dickie, Glasgow, Scotland, assignor to Nobel's Explosives Company, Limited, Glasgow, Scotland. Filed February 21, 1908. Three circular scales are arranged parallel and have different numbers and letters.



901,967.—OIL SWITCH

901,958. RAILWAY SIGNAL. Heinrich Diehl, Berlin, Germany, assignor to General Electric Company. Filed April 23, 1907. Means carried by the moving car throw light on selenium cells, which control the signal.

901,965. PREPARATION OF ELECTROTYPE MOLDS. Albert W. Harrison, Baltimore, Md. Filed July 16, 1906. The ingredients are in the proportion of one gallon of water, one ounce of kainite and a small quantity of graphite.

901,966. SOLUTION FOR TREATING ELECTROTYPE MOLDS. Albert W. Harrison, Baltimore, Md. Filed December 7, 1906. This solution consists of nitrate of soda dissolved in water, with graphite added thereto.

901,967. OIL SWITCH. Edward M. Hewlett, Schenectady, N.Y., assignor to General Electric Company. Filed November 7, 1904. A circulating oil system comprises a reservoir and a pump for storing oil under pressure therein.

901,974. TELEPHONE REPEATER. Lucius A. Lindsey, Crystal Springs, Ga. Filed March 20, 1906. The repeater has a carbon button, one plate of which is attached to the diaphragm.

901,975. RACK-RAIL LOCOMOTIVE. George E. Lynch, Columbus, Ohio, assignor to Jeffrey Manufacturing Company. Filed January 26, 1906. A motor-driven locomotive.

901,976. CURRENT-COLLECTING MEANS. Campbell Macmillan, Schenectady, N. Y., assignor to General Electric Company. Filed February 12, 1906. A rotating collecting ring and a stationary ring are connected by a rotating contact member.

901,977. MICROPHONE APPARATUS FOR TELEPHONE AND OTHER CIRCUITS. Quirino Majorana, Rome, Italy. Filed July 7, 1906. There is provided a liquid supply tube and an elastic connection between the diaphragm and the outlet end of the tube.

901,981. SUSPENSION DEVICE FOR TROLLEY WIRES OR OTHER CONDUCTORS CARRYING CURRENTS OF HIGH VOLTAGE. George A. Mead, Mansfield, Ohio. Filed December 2, 1904. A bracket has an insulator sleeved thereon. A trolley wire is supported by the insulator and an insulated brace rod is connected to the wire.

901,993. CARBON PENCIL OF ELECTRIC ARC LIGHTS. John Nicholson, Frackville, Pa. Filed April 20, 1908. This arc lamp electrode comprises a cored carbon pencil having a metal cap and metal jacket.

901,997. ELECTRIC RAILWAY SYSTEM. Horace F. Parshall, London Wall, London, England, assignor to General Electric Company. Filed August 19, 1904. A switch on the car for automatically changing the car circuits from single-phase trolley to direct-current third rail.

902,003. ELECTRIC FIREPLACE. Alfred D. Rathbone, Grand Rapids, Mich. Filed February 4, 1908. The heating element is made luminous.

902,004. PLURAL-LAMP FIXTURE. Frank J. Russell, New York, N. Y. Filed October 20, 1906. A wireless cluster bracket.

902,014. SIGNALING SYSTEM FOR RAILROAD TRAINS. Shellman T. Stewart, Newark, N. J. Filed January 31, 1908. This system is equipped with gates to make and break the signal circuit and latches for locking the gates and a second circuit to operate the latches.

902,017. ELECTRIC CAR TRUCK. Fernando F. Stowe, Worcester, Mass. Filed March 10, 1905. Renewed March 16, 1908. On the truck frame is an electric motor and spring-pressed cone bearings holding the motor in place in the frame.

902,019 and 902,020. DYNAMO-ELECTRIC MACHINE. Karl Sulzberger, Charlottenburg, Germany, assignor to General Electric Company. Filed April 8, 1905, and December 12, 1906. A rotating field magnet has a distributed winding and special winding holders arranged between the parts of the same.

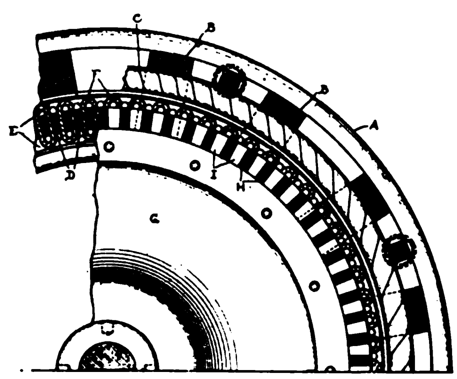
902,024. ELECTRIC HEATER. Elihu Thomson, Swampscott, Mass., assignor to General Electric Company. Filed June 17, 1907. In this heater is a fluid container, an electric heating device and a casing forming a condensing space for the fluid.

902,026. RAIL BOND. Eugene W. Vogel, Chicago, Ill., assignor to the Railroad Supply Company, Chicago, Ill. Filed February 9, 1906. The bond has shallow superficial grooves in its outer surface.

902,028. ELECTRIC SIGN. Henry J. Walser, Cleveland, Ohio. Filed May 29, 1906. This is an advertising display sign.

902,032. INCANDESCENT ELECTRIC LAMP. Willis R. Whitney, Schenectady, N. Y., assignor to General Electric Company. Filed October 31, 1904. The patent relates to the base terminals.

902,033. SWITCH MECHANISM. John B. Wiard, Lynn, Mass., assignor to General Electric Company. Filed April 28, 1906. A reversing switch has two sets of resilient contact fingers and a rocker member.



902,195.—TELEPHONE RELAY

902,035. ELECTRIC RAILROAD SWITCH. Merle J. Wightman, New York, N. Y. Filed January 2, 1908. A motor-operated track switch.

902,040. WIRE CONNECTOR. Homer W. Wyckoff, Indianapolis, Ind.; Nathan H. Richardson, administrator of said Homer W. Wyckoff, deceased. Filed March 12, 1906. Two metal plates are placed on each side of the wire and clamped together by a bolt.

902,043. TELEPHONE TRANSMITTER. George F. Atwood, East Orange, N. J., assignor to Western Electric Company, Chicago, Ill. Filed March 12, 1906. The containing case of the transmitter has a chamber secured to its rear wall.

902,048. MOLDED RESISTANCE. Lawrence E. Barringer, Schenectady, N. Y., assignor to General Electric Company. Filed February 2, 1906. Constituents are comminuted conducting material and hydrous silicate of calcium.

902,061. MOTOR CONTROLLER. Henry F. Elshoff, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed June 30, 1906. A multiple-voltage controller has a drum controlling the resistance switches.

902,065. DYNAMO-ELECTRIC MACHINE. Allan B. Field, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed May 13, 1907. A rotating field has damper rods extending through its field poles.

902,069. INCANDESCENT LAMP. Hugo Gernsback, New York, N. Y., assignor to the Motor Car Equipment Company, New York, N. Y. Filed March 12, 1907. A number of filaments are adapted to burn in parallel. Non-conductive stiffening members connect their feed wires.

902,074. SPEED INDICATOR. John L. Hall, Schenectady, N. Y., assignor to General Electric Company. Filed February 28, 1906. Electrically controlled means periodically lock a constantly rotating and an intermittently rotating member together.

902,099. SELECTIVE SIGNALING DEVICE. Ira F. Manny, Milwaukee, Wis., assignor to the Manny Signal Company, Milwaukee, Wis. Filed December 12, 1907. A motor-driven rotary member has escapement teeth engaged by the pawl and a signaling member that can be engaged by the pawl when it is moved out of the path of the teeth.

902,101. MOTOR CONTROLLER. Anthony L. McHugh, Cincinnati, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed June 30, 1906. A modification of No. 902,062.

902,105. ELECTRIC BELL. Charles H. North, Cleveland, Ohio, assignor to the North Electric Company, Cleveland, Ohio. Filed April 22, 1905. An adjustable weight is slidably mounted on the bell tapper for adapting the bell to selective actuation by different currents.

902,106. METHOD OF AND MEANS FOR UTILIZING THE PRESSURE IN THE INTERIOR OF AN ELECTRIC CONDUCTOR CARRYING CURRENT. Edwin F. Northrup, Philadelphia, Pa., assignor to the Leeds & Northrup Company, Philadelphia, Pa. Filed March 1, 1907. Chambers containing a liquid conductor communicate with each other by a passage from a point near the center of one chamber to a point more remote from the center of the adjacent chamber.

902,108. MOTOR CONTROLLER. William D. Pomeroy, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed December 31, 1906. A switch biased toward closed position is arranged to be opened by the drum when the latter is moved between certain positions.

902,118. SIGNAL SYSTEM. Burt A. Slater and Michael J. McDermott, Boise, Idaho. Filed March 5, 1908. An electric block signaling system for railways.

902,121. ELECTRIC FIXTURE. Edgar C. Suiter, Olympia, Wash. Filed April 30, 1907. A slack adjusting device for drop lamps.

902,157. PROCESS FOR PRODUCING PHOSPHORIC ACID. Frederick J. Maywald, Brooklyn, N. Y. Filed September 10, 1902. A low potential arc is applied to a granular mass of phosphates.

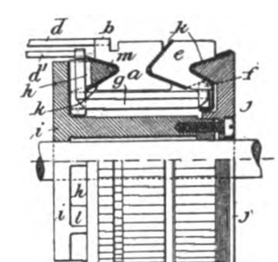
902,173. ELECTRIC CELL. Georges Schaull, London, England. Filed September 18, 1906. The metallic plate is a compound one, composed of a continuous fluid-tight plate and a perforated plate in metallic contact therewith.

902,176. RAILWAY SIGNALING SYSTEM. Carl J. Schwarze, Adrian, Mich. Filed July 18, 1906. Combined with a trolley wire are signaling conductors mounted on each side thereof.

902,184. ELECTRO-PNEUMATIC BRAKE. Walter V. Turner, Wilkinsburg, Pa., assignor to the Westinghouse Air Brake Company, Pittsburg, Pa. Filed March 20, 1905. An electric application valve for controlling the supply of air to the brake cylinder and a normally open electric release valve for controlling the exhaust port.

902,195. TELEPHONE RELAY. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. Filed January 25, 1908. A high-frequency induction alternator has its stationary field winding connected in the primary circuit and the stationary armature connected in the secondary circuit.

902,216. ELECTRIC LAMP FOR HELMETS AND SIMILAR HEAD COVERINGS. Johann H. Dräger, Lübeck, Germany. Filed January 2, 1908. Mounted in the helmet is a battery connected with an electric lamp.



902,424.—DUPLEX COMMUTATOR

902,235. CABLE TIP. Louis Kellner, New York, N. Y., assignor to Metropolitan Switchboard Company. Filed November 11, 1907. The cable conductor fits into a conical hole, at the outer end of which is a screw plug.

902,244. ELECTRICALLY-CONTROLLED LOCK. Edward W. Marvel, Philadelphia, Pa., assignor to William H. Hollar, Philadelphia, Pa. Filed May 12, 1908. Electric motors operate the locking mechanism.

902,262. INSULATOR PROTECTOR. Robert R. Sparks, Greenfield, Mass. Filed May 20, 1908. About the insulator is a removable jacket forming a housing.

902,275. BANK OF LOCKING SWITCH KEYS. Elmer R. Corwin and Charles A. Bals, Chicago, Ill., assignors to Corwin Telephone Manufacturing Company, Chicago, Ill. Filed March 28, 1908. In a party line switch depression of any one of the push-buttons operates locking bars whereby any of the push-button keys which has been depressed is released.

902,285. CONDUIT. John A. Garey, Mound City, Mo. Filed August 12, 1907. A pair of loosely mounted plates is held by springs to form a wholly-closing shield for the third rail.

902,297. RAILWAY SIGNALING APPARATUS. Winthrop K. Howe, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Filed November 27, 1905. Renewed June 6, 1908. A double signal is operated by a motor through an electromagnet clutch for each signaling part.

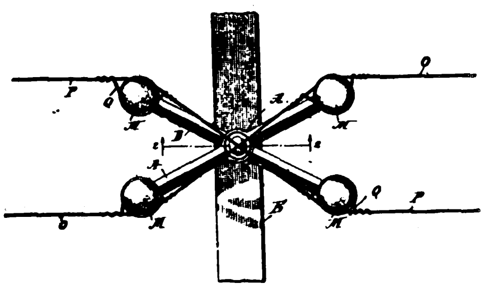
902,307. ELECTRIC CONTROLLING DEVICE. Harry W. Leonard, Bronxville, N. Y. Filed May 13, 1905. This motor starting box has an auxiliary movable contact device, carried by the main control switch, and means for causing this contact to quickly close the circuit independently of the rate of movement of the switch.

902,320. GAME REGISTER. Edward O. Parker and Harold E. Grey, Independence, Iowa. Filed April 19, 1906. Electrically operated means advance an index step by step and simultaneously operate an electromagnetic signal apparatus.

902,338. TELEPHONE SYSTEM. Paul V. Smith, Lyons, Kan. Filed December 22, 1906. An intercommunicating system.

902,354. ELECTRODE FOR ARC LAMPS. Willis R. Whitney, Boston, Mass., assignor to General Electric Company. Filed December 10, 1903. An electrode formed from a pure metal having a melting point higher than iron and yielding a luminous or flaming arc.

902,356. FOUR-PARTY-LINE INDICATING - RINGING KEY. Charles S. Winston, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed August 3, 1907. There are four switch-actuating plungers and four auxiliary plungers, one for each of the previous ones to indicate the last one that has been depressed.



902,455.—TRANSPOSITION BRACKET

902,373. SPARK-PLUG ATTACHMENT. Frederick D. Casey, North Water Gap, Pa. Filed July 25, 1907. A cover for the plug has an opening to permit the passage of a conductor.

902,389. APPARATUS FOR CONNECTING CONDUCTING AND OTHER WIRES. Anthony Fodor, Budapest, Austria-Hungary. Filed November 14, 1907. Holding and twisting devices are independently adjustable, and there are means for locking the holding device in position.

902,396. CONTROLLING SYSTEM FOR ELECTRIC MOTORS. Jay H. Hall, Cleveland, Ohio, assignor to Electric Controller and Supply Company, Cleveland, Ohio. Filed March 13, 1906. A master controller for a number of motors.

902,420. TROLLEY GUARD. William D. Lewis, Plymouth, Pa. Filed April 11, 1908. A guard frame is provided at one end with a segment-shaped enlargement.

902,424. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES. Frederick H. Loring, London, England. Filed December 31, 1907. Two independent commutators are arranged side by side, integral projections being formed on the end face of one commutator and entering recesses on the end face of the adjacent one.

902,427. ELECTRIC SPARKING DEVICE. Willie H. R. Mildeprath, Jacksonville, Fla. Filed January 20, 1906. A stationary electrode is associated with a movable electrode operated by an electromagnet.

902,455. TRANSPOSITION BRACKET FOR INSULATORS. James E. Skinner, Kingman, Kan. Filed June 17, 1908. A pair of superimposed hubs is provided with radially projecting arms, having bearings at the free ends.

902,476. ELECTRIC LOCOMOTIVE. William Dalton, Schenectady, N. Y., assignor to American Locomotive Company, New York, N. Y. Filed July 22, 1907. There are two swiveling trucks having each a pair of guide wheels at each end and two pairs of driving wheels between the guide wheels.

902,499. INDUCTOR MAGNETO-ALTERNATOR. Leon Le Pontois, New Rochelle, N. Y., assignor to Hurd & Haggin. Filed October 24, 1907. A diamond-shaped field frame has the windings at the nearer corners, which have soft iron internal poles adjacent to a rotor.

902,513. ENDOSCOPE. Reinhold H. Wappler, New York, N. Y., assignor to Wappler Electric Controller Company, New York, N. Y. Filed January 11, 1908. An electric light bulb is screwed into the socket member.

902,522. ELECTRIC-CIRCUIT CONTROLLER FOR INTERNAL-COMBUSTION ENGINES. Charles Cuno, Oconomowoc, Wis., assignor to Connecticut Auto Engineering Corporation, Meriden, Conn. Filed September 19, 1906. A contact arm carried by the shaft engages an insulated contact block carried by the case.

REISSUES.

12,871. PROCESS OF TREATING NEGATIVE-POLE PLATES. Joseph Bijur, New York, N. Y., assignor to the General Storage Battery Company. Filed January 14, 1908. Original No. 485,391, dated February 26, 1907. (Division A.) The process consists in soaking the plate in a solution of sugar, in depositing sugar in its pores and ultimately carbon, then drying the plate and heating it to carbonize the sugar and forming a final inert deposit of carbon.

12,872. NEGATIVE-POLE PLATE. Joseph Bijur, New York, N. Y., assignor to the General Storage Battery Company. Filed January 14, 1908. Original No. 845,391, dated February 26, 1907, (Division B.) A Planté plate characterized by having inert material incorporated in the active material and a substantially sustained capacity in use.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired November 3, 1908:

462,231. ELECTRIC RAILWAY. E. M. Bentley, New York, N. Y.

462,237. ELECTRIC LIGHTING SYSTEM. J. I. Conklin, Brooklyn, N. Y.

462,261. AUTOMATIC ELECTRIC WELDING MACHINE. H. Lemp and C. G. Anderson, Lynn, Mass.

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CONTENTS.

THE BUSINESS REVIVAL.

Immediately following the election there appeared from every quarter indications that business had taken a new hold upon things, and that, in spite of the improvement which had taken place for the past two or three months, and which it was feared had discounted the results of the election, we are about to indulge in a season of conspicuous prosperity. Large orders which were contingent upon the result of the election were put in force, and it is estimated that with the starting up of industrial undertakings in every part of the country, that over a million men have been put to work on full time, where for the past six or eight months there has been either partial or complete shutdown. That this should be the case is remarkable, because the statistics at present available show that although there has been a great falling off in the rate of production and the development of wealth for the past year, the totals do not compare unfavorably with the totals for the last two years; and these totals were far greater than had ever been built up before, and were considered phenomenal. It is positively the case that there has not been a great falling off, but what has happened is that there was a sudden and maintained check to the acceleration. The country was never in a better condition to cope with the opportunity for rapid assimilation of orders and for the proper handling of huge demands than at the present time. During the trying period of the past twelve months the agriculturist has built up a large bank balance, conservative handling of money resources has established plentiful reserves, the railroads have been overhauling their systems, the manufacturers have been making improvements which were impossible of consideration during the strenuous period which culminated a year ago last month, the stocks in store-yards and on the shelves have been depleted, and the people have learned great lessons in economy and the wisdom of harboring their perishable resources. Concurrently with the slacking of work in a great many industries, there was a retrograde flood of emigration, which will make it difficult for a number of the milling and mining industries to man their workings. The places of those who fled upon the approach of hard times will be filled, however, by a better class of workmen, and with the improved conditions of labor, which are bound to come with a more intelligent class of help, and with the better understanding of the relation of the employer and the employé, there will be a wiser distribution of the earnings and a greater spreading out and utilization of the purchasing power of earnable money, with the elimination of labor disputes and their contributing unfortunate conditions.

RAILWAY ACCUMULATOR CARS.

The Prussian Railroad Administration has recently been experimenting with accumulator cars, running upon the system of suburban lines around Mayence. Passenger cars of the side-opening compartment type, carrying sixty persons, have been used for some time, and their operation has been so satisfactory that it has been decided to considerably increase the number of accumulator cars upon these lines. The accumulators are stowed under the seats of the car, in each of the six compartments with which the cars are fitted. The cells are placed permanently in position and arrangements are made for facilitating the examination of connections and for easy charging. The cars are able to cover a distance of thirty-six miles when running at a speed of twenty-four miles an hour on a single discharge of the 180-cell battery, which has a capacity of 230 ampere-hours at the 100-hour discharge rate. With this capacity the cars can make two trips to the suburbs and return without recharging.

The 180 cells represent a total weight of about ten tons, and their energy capacity is therefore about 3.1 watt-hours per pound. The life of the positive plate is estimated at 62,500 car-miles, and that of the negative plate at 37,200 car-miles. The cost of the entire equipment, including the battery, electrical installation and car, amounts to $6,750.

There are many installations where the accumulator car would be advantageous, particularly for cross-town traffic, where the run is short and the traffic does not justify the laying down of an elaborate conduit system, and where the city restrictions prohibit the use of the overhead trolley. For long distances, where the traffic is very heavy, the accumulator car does not appear to be a paying investment.

One of the unfortunate features of what appeared to be essentially a successful system operating in New York city only a few years ago was the distress caused by the fumes, which poisoned the atmosphere of the car while in transit. It is stated that in the present installation this is overcome by a system of ventilation which gives a good supply of air to the interior of the compartment in which the cells are placed, carrying away the fumes from contact with the air which is breathed within the car.

ELECTRIC FIRE PUMPS.

Recent tests of the motor-driven fire pumps which have been installed for the high-pressure fire service in New York city have focused attention on the valuable addition that such a system affords to the fire-fighting apparatus of a large city. The fire loss in all large cities, no matter how well equipped they may be with fire-fighting apparatus, has always been of great magnitude, and a considerable expenditure can be made for additional fire-fighting equipment with no possible opportunity for criticism because of unnecessary extravagance. In line with the satisfactory results of the tests in New York, the Chicago Board of Underwriters has appointed a committee of five to confer with the city authorities regarding a proposed ordinance requiring standard standpipes and fire pumps in all buildings of 100 feet in height, that can be used by the city fire department. For some time this has been urged as a solution of the hazardous condition presented by the congested district, and as a ready means of protection until the proposed high-pressure system can be installed. It is believed that each building can thus be equipped to take care of any fire within itself or within its immediate neighborhood, without being forced to depend upon engines outside. The installation of electrical pumps which can be started in operation by pressing a button is perfect. Figures have been secured from manufacturers showing that a 500-gallon pump could be installed for $1,750, and would require a fifty-horsepower motor; while a 1,500-gallon pump would cost $2,900, and would require a 150-horsepower motor. These pumps would be able to maintain a constant pressure at the pumps of 100 pounds above the city pressure, giving a pressure of approximately forty-five pounds on the top story of a fifteen-story building.

Where a building is kept under steam all night the probability is that steam-driven pumps would be practicable, but where there is a shutdown of steam, or where a building is isolated from its source of power, not even an internal-combustion engine can take the place of an automatically controlled electric motor for quick starting and dependability in the face of an emergency.

THE ELECTRICAL SMELTING OF IRON.

On another page of this issue there appears a letter from Mr. C. F. Elwell concerning the electrical smelting of iron. Mr. Elwell has been engaged in testing out a system of electrical smelting at Heroult, Cal., and his estimate of the cost of production is interesting.

In the issue of the ELECTRICAL REVIEW for August 15 we reviewed the efforts which have been made recently to bring about a commercially practicable electric furnace, and described the work of H. H. Noble in California. From the figures available at that time it was concluded that this furnace could be applied successfully only under special conditions, and that it could not compete with the large blast furnaces.

In the present communication Mr. Elwell states that an estimate of $16.14 as the cost of producing a ton of pig iron is well within reason. Pig iron is worth $28 per ton on the Pacific Coast, and the freight rate is $2 per ton to San Francisco. Under these conditions it would seem that a price of $25 per ton. f. o. b. Heroult was practicable.

As far as competing with the larger units is concerned, Mr. Elwell is of the opinion that a fifteen-ton furnace, using 1,500 kilowatts, can be operated commercially, and that larger furnaces using more power will soon be put into operation. These larger furnaces will involve mechanical feeding and other elaborate labor-saving devices, which will tend to keep the cost of production at a point at which the electric furnace can be entirely successful in localities adapted to its use.

LOW-VOLTAGE TRANSFORMERS FOR METALLIC-FILAMENT LAMPS.

Electrical supply may be materially extended by the frequent use of low-voltage transformers with metallic-filament lamps. Such an extension will benefit electric manufacturers, central stations and consumers alike.

A large part of residence lighting is now being done with gas and kerosene, and low-voltage transformers with metallic-filament lamps will go far to secure this lighting for electric stations. Sign and outline lighting are other branches of service that may be much extended by the same means.

Two factors, the relatively high first cost and the high candlepowers of metallic-filament lamps, stand between central stations and the full benefit that may be got from the increase of efficiency represented by the difference between three watts and one and one-quarter watts per candlepower.

At 100 watts or more the tungsten and osram filaments are inherently expensive, because of their considerable lengths, minute diameters, and the numerous points of support necessary. More than this, a lamp of thirty-two or even twenty candlepower is more than is wanted at many points about a house, or for parts of sign and outline lighting, and the cost of operating these lamps in such locations is often more than a consumer will pay.

At the price of $1.50 each, the cost of a forty-watt, thirty-two-candlepower tungsten lamp, burning 1,000 hours, is fifty-five one-hundredths of a cent per hour, with electric current at ten cents per kilowatt-hour. If an eight-candlepower, ten-watt tungsten lamp is sold for one dollar, its total cost is only twenty one-hundredths of a cent per hour of operation, other conditions being as before. No argument is required to show that this ten-watt tungsten lamp has a wide field of application that the forty-watt lamp cannot cover. To make the ten-watt tungsten lamp practicable, however, it must be operated at low voltage, say twenty-five or fifty, and it is for this reason that low-voltage transformers are coming into use.

In England and other parts of Europe, metallic-filament lamps of small candlepowers are regularly operated with special transformers at ten to fifty volts, and the manufacturers are now offering similar transformers in the United States. As a rule, these special transformers are located on the premises of consumers, beyond the meter and main switch, and take current from the supply circuit at the usual service pressures of 100 to 250 volts. The saving to consumers by the use of the high-efficiency tungsten lamps is so great that they can well afford to pay for these low-voltage transformers, and also for the small loss of energy in them. With the low-voltage transformer on the house side of the main switch, its core loss can of course be avoided, when lamps are not in use, by opening the switch.

The favorite voltages for house lighting with metallic-filament lamps, in England, appear to be twenty-five and fifty, and with tantalum lamps on short-circuits the necessary wiring is not heavy. There are other advantages, too, with the other high-efficiency incandescents, which affect the decision in their favor.

THE FUTURE OF METALLIC-FILAMENT LAMPS—A GERMAN VIEW.

In a recent issue of the *Elektrotechnische Zeitschrift,* Mr. H. Remané makes an interesting summary of the position of metallic-filament lamps. The popularity with which the sixty-candlepower or higher-power metallic-filament lamps have been received indicates to his mind that the people in general are in favor of units of greater illuminating intensity than the carbon-filament, sixteen-candlepower lamp. He believes that the osram lamp of about thirty-two candlepower will take the place of the sixteen-candlepower carbon lamp, especially when it is remembered that the cost of installing a certain total candlepower is reduced as the candlepower of the unit increases.

He does not agree with a number of our recent writers, who believe in the future of the 220-volt, metallic-filament lamp. Undoubtedly the higher-voltage lamp is less efficient than the 110-volt lamp, and experience has shown that if the 110-volt lamp works at one watt per candlepower, the 220-volt lamp will require for the same length of life a constancy of about one and one-quarter watts per candle in sizes of forty candlepower to 100 candlepower. Mr. Remané does not think that the lamp makers' skill will bring about any considerable percentage of increase in either the life or efficiency of the 220-volt lamp, because of the fineness of the filaments, which prevents their being safely handled in quantities, the inevitable variations in diameter, and other mechanical difficulties which enter into the construction of the higher-voltage lamps. The economies introduced in the wiring system by the higher voltage are hardly likely to reduce the cost of current sufficiently to effect a commercial competition with the 110-volt lamps, with their slightly more expensive system of wiring.

THE CHICAGO MUNICIPAL LIGHTING PLANT.

A report has just been made to Mayor Busse, of Chicago, by Mr. Bion J. Arnold, acting as engineer, and Mr. Arthur Young, acting as auditor, indicating that the city of Chicago would save from $200,000 to $300,000 a year by abandoning the manufacture of electricity and purchasing current entirely from private sources. The report shows that the taxpayers have sunk $3,639,031 in the plant and equipment, which now have a book value of $2,603,144, or an actual value of $2,353,869. It cost the city last year $81.64 to maintain each of the 7,647 street lamps. At the same time, the city is renting lights from the Commonwealth Edison Company at $75 per lamp per annum. In the report it is estimated that if the city steam plants were abandoned, the city could purchase current from private companies, under a special contract, at a cost of from $52.50 to $63 per lamp per year. The municipal department of electricity has been conducted by City Electrician Carroll with good judgment and great economy. In spite of this, the cost for municipal service has been continually increasing, and with a correct system of bookkeeping, wherein proper account is taken of depreciation, loss of taxes and upkeep, it is apparent that the cost to the municipality for generating its own current is greater than it would be under other circumstances.

The International Electrotechnical Commission.

Coincident with the International Conference on Electrical Units and Standards, but distinct from that body, there were held in London the sessions of the International Electrotechnical Commission. Both of these organizations are the outgrowth of the International Congress held at St. Louis in 1904. A preliminary meeting of the Electrotechnical Commission was held in London during June, 1906, at which the late Lord Kelvin was elected president and Col. R. E. Crompton, secretary. Provisional rules were also adopted subject to ratification by the several authorities that had appointed delegates.

On October 19 the first meeting of the Council was held in the Royal Colleges of Physicians and Surgeons, Victoria Embankment, London, with Sir John Gavey, chairman of the British committee, in the chair. A cordial address of welcome was made by the Right-Honorable A. J. Balfour. This was briefly responded to by Dr. E. Budde and M. Paul Boucherot. The first subject to come before the meeting was the election of a president to succeed Lord Kelvin. Dr. E. Budde nominated Prof. Elihu Thomson. Sir John Gavey seconded the nomination, and on a vote Professor Thomson was unanimously elected president of the International Electrotechnical Commission. He was immediately notified by telegram. Colonel Crompton was unanimously re-elected honorary secretary of the Commission. He then made a long report on the work done by the Commission, through its central office at 28 Victoria Street, Westminster, London. Ten countries had appointed committees, six were ready to do so, and six others were still considering the question. Colonel Crompton's report was adopted. Then there was a discussion of some of the rules proposed in 1906. The title "electrotechnical" and the location of the central office were adopted and the other suggestions postponed till the closing meeting of the Council. Owing to the small number of delegates present, the chairman proposed that all become members of the committee of the whole, which is designated by the title "Sous-Commission." This was done, and the subjects of nomenclature, standards of light, were referred to it.

With Prof. S. P. Thompson in the chair, the Sous-Commission met on Tuesday morning. A spirited debate ensued in regard to the rules submitted by the French delegates. In its final form the rule adopted regarding the method of reading conclusions was that each country be given one vote only, regardless of the number of its delegates, and that all recommendations require a four-fifths vote for passage. A system of international electrical nomenclature was then discussed. Doctor Budde, of the German committee, suggested cooperation with the technolexicon being prepared in Germany. This met with little favor, as it was regarded by the delegates that the scope of the Commission was rather to decide on certain electrical terms instead of compiling an electrical dictionary. The following recommendations on the subject of nomenclature were then adopted:

"Each electrotechnical committee should forthwith commence its work in nomenclature by preparing an electrotechnical glossary, arranged in alphabetical order, in its own language. These terms, together with their explanations translated into the official languages of the Commission (English and French), shall as soon as the list for the first five letters (A—E) is completed, be forwarded to the central office for communication to the other electrotechnical committees. The same procedure shall be followed for the next five letters, and so on, until the alphabet is completed. In carrying out this work each committee should, as far as practicable, utilize the work already done by others."

A discussion was then begun on a provisional standard of light. It was agreed to refer this subject back to the various committees for further consideration. The metric system was considered and practically adopted for the use of the Commission. A recommendation from the electrical congress at Marseilles that the Commission study uniform rules for interior wiring was postponed to a future meeting. Prof. S. P. Thompson then gave a very interesting address on the system of symbols proposed by Mr. Miles Walker. The chairman advocated the expression of Ohm's law in the same symbols by all nations. This matter was referred to the central office and the committees of the Commission for further study.

On October 22 the Sous-Commission resumed its meeting with the consideration of several minor matters of organization and then reported to a full meeting of the Council in the afternoon. The German delegates invited the Council to assemble in Berlin in 1910. After a vote of thanks to Sir John Gavey and Prof. S. P. Thompson for their courteous presidence and to Mr. C. O. Mailloux for his careful interpretations, the meeting adjourned.

An Interesting Lecture at Schenectady.

About 400 assembled Thursday night to hear the first of Dr. C. P. Steinmetz's three lectures before the Schenectady Section of the American Institute of Electrical Engineers, on "Thermodynamics."

Chairman E. J. Berg, in introducing Dr. Steinmetz, called attention to his work in improving the efficiency of electrical apparatus, which now in most instances is well above ninety per cent, and pointed out that in thermodynamics the engineers of the past have been confined to the use of empirical formulæ and efficiencies below ten per cent.

In the first of a series of three lectures on thermodynamics, Dr. Steinmetz proved that all phenomena incidental to heat can be explained by the assumption that heat energy is the energy of irregular motion.

He showed how the properties of solids, liquids and gases can be calculated from the same general equations which govern motion in general. The law of gravitation regulating the motion of fixed stars hundreds of thousands of times as large as the earth and separated hundreds of millions of miles in space also controls the relative motion of molecules, although the molecules are so small and so numerous that the smallest part of matter which can be weighed contains millions and millions of them.

In order to arrive at the equations governing heat, Dr. Steinmetz necessarily had to use a great deal of mathematics, part of which, no doubt, was not readily followed by a part of the audience. In concluding, he showed, however, that the practical application of these equations were simple and the equations tangible even for those not skilled in mathematics. The lecture closed by deducting the two fundamental equations of thermodynamics

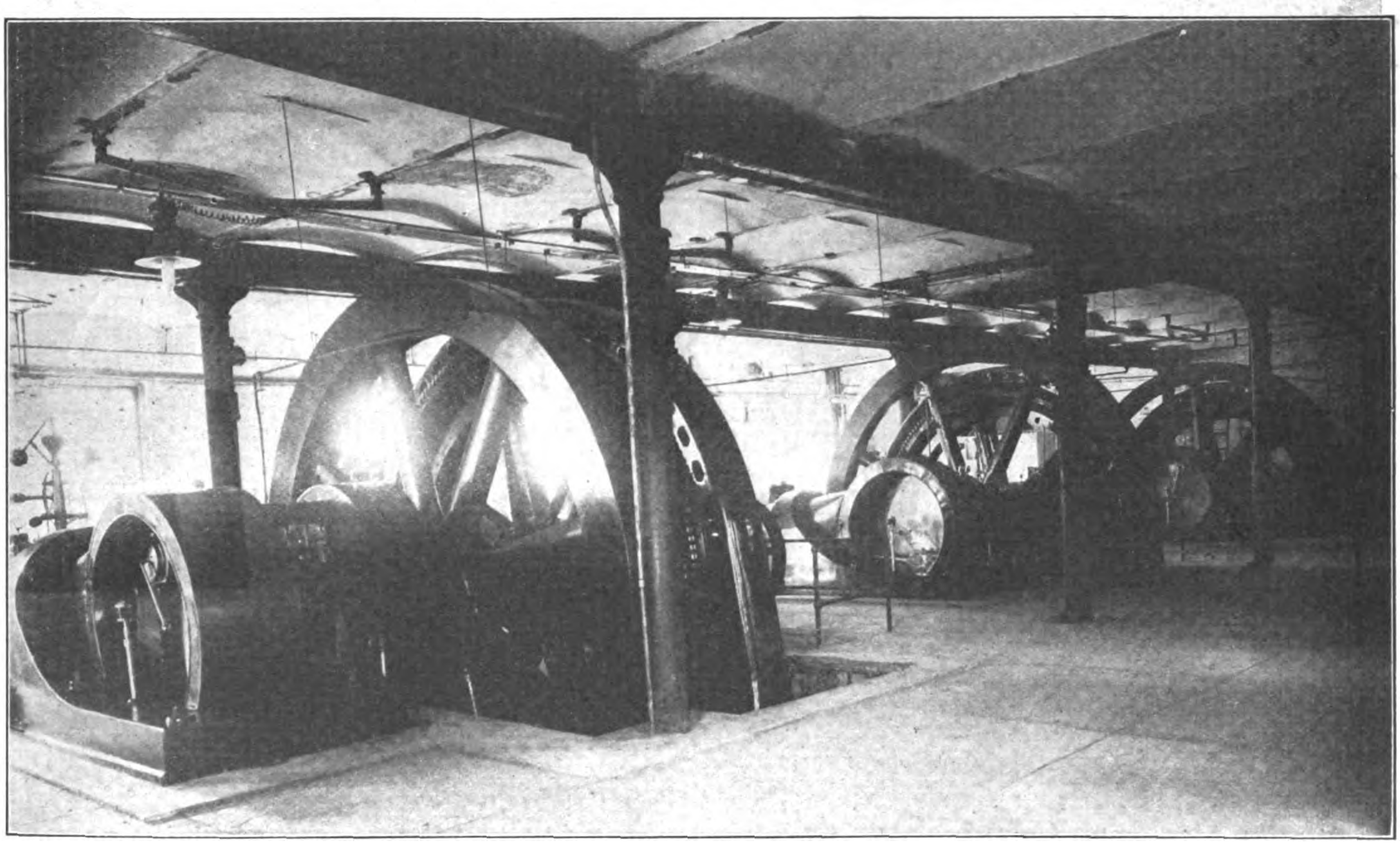
$$pv = \frac{RT}{W} \text{ and } pv^a = \text{constant.}$$

Mr. Berg, in closing, stated that the doctor's lecture was one of the most remarkable and interesting ever delivered before the local engineers. It provoked much discussion from W. L. R. Emmet and the other engineers, who insisted on Dr. Steinmetz clearing up some of the intricate problems involved, and which Dr. Steinmetz had presented in such a novel manner.

Electric Power Plant of the Missouri State Penitentiary.

A complete change in the method of power transmission has been brought about at the Missouri State Penitentiary, located at Jefferson City, Mo., by the installation of an electric power plant, and electric motors, which have replaced a number of steam engines.

The penitentiary has an average of more than 2,000 inmates, most of whom are employed in the various factories located within the prison walls. There are six shoe factories, one twine factory, one broom factory, one clothing factory, one saddle-tree factory, one harness shop, and one machine shop.



A VIEW IN THE POWER PLANT OF THE MISSOURI STATE PENITENTIARY.

Before the installation of the new electric power plant, each of these factories was driven by means of a steam engine, and these steam engines were supplied with steam from a boiler plant located outside of the prison walls. The steam engine in the twine factory, a 20-inch by 42-inch simple Corliss engine, was located at a distance of 1,500 feet from the boilers.

There were eleven steam engines used for driving the factories, in addition to the engines used for operating the dynamos for lighting and small-power service. The total indicated horsepower of all steam engines was approximately 900. The buildings were heated in some cases from engine exhaust, and in other cases with reduced high-pressure steam.

On account of the great amount of steam pipe installed, it was found to be practically impossible to keep it free from leaks and to maintain the proper steam pressure at the engines.

The fuel burned during the last year of operation of the old plant averaged about seventy tons per day; the coal used being mine run, equal to Illinois coal.

It was decided to install a complete new boiler plant adjacent to the old boiler plant, and a new centrally-located electric power plant, having sufficient capacity for operating all of the factories and for furnishing light and power for the State Capitol Building and other state buildings.

A new boiler house was designed to be constructed immediately adjacent to the old boiler house, and three Heine water-tube boilers, each of 500 horsepower capacity, were installed. Connection was made to the present brick stack by means of a long breeching, and a separate pump room was installed, this room containing the boiler-feed pumps and the feed-water heater. An independent steam connection was made connecting the new boiler plant with the engines installed in the new electric power plant. Arrangement was also made so that as soon as the new plant was placed in operation, the old boilers could be put in repair, and the steam connection from the old boiler plant was arranged for cross-connecting with the new steam main, and arrangements made so that reduced live steam from either of the boiler plants could be turned into the low-pressure heating mains.

The new electric power plant consists of three alternators, one of 500 kilowatts capacity, and two of 250 kilowatts capacity each; all of the alternators operating at a speed of 100 revolutions per minute, and direct-connected to simple Corliss engines, the large engine having a diameter of twenty-eight inches and stroke of forty-two inches; each of the smaller engines having a diameter of twenty inches and stroke of forty-two inches.

The dynamos and switchboard were constructed and installed by the Western Electric Company, and the steam engines by the St. Louis Iron and Machine Works.

Each dynamo was arranged with independent exciter, the exciter being driven by means of a Renold chain from the engine shaft. The dynamos are wound for 440 volts, three-phase, sixty cycles. All of the motors are wound for 440 volts, sixty cycles.

For the lighting service within the prison a transformer of 125 kilowatts capacity was installed, having a voltage ratio of 440 volts primary, 220-110 volts secondary.

For the purpose of lighting the Capitol Building and grounds, the Governor's Mansion, Supreme Court Building, etc., step-up transformers were installed having 2,300 volts secondary; this voltage being again reduced at the Capitol Building to the proper voltage for light and power.

The electric motors were furnished and installed complete by the Westinghouse Electric and Manufacturing Company. There are three 100-horsepower, two seventy-five-horsepower, one fifty-horsepower, nine thirty-horsepower, six twenty-horsepower, four fifteen-horsepower, three ten-horsepower, three five-horsepower and one two-horsepower machines.

These do not include the motors furnished and installed by the contractor for heating and ventilating purposes; there being thus used one seven-and-one-half-horsepower and one ten-horsepower motors.

The wiring for motors and power service between the power house and all of the buildings is installed under ground; McRoy conduit and paper-insulated, lead-armored cable, furnished by the Standard Underground Cable Company, being used. The underground work and electric wiring inside of buildings was installed by F. E. Newbery & Company, St. Louis, Mo.

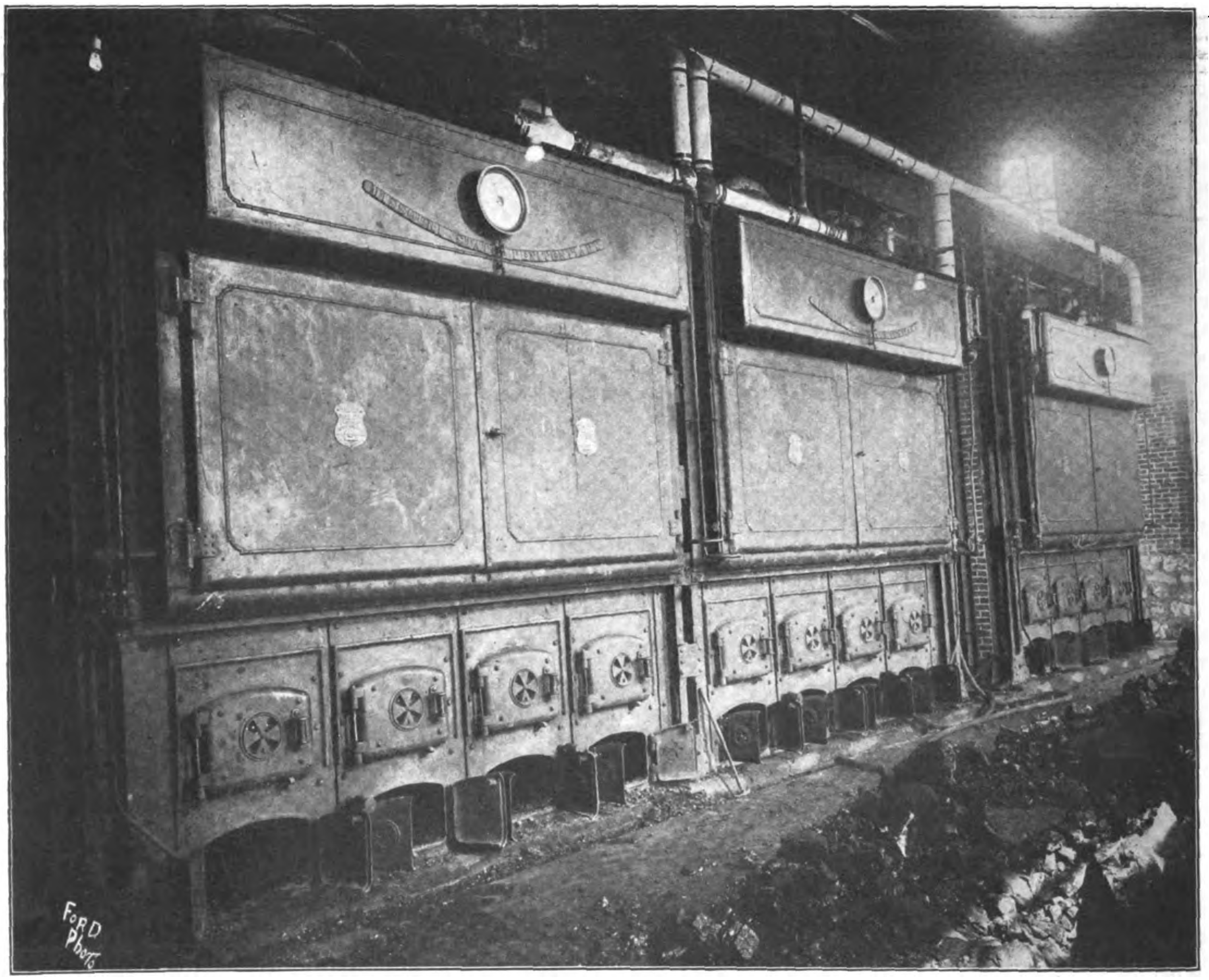
All electric lighting in the buildings is taken from one phase, and this phase is regulated by means of a Tirrill regulator. The arc lights around the prison grounds are divided on the phases, multiple Adams-Bagnall arc lamps being used.

All of the power piping and heating and ventilating systems were installed by the Peters-Eichler Heating Company, St. Louis, Mo.

The boilers are connected into a common header by means of a long bend, and one main steam pipe connects the new boiler plant with the engines in the power house. All of this work is run in tunnels.

The exhaust from the engines connects into a thirty-inch main, and arrangement is made for making direct connection with the boilers, through reducing valves, in case the exhaust from the steam engines is not sufficient for heating. The steam-heating supply starts with thirty-inch mains, and gradually reduces throughout the length of the run of the heating system.

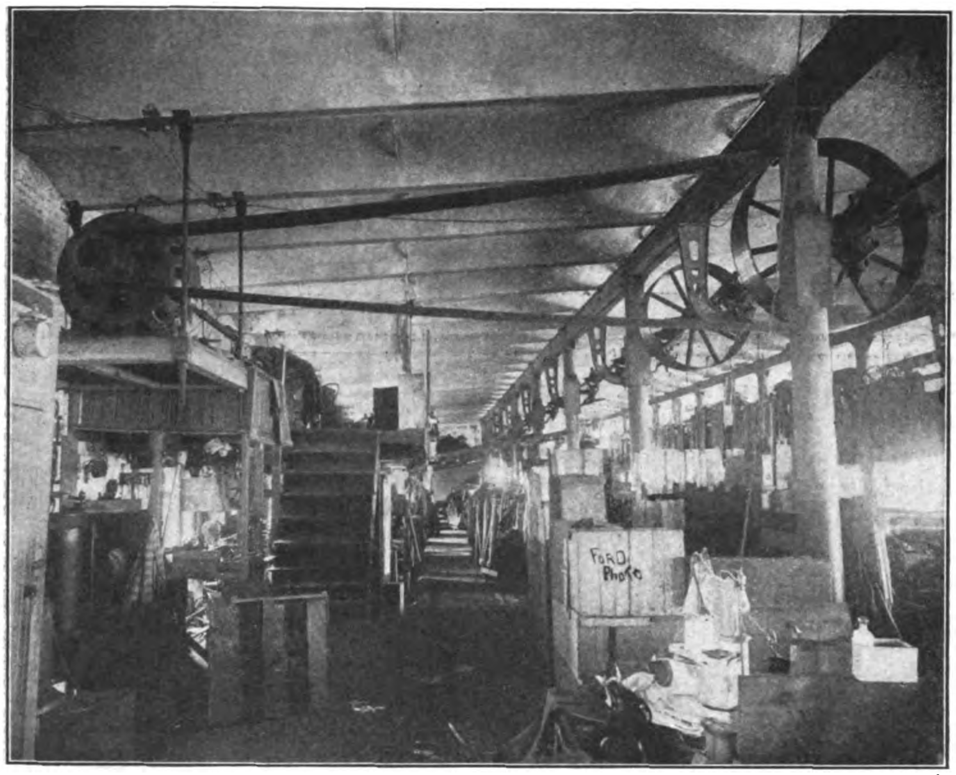
The buildings are all heated with pipe coils and radiators, with the exception of the Administration Building, Hospital Building and two cell buildings. All of these buildings are equipped with a hot-blast heating system, the two cell buildings being partially heated with pipe coils in addition to the hot blast. The hot-blast heating in all cases is automatically regu-



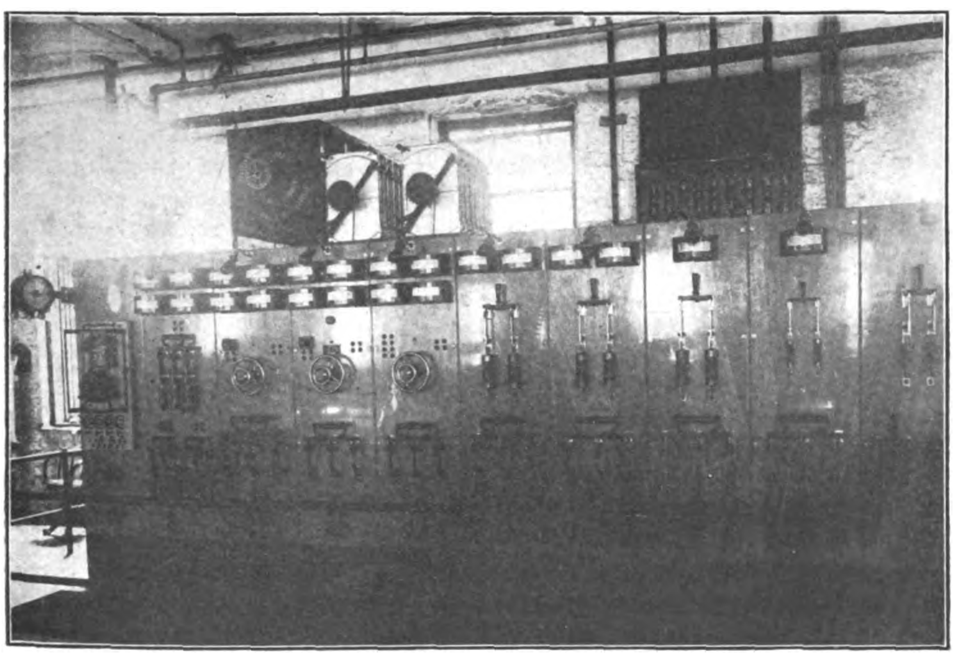
BOILER ROOM IN POWER PLANT OF MISSOURI STATE PENITENTIARY.

lated. The total amount of radiation in all buildings is approximately 85,000 square feet.

A duplicate set of pumps is installed at the lowest point of the prison grounds, and all returns are brought to this point, where they are taken by the pumps and returned to the new boiler plant.



AN EXAMPLE OF MOTOR DRIVE, MISSOURI STATE PENITENTIARY SHOPS.



SWITCHBOARD IN POWER PLANT, MISSOURI STATE PENITENTIARY.

An oil separator is installed in the heating mains near the electric power plant so that all steam used for heating is practically free from oil.

The new boiler plant and new electric-power plant were placed in operation about July 15. The entire change was made so that the work at the factories was not interrupted, and at the present time all factories are operated from the new power plant, and all of the old engines have been taken out of service and sold and moved from the premises. The old boilers are now being repaired and put in shape so that they can be used at any time should it be found necessary either for heating or power service.

It was found when the motors were placed in service that the indicated horsepower was considerably less than was the case when individual engines were used to drive the factories. The total indicated horsepower at this time is about 750 as against 900 with the old system. This is accounted for, in a measure, by the fact that a number of motors were used to replace one engine. In this way, all vertical belts were done away with, and in other ways the friction loss in the different factories was reduced.

The power plant was arranged so that the 500-kilowatt alternator could at any time carry the entire day power load, leaving either of the two 250-kilowatt alternators available for the night load, and in case of emergency the two 250-kilowatt alternators could be operated in multiple for carrying the power load, and the plant is now operating on this basis. It was found, however, in a test, that one of the 250-kilowatt alternators was able to carry the entire factory load for a day, so that this arrangement gives an abundant reserve capacity. This matter of reserve capacity is very important, for the reason that under the present contract arrangement for prison labor, a shut-down of the power plant would cost the state a considerable amount of money.

Since the new plant has been started, it has operated easily with two of the new boilers in service, and the fuel burned has been considerably reduced, the new plant having operated for one month on an average of about twenty-two tons of coal per day.

One object in the design of the power plant was to make it as simple and easily operated as possible, inasmuch as practically the entire power plant is operated by convict labor. Since the new plant was placed in operation, it was found that the service of about twenty-five of the convicts could be dispensed with as far as the operation of the power plant was concerned.

The installation of the new power plant was carried out under the management of Matthew W. Hall, Warden, and the Board of Prison Inspectors, consisting of Jacob Gmelich, treasurer of state; W. W. Wilder, Auditor of State, and H. S. Hadley, Attorney-General.

The plans and specifications for the entire installation, and the supervision of all work were under the charge of Ruebel & Wells, consulting engineers, Chemical Building, St. Louis, Mo.

QUESTIONS AND ANSWERS.

Ayrton Universal Shunt.—How is it that the multiplying power of an Ayrton universal shunt remains the same regardless of the resistance of the galvanometer used in connection with it?—M. A. G., Chicago.

In the accompanying diagram the arrangement and connections of a common form of this galvanometer shunt are shown. It was designed by the late Prof. W. E. Ayrton to be used with a galvanometer of any resistance. A plug placed in f sends all the current through the galvanometer G; plugs in f and j short-circuit the galvanometer; a plug in j alone cuts it out of circuit; in normal use a plug is left in h and another inserted in a, b, c or d, thus connecting in various portions of the coil r as a shunt and the remainder thereof in series with the galvanometer. Let the resistance of the latter be represented by g and that of the shunt by s. Let I be the total current, Is that portion thereof passing through the shunt, and Ig the portion passing through the galvanometer. Then

$$\frac{Is}{Ig} = \frac{s}{g + r - s}$$

and

$$\frac{Ig}{Ig + Is} = \frac{s}{g + r - s + s}$$

or

$$\frac{Ig}{I} = \frac{s}{g + r}$$

therefore

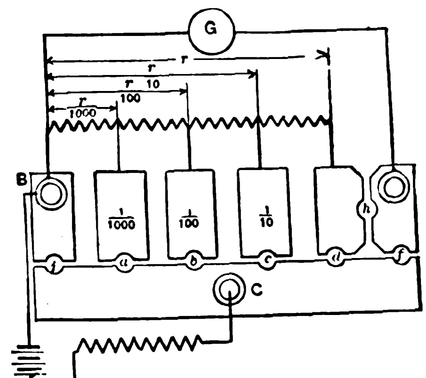
$$Ig = I \frac{s}{g + r}.$$

Since s is always equal to a decimal part of r, it may be written $s = \frac{r}{n}$, where n has the value 1, 10, 100, 1,000, etc.

Hence $Ig = \frac{I}{n} \frac{r}{g + r}$. The value $\frac{r}{g + r}$ is constant for any particular galvanometer used in connection with the shunt box and represents the ratio of the galvanometer current to the total current when $n = 1$, i. e., when there is a plug in h and another in d or f. When this other plug is in any hole but j, n has the values given above, regardless of the value of g. If r or g are not known the absolute value of I can not be determined from the galvanometer readings. The diagram given herewith is from Foster's "Electrical Engineer's Pocket-Book."

Relation of Watts to Volt-Amperes.—Please tell me why a kilowatt meter reads ahead of the kilovolt-amperes at certain times.—C. R., Mobile, Ala.

In general the reading of a wattmeter in kilowatts is less than the product of the voltage and current in kilovolt-amperes. The ratio between the former or true power to the latter or apparent power is the power-factor, which is always one or less than one. In a single-phase circuit the wattmeter will always indicate the same or less than the apparent power. In a polyphase circuit, when the power-factor is less than one and the two-wattmeter method is used, one wattmeter will read more than the true power in that phase and the other wattmeter will read less than the true power in its phase, in fact sometimes even negative. The algebraic sum of the readings gives the true total power. The reason for this difference in readings in a three-phase circuit is that one wattmeter reads the average product of the instantaneous resultant current and voltage in one phase multiplied by the cosine of thirty degrees plus the angle of lead or lag, while the other wattmeter reads



AYRTON'S UNIVERSAL SHUNT.

the average product of the instantaneous resultant current and voltage of another phase multiplied by the cosine of thirty degrees minus the angle of lead or lag. The effect of this difference of angles is to cause one wattmeter to generally read more than the volt-amperes of its phase.

Exide Accumulators.—What are the constituents of the Exide accumulator and its rating in voltage and amperes at full charge?—G. W. A., Morocco, Ind.

The Exide accumulator is of the common lead storage-battery type in which the positive plates are of lead peroxide, the negatives of a spongy form of lead and the electrolyte is dilute sulphuric acid. The name "Exide" is a trade name used by a well-known storage-battery company to designate its storage batteries for automobile use. Fully charged, this battery, like other storage batteries, gives an electromotive force of two to 2.1 volts per cell, which gradually diminishes during the discharge to about one and eight-tenths volts at its end. A fully charged cell has a discharge capacity in ampere-hours, dependent on its size. For example, a sparking-battery cell having five plates of type "S" is nominally rated at forty ampere-hours at the service discharge rate.

Behavior of Alternators in Parallel.—What would happen if two three-phase alternators were running in parallel and one should lose its excitation, as, say, by accidental opening of the exciter circuit or breaking of the exciter's belt? If two similar machines were running in parallel and the fuse in one phase of one machine should blow, would the other two phases still remain intact?—R. W. B., Kankakee, Ill.

In the first case the machine that lost its excitation would continue to run as an induction motor supplied with current by the intact machine operating as a generator. If the combined load for this generator should prove to be too large, its circuit-breakers will doubtless open, leaving the motorized machine now idle but probably still driven by its own prime mover. Blowing the fuse in one wire of a three-wire, three-phase machine cuts off the load from the two adjacent phases depending on this wire for their common lead. If the added load is too great for the other machine the fuse in its corresponding wire will blow, or it may be so great as to blow all three of its fuses. If the machines are four-wire, Y-wound, and the original fuse in any wire but the neutral wire blows, it will probably cut out that phase alone, the other phases running on intact. The extent to which the system as a whole is affected is dependent on the amount of load on it at the time.

Excitation of Synchronous Motors.—Is it correct to increase the field strength of a synchronous motor as the load increases? If so, why?—J. M. W., Portsmouth, Va.

Probably the chief reason for the use of synchronous motors as compared with induction motors is that they are capable of reacting on the line to give a leading current just as a condenser does. Therefore they are used to neutralize the effect of lagging currents due to induction motors, arc lamps or other inductive load, and thus to give unity power-factor in the system. For each particular load there is a particular value of field current that will give unity power-factor. Hence, to get the full benefit of the synchronous motor, it is desirable to increase the field current with each increase of load, the exact amount of increased excitation being determined best by adjusting the field current till a power-factor indicator indicates the ideal unit value.

POWER SUPPLY AND ITS EFFECT ON THE INDUSTRIES OF THE NORTHEAST COAST.[1]

BY CHARLES H. MERZ.

SCOPE OF PAPER.

In this paper, power supply refers to the provision of electricity for industrial use by companies[2] specially constituted for the purpose. It is assumed that the general effects of power supply on the industrial development of the district are likely to be of more interest to members of this Institute than would be a technical description of power-station plant, so that, beyond indicating by a schedule the extent and nature of the system, the paper deals chiefly with the general aspect of the question. Power supply, though of comparatively recent development, has already had a marked effect upon the industries of the northeast coast:

1. A great saving of coal and reduction of smoke has resulted; there is now, apart from the power company, practically speaking, no coal burned on the Tyne for power purposes except in chemical factories. The Tyne shipyards and engineering works may be said to have adopted electricity to the exclusion of all other forms of motive power.

2. The application of electricity to all new uses has been facilitated; the suburban traffic facilities of Newcastle are more ample than those of any other town of similar size at home or abroad; four new rolling mills are about to be driven electrically.

3. New industries have been established in the district purely because of the cheap power supply available.

4. A substantial commencement has been made in the utilization of the waste heat and gases existing in the area, and in this regard the district occupies a unique position, owing to the extent to which its future power requirements can be met by electricity produced as a byproduct of two of its largest industries, the making of pig iron and the making of coke.

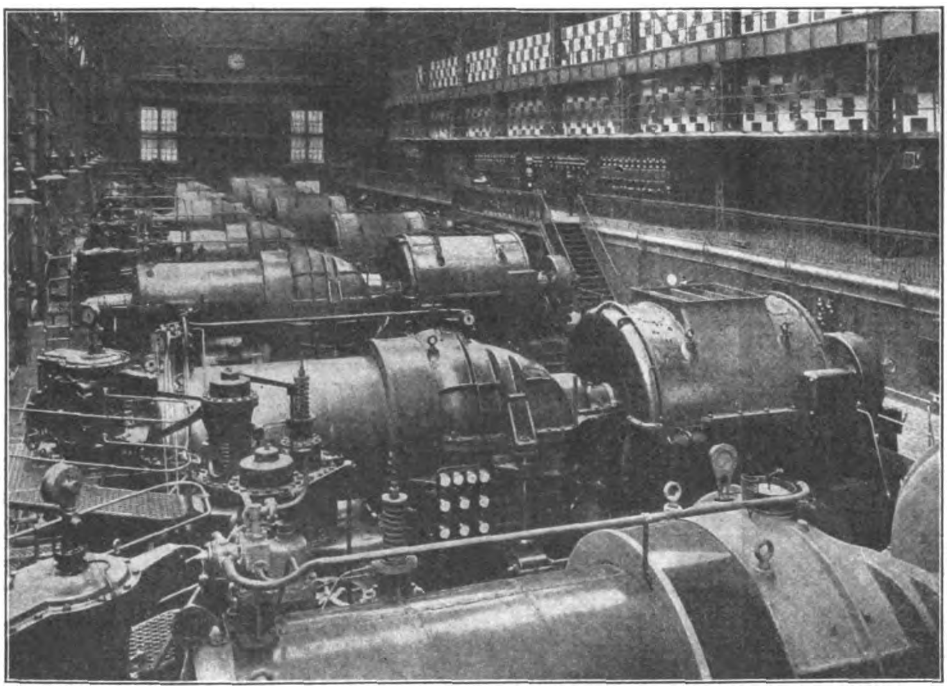


FIG. 1.—CARVILLE POWER STATION.

NATURE OF NORTHEAST COAST INDUSTRIES.

The problem of power supply in any district is so completely governed by local conditions that it may be permitted at the outset to summarize the nature and extent of the staple industries of the northeast coast. The table below does this in convenient form:

	Population. 1901.	Coal Mined. 1906. Tons.	Make of Coke. 1906. Tons.	Ironstone Mined. 1906. Tons.	Pig Iron. 1906. Tons.	Shipping Built. 1906. Net Tonnage.
N.-E. Coast industrial area...	2,015,000	52,097,377	7,830,000	6,126,324	3,628,651	630,872
United Kingdom	41,458,721	251,067,628	19,296,526	15,500,406	10,109,453	1,156,771
Ratio:— N.-E. Coast / United Kingdom	4.8%	20.7%	40.5%	39.5%	36.0%	54.5%

It will be seen that in coal, iron and shipbuilding the northeast coast figures represent, respectively, one-fifth, one-third and one-half of the nation's output.

POLICY OF ELECTRIC-POWER COMPANIES.

It was early realized that the more completely the electrical wants of the whole community could be met, the more cheaply could a supply of electricity be given and the more stable would the supply industry become. Efforts were, therefore, made to design a system which would be capable of producing current at a minimum of cost and of providing a satisfactory supply for all purposes—power, traction and lighting.

EXTENT OF POWER SUPPLY SYSTEM.

The extent of the area to be covered necessitated the generation of electricity at a pressure and in a form facilitating transmission over long distances, while the nature of the market to be catered for made it essential that the current should be produced as cheaply as possible, which in turn involved the use of an extensive site with ample coal and water facilities. The station from which the greater portion of the current is now supplied—Carville—was begun in 1903 by the installation of 14,000 electrical horsepower of steam-turbine-driven generators producing three-phase, forty-cycle current at a pressure of 6,000 volts. This installation has been increased fourfold during the past four years, so that the generating plant now aggregates 56,000 electric horsepower, and Carville has now a greater output of electricity than any other public supply station in Europe. (See Figs. 2 and 3.) From Carville the transmission and distribution networks extend westward to and through the city of Newcastle-upon-Tyne, northward to Blyth, and eastward along the river Tyne to North Shields, while in a southerly direction the cables at present reach a point some thirty miles south of Carville, and extensions will shortly be completed linking up the northern cable network to the power system, which has now been in operation some eighteen months in the Middleboro district.

Unity of policy and uniformity of system on the part of the three power companies have been secured by working

[1] A paper read before the Iron and Steel Institute, at Middlesboro, England, September 28-29.

[2] The companies and municipalities supplying current in different sections of the northeast coast are twelve in number, but as nine-tenths of the total electricity sold is produced by the Newcastle-upon-Tyne Electric Supply Company, the Durham Electrical Power Distribution Company and the Cleveland & Durham Electric Power Company, and as the author's information is only complete so far as these companies are concerned, the remarks in this paper have application exclusively to these companies.

agreements. The development has gradually extended northward and southward from the Tyne, and it is now possible to obtain electricity on the same system throughout practically the whole area. The table herewith gives the number and size of generating stations and a few leading particulars of the transmission and distribution systems. The capacity of plant installed represents about one-ninth of the total plant installed in public supply stations of the United Kingdom. But as the power companies are working on a more constant load, i. e., a better "load factor," the electricity actually generated is about one-quarter of that generated in the whole of the public supply stations of the United Kingdom.

That of the Durham Collieries Company, the operation of which the Newcastle-upon-Tyne Electric Supply Company took over this year, was a fifty-cycle, three-phase system, while the Tees area of the Cleveland & Durham Electric Power Company, where supply was begun in January of last year, was originally designed for twenty-five cycles. The same company's Bishop-Auckland and Consett stations were designed, one to give three-phase, twenty-five-cycle current, the other two-phase, fifty-cycle current.

It will be appreciated that these alterations (involving in some cases the complete redesign of system) have necessarily delayed development, but it was felt better to sacrifice something for the sake of uniformity.[1] The work of making the systems uniform has now been completed, and, in addition, nine small, and therefore uneconomical, generating stations, not mentioned in the table, have been shut down.

PARTICULARS OF GENERATING STATIONS.

Power Station.	Type.	Horsepower of Plant Installed.	Type of Current.	Voltage.	Remarks.
Carville	Coal-fired.	56,000	3-phase 40 cycles	6,000	In operation.
Philadelphia	Coal-fired.	13,000	3-phase 40 cycles	6,000	In operation.
Neptune Bank	Coal-fired.	6,800	3-phase 40 cycles	6,000	In operation. (stand-by)
Grangetown	Coal-fired.	8,000	3-phase 40 cycles	12,000	In operation.
Hebburn	Coal-fired.	4,500	3-phase 40 cycles	6,000	In operation (stand-by)
Weardale	Waste-heat.	6,650	3-phase 40 cylces	3,000	In operation.
Newport	Waste-heat.	4,000	3-phase 40 cycles	3,000	In operation.
Blaydon	Waste-heat.	3,000	3-phase 40 cycles	6,000	In operation.
Capacity of Plant Installed		101,950			
Dunston	Coal-fired.	30,000	3-phase 40-cycles	6,000	Under construction.
Bankfoot	Waste-heat.	3,300	3-phase 40 cycles	3,000	Under construction.
Tees-bridge	Waste-heat.	1,300	3-phase 40 cycles	3,000	Under construction.
Capacity of Plant under construction		34,600			
	Total	136,550			

MAIN TRANSMISSION AND DISTRIBUTION NETWORKS.

Main Trunk System	3-phase 40 cycles	20,000 volts	Underground and overhead.
Main High-Tension Power Distribution System—			
Tyne and North Durham Area	3-phase 40 cycles	6,000 volts	Underground and overhead.
Tees Area	3-phase 40 cycles	12,000 volts	Underground and overhead.
Power Supply	3-phase 40 cycles	3,000 and 440 volts	Underground and overhead.
Railway Supply	Continuous current	600 volts	Third rail.
Lighting Supply (and Small Motors)	Continuous current	480 and 240 volts	Three-wire.
	and 3-phase 40 cycles	440 and 250 volts	Four-wire.

Though the extension of the power-supply system has been rapid, its development and the growth of its profit-earning capacity were considerably delayed by the work which had to be done from time to time to secure uniformity of system. Unfortunately, with each amalgamation or extension of area considerable alterations had to be effected in the system of the new company concerned. For example, the system of the Newcastle-upon-Tyne Electric Supply Company, the pioneer company, is a three-phase, forty-cycle system.

GENERAL AND LOCAL CONDITIONS GOVERNING POWER SUPPLY.

A factor invariably of vital importance in the production of cheap current, whether by a public company or by a private manufacturer, is the capital expenditure per useful horsepower of plant. This decreases as the size of plant grows, while the running efficiency at the same time increases. The local conditions governing power supply in this district are:

1. The low price of coal, enabling manufacturers to produce power themselves at relatively low rates.

2. The fact that the manufacturers' works are mostly of considerable size, i. e., their individual electrical requirements are large.

3. The existence of large quantities of potential energy in the form of waste heat and combustible gas.

The first and second conditions have been met by the power companies, in erecting their main generating stations (a) taking full advantage of the best coal and water facilities available, (b) installing plant of capacity much in excess of that which any individual manufacturer, however large, could adopt, (c) by catering for all classes of consumers, thereby securing a diversity of load with a resulting constancy of output, and so utilizing the plant installed to the best possible advantage. These factors, combined with the employment of a highly skilled technical staff and attention to numberless relatively minor details, have resulted in securing an efficiency of production much greater than that practicable to any manufacturer producing power merely as an auxiliary to his main business. This is, after all, an age of specialization, and the production of electricity from coal at a minimum of cost presents opportunities for the highest technical skill and for unremitting vigilance.

Power supply in this district began on the north bank of the Tyne. It has naturally, therefore, reached its highest development there, and although even in this section of the area it is only seven years old, there is at the present moment not a single firm of shipbuilders or engineers on the north bank of the Tyne inside the power company's area of supply which does not take ninety-five per cent of its power from the company, the remaining five per cent being produced from small gas engines or from boilers fired with scrap wood. On the south bank of the Tyne, progress has, since power supply started, been equally rapid, while in the Tees area, although the power company only began operations in January of last year, they have already connected over 20,000 horsepower of motors.

[1] From the point of view of uniformity, the important things are the type of current and the periodicity—the voltage itself can be easily transformed.

The credit of electrifying the Newcastle suburban railways is, of course, due to the enterprise of the North-Eastern Railway Company; but the fact that they were the first important English railway to electrify a portion of its system, and that it purchased the necessary electricity from the power company, shows that the availability of cheap power is an advantage not only to manufacturers but to the public generally in facilitating the introduction of electric traction. Since the electrification of the Newcastle system the train service has been more than doubled, and the schedule speed improved by twenty per cent. A comparison with other cities at home and abroad shows that no other town of similar population, or indeed having twice the population, has so extensive an electrified-railway system and so frequent a suburban service, and this has, of course, resulted in a large increase of travel.

The application of electricity to rolling mills of the largest size is one of the most interesting industrial developments of recent years. It had its origin in Germany, and is making rapid progress there. The advantages offered are economy of running, closer speed regulation, better control of operations, and fewer breakages. There are now four new electrically driven rolling mills being installed in this area—two by Dorman, Long & Co., one by the Bowesfield Steel Company, and one by a new company now being formed. The electricity for these will be purchased from the power company, so that in this direction also power supply has facilitated new developments.

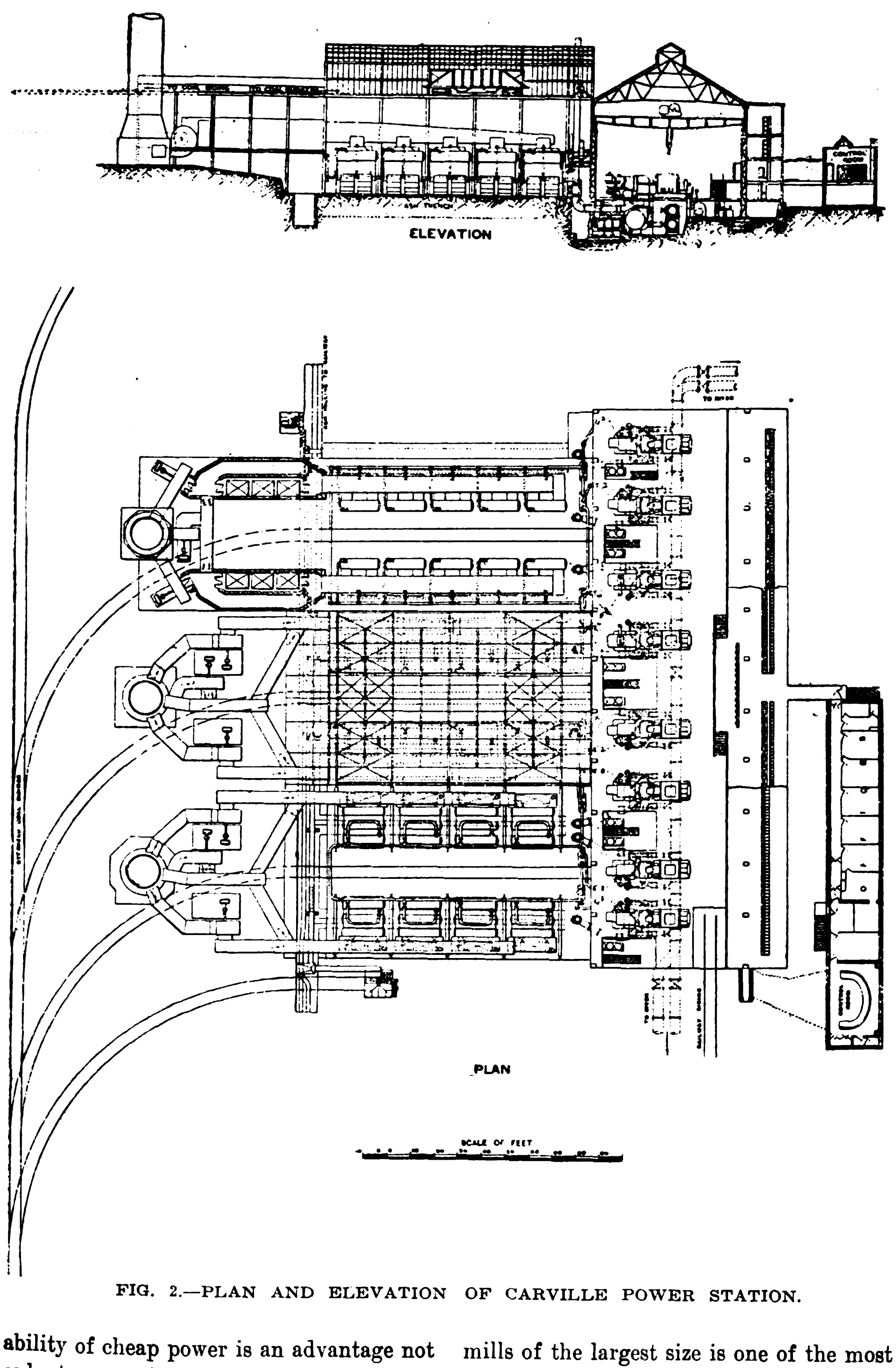


FIG. 2.—PLAN AND ELEVATION OF CARVILLE POWER STATION.

The supply of electricity to coal-mines, beginning as it did not more than four years ago, has not reached the same stage of development as in the case of other industries, though collieries having an output of some 8,000,000 tons per annum are taking, or are arranging to take, practically their whole supply from the power companies. This supply will include, among other apparatus, winders of 1,600 horsepower each; and it would appear that the supply of electricity to coal mines is likely to be of even greater magnitude than the supply to shipbuilding and heavy engineering works. In the latter case the effect has been to conserve over fifty per cent of the coal previously burnt for power generation.

The output of coal from Northumberland and Durham in 1906 was over 52,000,000 tons, and, according to the report of the Royal Commission on Coal Supplies, between six per cent and eight per cent of the total coal brought to bank is used by the collieries for the purpose of power generation. From the making of coke given by the table, it appears that about one-fifth of the coal mined on the northeast coast is converted into coke. Making a liberal allowance, therefore, for the power at present used from the surplus heat resulting from the coking process, the collieries of Northumberland and Durham must burn for their own power requirements some 2,500,000 tons of coal per annum. As the almost invariable rule is to work non-condensing, as the steam piping is usually long, and as a large portion of the load is intermittent, it is certain, and is proved by experience in this district, that the same power can be provided electrically in a large central power station by the consumption of less than a quarter of this coal. Apart, therefore, from the efficient utilization of waste heat discussed hereafter, apart from the saving of coal in shipbuilding and engineering works, and apart from the saving resulting from the electrification of railways, the application of electricity to coal mines in this district, when as complete as that to the Tyne shipyards, will render available for outside sale over 1¾ million tons of coal, equivalent to, say, over half a million sterling per annum.

SUMMARY OF PRESENT RESULTS.

To summarize present results, the three power companies are now responsible for the supply of current to eighty miles (single truck) of electrified railway, four tramway systems, the lighting in towns having populations aggregating over 700,000, motive power to the extent of 85,000 horsepower, and electrochemical works of over 12,000 horsepower. The last named are new industries attracted to the Tyne solely by cheap power supply, and there is every indication that their number will in future be largely increased.

SURPLUS OR "WASTE" ENERGY FROM COKE OVENS AND BLAST FURNACES.

This brings us to what is perhaps the most interesting section of the problem, and one which it is not too much to say is also of considerable national importance, namely, the efficient utilization of waste heat. The counties of Northumberland and Durham and the North Riding of Yorkshire last year produced together 7,800,000 tons of coke. The bulk of this was made in the older-fashioned beehive oven, but the retort type of oven, by virtue of the increased coke yield and of the recovery of the by-products, is making rapid progress, and it can be proved that were the whole of the above coke output produced in retort ovens, there would be available waste gas and waste heat capable of developing over 150,000 horsepower continuously, if used under boilers, or probably rather less than twice this amount, or, say, a quarter of a million horsepower, if the gas were used in gas engines.

The blast furnaces form a second but less important potential source of power. In evidence given before the Royal Commission on Coal Supplies, it was estimated that if gas engines were used exclusively for power purposes, then, after the requirements of the stoves and blowing engines had been met, there would still be available from the Cleveland furnaces a supply of surplus gas equivalent to 61,000 horsepower continuously.

THE UTILIZATION OF WASTE ENERGY AND ITS COMMERCIAL VALUE.

The question then arises as to the best method of turning this "waste heat" and gas to useful purpose. The problem is one of great moment, and however dealt with, will involve years of work before a complete solution can be achieved. It is, therefore, the more important that the efforts directed toward such a solution should proceed on a commercially sound basis and along correct engineering lines. On a rigorous analysis of the situation it will be found that financial and other practical considerations definitely limit the pace at which progress can be made, and, especially in the case of blast furnaces, greatly reduce the amount of power immediately available.

Many engineers, fascinated by the magnitude of the figures, have proceeded to calculate the commercial value of the gas; the more cautious of them by estimating the total heat units contained in the gas, and then calculating the value of the coal necessary to give the same heat units; others by first assuming the gas is utilized in gas engines, and then calculating the tonnage and value of the coal required to produce the same horsepower from steam engines. The second method gives a result twice as great as the first, which is itself already much too high, having left out of account the fact that the gas or heat in question can only be regarded as of the same value as coal if it can be utilized as cheaply from a capital expenditure point of view, if it can be stored as conveniently, and if it be available where and when required; in short, the commercial value of these waste products bears no direct relation to their value arrived at by either of the above methods.

Dealing first with the waste energy from coke ovens, each separate group of ovens usually consists of between forty and 120 ovens, rarely exceeding the latter figure. The batteries of ovens are widely scattered throughout the county of Durham, and are for the most part at relatively long distances from the populous centers—that is to say, from the centers of power demand. The gas might be piped to some central point, as is the practice followed in America with natural gas, which is transmitted in some cases 200 miles; but this natural gas has twice the calorific value of coke-oven gas, and it is usually available at a pressure of fifty pounds per square inch or upward, rendering it practicable to transmit a large volume of energy through a relatively small pipe, whereas, to transmit coke-oven gas any distance, there would have to be installed an expensive compressing plant. Further, there is, in addition to the gas given off from the coke ovens, a certain quantity of waste heat which can only be utilized locally under boilers; and in no calculations which the author has made has he been able to establish a case for the transmission of gas for power purposes as against the alternative of converting the gas into electricity and transmitting the power in this form. Admitting the desirability of converting the gas into electricity, the doubtful point then remaining is whether it is cheaper for an owner of coke ovens to put down his own generating station and to utilize the electricity so produced for his mines; or, alternatively, to cooperate with a power company, which he can do either by selling them the whole of the gas and

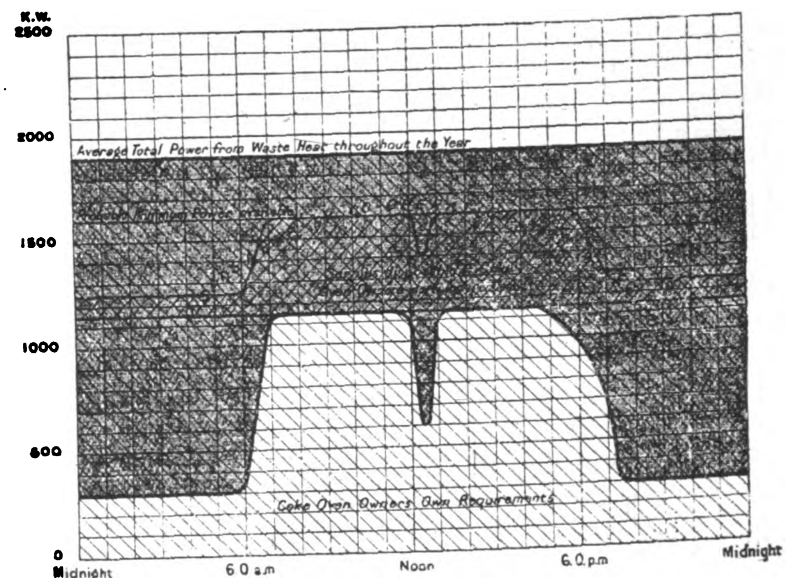


FIG. 3.—ESTIMATED DAILY OUTPUT AND LOAD CURVE OF WASTE-HEAT STATION AT CROOK.

Electricity utilized by coke-oven owners at mines and ovens=5½ million Board of Trade units per annum. Maximum surplus available for outside sale, if coke-oven owners work independently=2¼ million Board of Trade units per annum. Surplus disposable by cooperating with power company=ten million Board of Trade units per annum.

purchasing in return what electricity he needs; or, by undertaking to provide a portion of the capital required for generating stations, which, when erected, would be operated by the power company, and the profits shared between the parties.

COOPERATION WITH A POWER COMPANY THE MOST EFFICIENT MEANS OF UTILIZATION.

In all cases investigated by the author it has been found that a greater profit will accrue to the coke-oven owner by cooperating with a power company than by proceeding on independent lines. There are three reasons for this:

(1) When a private owner erects a generating plant independently, he must install some reserve or spare plant, with a consequent heavier outlay of capital than is necessary to a power company, which, possessing a coal-fired station, need install no spare plant in any of its waste-heat stations, but can, instead, meet any variation of load by the coal-fired station, which also acts as a standby against any breakdown.

(2) This necessity of putting down spare plant results in smaller, and therefore more expensive and less efficient, plant. To take a case: Supposing 2,000 horsepower is available, if the station is to be used in conjunction with the power company's system, one 2,000-horsepower unit would be entirely satisfactory, the power system acting as a standby. If it is to be used in a separate generating station, one would probably install three 1,000-horsepower units—two working and one spare. The gain in the former case in capital cost, running cost, and efficiency is obvious. As a matter of fact, the capital cost in the second case would be nearly double what it would be in the first.

(3) The power company, having a market for current many times greater than the output of any individual waste-heat station, can run such a station continuously at maximum output, so utilizing completely all the current that can be produced; whereas, it is impossible to conceive the power requirements of an individual coke-oven and colliery owner coinciding, even approximately, over twenty-four hours with the amount of gas or waste heat available.

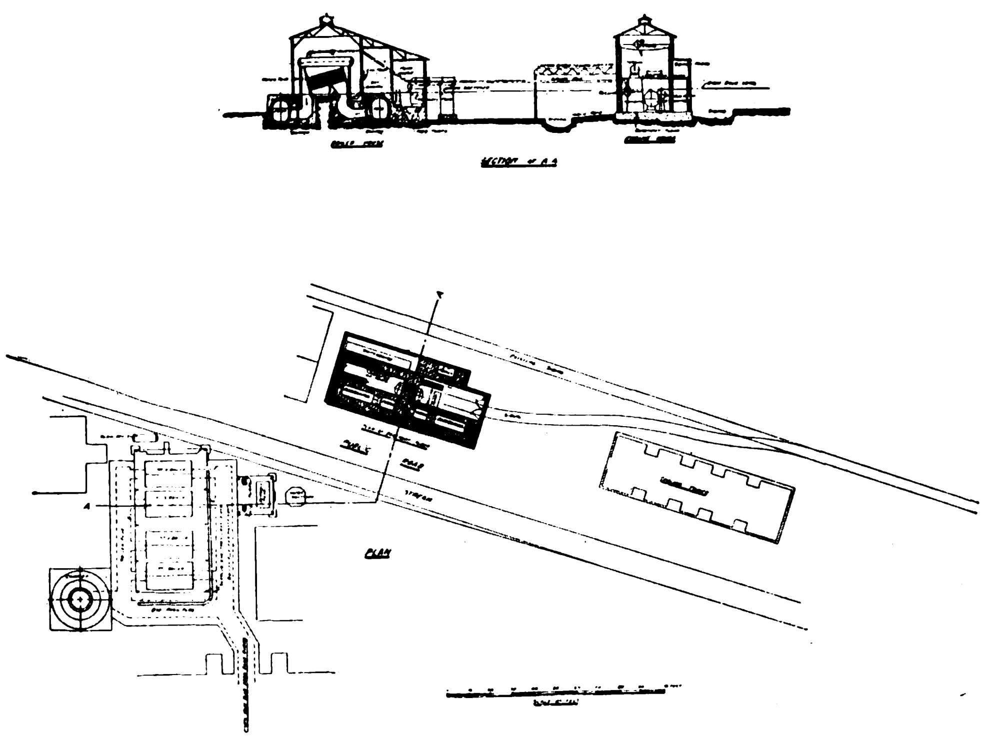


FIG. 4.—BANKFOOT WASTE-HEAT STATION.

The diagram (Fig. 3) which refers to Messrs. Pease & Partners' installation at Crook, shows the advantage of cooperation very strikingly. It will be seen that the area of the rectangle enclosed between the top line and the base (shown hatched) represents the total amount of power available, that "hatched" (but not shaded) the requirements of the colliery owner, and that "cross-hatched" the amount disposable had the colliery owner put in his own plant independently, and been able to find a purchaser; it also assumes that the outside purchaser had approximately the same load curve as the colliery owner himself, which is a reasonable assumption, unless the power be transmitted long distances, as the only users of power in the vicinity of coke ovens are other colliery owners. The area shaded gray represents the surplus power actually used under the cooperative arrangement.

THE COOPERATIVE PRINCIPLE AND BLAST-FURNACE GAS.

It is more difficult to get out so typical a curve in the case of blast furnaces, as the conditions vary so widely. Of course, if a company produces pig iron only, and does not convert the iron into steel, cooperation with a power company is at

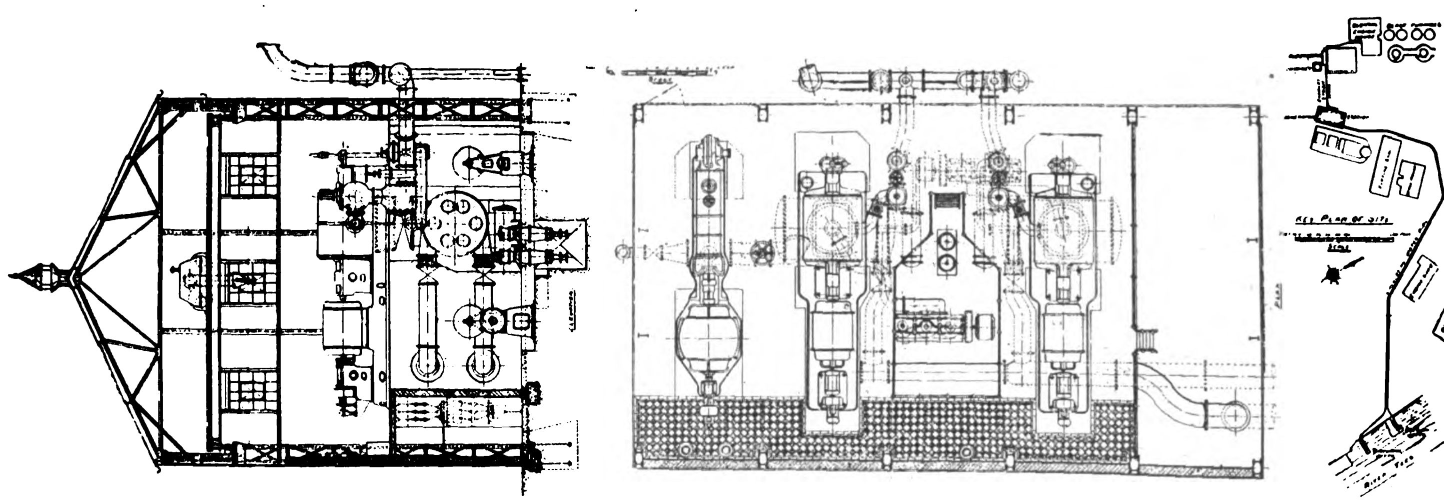


FIG. 5.—NEWPORT EXHAUST-STEAM STATION.

present, practically speaking, the only outlet which it has for its surplus power. If, however, a blast-furnace works has a steel mill attached, it may be argued that the correct thing to do is to follow the plan adopted by many large works in Germany, namely, to install gas-engine blowers and gas-driven dynamos at the blast furnaces, the latter plant producing the necessary power for driving the steel mills.

Capital charges are invariably the controlling factor in the total cost of electricity, and the question raised above, namely, whether it is commercially sound for a blast-furnace owner to cooperate with a power company or not, can only be decided in each individual case after full consideration of the capital outlay involved, the amount of spare plant that has to be provided, and the degree of coincidenec between supply and demand. It is clear that if it be decided to make the works self-contained, then the supply capacity must always be in excess of the possible demand; otherwise a risk is run of a portion of the works having to be stopped, and as the demand varies from time to time, there must be a variable amount of gas utilized, involving wastage when supply exceeds demand, or the burning of coal at certain periods when demand exceeds supply. Given an equitable arrangement, it is clear that the same general arguments in favor of cooperation which hold in the case of coke ovens are applicable to blast furnaces with steel works attached.

UTILIZATION OF BLAST-FURNACE GAS IN GERMANY.

As illustrating one aspect of the case, I quote from an article on the German Steelworks Union, published in the Financial and Commercial Supplement to the *Times*, dated July 3, 1908:

"The latter concerns (the German iron and steel works) have grown up under the economic impulse to find and employ the cheapest method of production in order to secure iron at the lowest possible cost. They have erected blast furnaces around their mills. . . . The gases formerly escaping from their furnaces and going to waste now supply a cheap motive power for their steel and rolling mills. They make their own coke, and the coking process furnishes valuable by-products, besides supplying, in many cases, an additional source of fuel gas for the power plants."

Later on, in speaking of the big iron producers who form the Dusseldorf Syndicate, the writer says that in spite of dull trade "the great works continue to smelt iron at almost the pace they set when the recent wave of prosperity was at its height. The economies involved in the situation almost compel them to do so. To a considerable extent, they have long-term contracts for foreign ores for mixing with home ores; their coking ovens must continue in operation for the sake of the by-products, and the coke produced would deteriorate in quality if stored. But more than this, the furnace gases are needed for driving their steel mills, and it is often difficult to blow out a furnace or two without seriously disturbing the power supply."

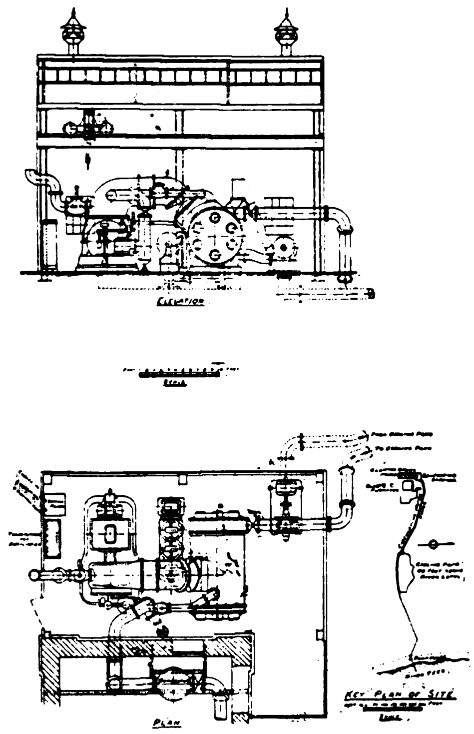


FIG. 6.—TEES-BRIDGE EXHAUST-STEAM STATION.

It would therefore appear that even after a rough approximate balance has been secured between supply and demand it is readily upset by ordinary market fluctuations. The natural variation of trade thus furnishes a further argument in favor of the cooperative principle.

COOPERATION WITH A POWER COMPANY THE ONLY MEANS OF OBTAINING FULL VALUE FROM SURPLUS ENERGY.

The power companies in this district having their transmission cables interlacing the entire industrial area, and being in a position, with their large load already developed, to utilize any amount of electricity whenever and wherever produced, are arranging for waste-heat stations at different points, turning all the electricity so produced into a common network from which the colliery company, the coke-oven owner, or the blast-furnace owner can purchase any amount he may require, all spare plant and all plant to deal with exceptional peak loads being kept at the main central coal-fired station. Such a policy applied to other commodities is as old as the hills; it began in the most primitive market when a producer gave his raw material and received in exchange manufactured articles, but so far as the author is aware this is the first time it has been extensively applied to electricity, although the principle so applied is equally sound, and it appears that only in this way is it possible to conserve the full national value of the energy now being wasted.

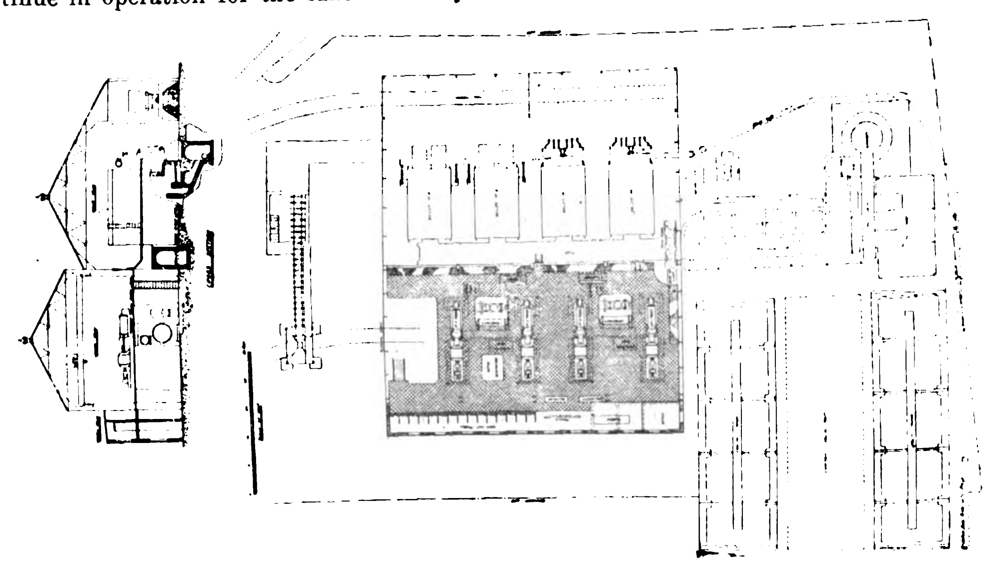


FIG. 7.—WEARDALE WASTE-HEAT STATION.

BRIEF OUTLINE OF WORK ALREADY DONE.

To summarize briefly, the work which has already been done in the utilization of surplus power, the first cooperative arrangement made by any of the power companies was brought about by the initiative of the owners of the Priestman Collieries, and resulted in the erection of the power station at Blaydon in 1905. At the present moment the three power companies have at work or in hand five waste-heat stations, three in connection with coke ovens, and two in connection with blast furnaces. Additional stations are under consideration.

To free any substantial quantity of gas for outside power users would involve therefore the substitution of gas engines for the existing steam blowers. Considerations of capital expenditure usually forbid this course, and had it not been for the genius of Mr. Parsons, whose exhaust steam-turbine provides another effective though less ambitious way of dealing with the situation the Cleveland furnaces could not be regarded by a power company as an immediately available source of energy.

In this connection, as capital outlay controls so completely the cost of electricity, and as exhaust steam turbines are so dependent on a high degree of vacuum for efficiency (at twenty-six inches they consume fifty per cent more steam than at twenty-nine), it is perhaps not always easy to justify the policy of installing small exhaust-steam turbines inland in conjunction with an intermittent supply of steam, such as that from a colliery winding engine, as this involves a cooling tower and a regenerator, with a consequent poor vacuum and high capital outlay.

The drawings (Figs. 4, 3, 6, 7) of typical waste-heat stations will, perhaps, be of interest. The Newport station, at Messrs. Samuelson's, and the Tees-bridge station are exhaust-steam stations, the Weardale station at Spennymoor is driven by coke-oven gas, while the Bankfoot station at Crook will derive its energy chiefly from waste heat from coke ovens. The Blaydon station also utilizes waste heat and gas from coke ovens.

The author is aware that it has lately become the fashion to argue that the resources of Great Britain have been developed on less scientific lines than those either of Germany or of America. He thinks, however, that the persons urging these views are in the majority of cases omitting to give full weight to local conditions. The fact that the connections to the local power companies' systems have recently been increasing at the rate of 20,000 horsepower per annum appears to him to prove fairly conclusively that manufacturers on the northeast coast are quick to avail themselves of new developments or of additional facilities.

Association of Car Lighting Engineers.

The Association of Car Lighting Engineers will hold its first annual convention in Chicago during the week of November 16. The opening session will be held on Monday morning at ten o'clock in the German Room of the Grand Pacific Hotel. The programme for this meeting includes addresses of welcome by city officials, followed with an informal talk by President A. J. Farrelly, and the secretary-treasurer's report, by G. B. Colegrove. Papers are to be read as follows: "History of Car Lighting," by P. Kennedy. "History of Axle Lighting," by W. L. Bliss. A paper on "Railway Train Lighting," which was read in Chicago on June 7, 1892, by A. H. Bauer, will be read by W. F. Bauer. The afternoon meeting will be given over to discussion of the topics of illumination and distribution of lights in cars, and the care and maintenance of storage batteries.

Tuesday morning will be taken up with the subjects of straight electric lighting of cars, and the head-end system, and in the afternoon lamps and axle-lighting will be discussed.

For the sessions of Wednesday the programme includes: "Straight Storage Lighting," "Organization and Systematizing of Work," and "Train Connectors and Wiring of Cars."

The convention banquet will be held Wednesday evening.

On Thursday morning at the closed meeting for active members the election of officers, selection of the next meeting place and other business will be transacted. In the evening an informal smoker will be held at the Grand Pacific Hotel. On Friday the car-lighting engineers will visit Milwaukee on a pleasure trip.

Meeting of the Chicago Electric Club.

The regular meeting of the Chicago Electric Club was held in the rooms of the Chicago Automobile Club on Wednesday, November 11, preceded by an informal luncheon at 12:15 o'clock. The guest and speaker was William Carroll, city electrician, who delivered an able address on the development of the Chicago lighting system, and made some interesting comparisons of the lighting system and those of other large cities. After the address several of the members present discussed the subject and asked a number of questions, which Mr. Carroll was pleased to answer.

Hudson River Water Power Bondholders' Committee.

A committee composed of F. J. Lisman, P. M. Chandler, of Chandler Brothers & Company, Philadelphia, and Arthur P. Stone, vice-president of the Commonwealth Trust Company of Boston, has been formed to represent the holders of the first mortgage five per cent bonds of the Hudson River Water Power Company, receivers for which were recently appointed. It is intended to increase the committee by representatives of the bondholders in Pittsburg and Canada. Bonds may be deposited with the Trust Company of America, New York, Commonwealth Trust Company of Boston, and the Real Estate Trust Company of Philadelphia.

Ohio Society of Engineers.

The annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held at Toledo, Ohio, November 20 and 21. Headquarters will be at the Secor Hotel. Among other papers to be read at this meeting will be "The Columbus Municipal Lighting Plant," by C. H. Gamper, Columbus; "The Laboratories of Electrical Engineering at Ohio State University," by Prof. F. C. Caldwell, Columbus; "Underground Heat Insulation of Steam and Hot-water Piping," by H. Gillett, Cleveland. David Gaehr has been appointed secretary to fill the unexpired term of W. B. Rowe, resigned.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

MONTREAL STREET-RAILWAY YEAR.

The Montreal Street Railway Company's full pamphlet report for the year ended September 30, 1908, has been issued. This shows a surplus, after interest and rentals, available for dividends amounting to $1,136,411, or 11.36 per cent, on the $10,000,000 capital stock. The general balance sheet of the company as of September 30, 1908, shows a surplus of $2,042,296, with total assets of $17,394,647.

Included in the report of the Montreal Street Railway Company is the report of the Montreal Park & Island Railway Company, owned by the former. The income account is as follows: Gross, $277,634; expenses, $181,488; net, $96,145; renewals, $25,000; net income, $71,145; charges, $129,224; deficit, $58,078, which compares with $69,849 for 1907.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER I. (PART VII.)—POWER IN ALTERNATING-CURRENT CIRCUITS.

CALCULATION OF POWER.

In a direct-current circuit the power can be calculated when the potential drop and the current are known, thus:

$$W = IE,$$

where E and I are, respectively, the effective values of the potential drop in volts and the current in amperes, W being the power in watts. On account of certain properties of the circuit the actual power delivered by an alternating-current generator is generally less than the apparent power or product of the electromotive force of the generator and the current flowing. Thus the power delivered by an alternating-current generator cannot always be determined by a voltmeter and an ammeter in the same manner as with direct currents.

WATTMETERS.

The wattmeter, which is therefore the most suitable means of measuring power in an alternating-current circuit, is in general a combined voltmeter and ammeter which multiplies simultaneous instantaneous values of current and voltage, and indicates or records the effective value of the result.

ALTERNATING-CURRENT POWER CURVES.

The power delivered by an alternating-current generator is illustrated in Fig. 17. Let the axis OX represent time as before, for example, the time axis of a sixty-cycle alternating current, in which case the distance OD represents one-sixtieth of a second. The OY axis represents amperes when considering the current curve OABCD, volts when considering the electromotive force curve OEBFD, and watts when considering the energy curve OMBND. The last curve is obtained from the other two by multiplying the instantaneous values of the current and electromotive force. Thus, the product of ES and AS is MS; of VW and UW, TW, and so on. The product of CP and FP, which are below the axis OX and represent negative quantities, gives the positive quantity NP. For this reason the curve representing watts lies entirely above the axis OX. This is what would be expected on first thought, for we consider the energy of a circuit as unidirectional. In this case the product of the reading of the alternating-current ammeter and that of the alternating-current voltmeter is equal to the reading of a wattmeter and is represented by the dotted line YY'. This is the case when the circuit is non-inductive, in other words, when the current and electromotive force are in phase with each other.

LAGGING CURRENT.

In an inductive circuit where the current is out of phase with the voltage it is

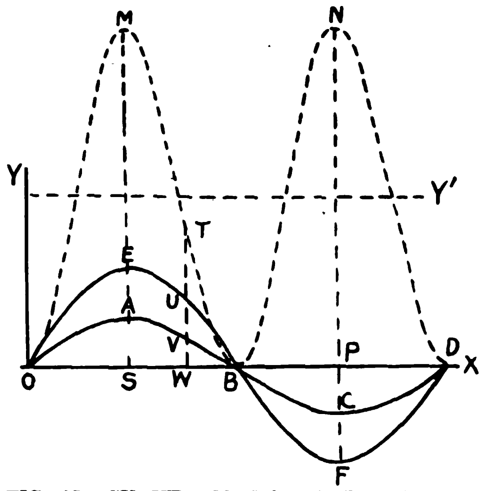


FIG. 17.—CURVES OF VOLTAGE, CURRENT AND POWER IN A CIRCUIT OF PURE RESISTANCE.

customary to speak of the current as lagging behind the electromotive force, the difference in phase being called the angle of lag. In the preceding case the angle of lag is zero, because the resistance is non-inductive. In Fig. 18, however, the angle of lag is forty-five degrees, as rep-

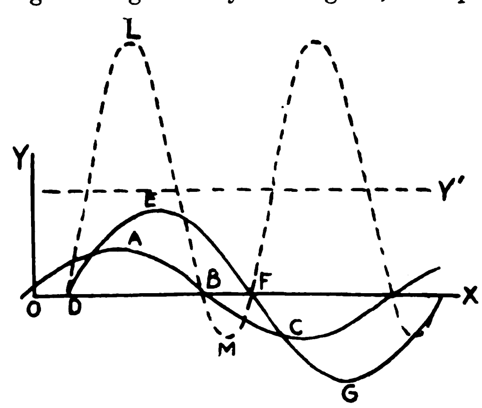


FIG. 18.—CURVES OF VOLTAGE, CURRENT AND POWER IN AN INDUCTIVE CIRCUIT OF 0.707 POWER-FACTOR.

resented by the length of the line OD. Let OABC represent the current, DEFG the electromotive force, and DLBM the energy. It is evident that these curves represent an inductive circuit. Although the current and electromotive force are drawn to the same scale as those in Fig. 17, it is will be noticed that the energy curve is not as large and the wattmeter reading represented by the height of YY' is not as great in the latter as in the former figure. Further, a part of the energy curve of Fig. 18 lies below the axis in this case. Those parts of the energy curve lying above the axis OX represent energy absorbed by the circuit to do work, while those below represent energy returned to the circuit.

POWER FACTOR.

It is an experimental fact that the energy available for use in an alternating-current circuit containing inductance is not the product of the voltmeter and ammeter reading, but is less, depending on the angle of lag. It is, in fact, equal to the product of the two by the cosine of the angle of lag, thus:

$$W = EI \cos \phi,$$

where ϕ is the angle of lag. In the case of Fig. 15, where ϕ is forty-five degrees,

$$W = 0.707\ EI.$$

In other words, the product of the ammeter and voltmeter reading, which is called the apparent watts, in this case bears the ratio of 1 to 0.707 to the reading of the wattmeter and shows the true watts. In general,

$$\frac{\text{True watts}}{\text{Apparent watts}} = \frac{EI \cos \phi}{EI} = \cos \phi.$$

$\cos \phi$ is called the power-factor. It may vary from zero to unity, being zero in the theoretical case of pure inductance in the circuit, and unity where there is no inductance, as is illustrated in Fig. 17, where ϕ is zero, hence $\cos \phi = 1$.

The practical meaning of the power-factor is that the actual power delivered to a receiving circuit is only that part of the apparent power which is represented by the fractional value of the power-factor; for example, if a 200-kilowatt generator is running at normal voltage and amperage on a circuit having a power-factor of 0.707, as above, only 141.4 kilowatts will be actually delivered, the remainder being represented by that part of the power curve below the line, which indicates the power stored in the magnetic field, like that stored in a coiled spring. It is returned to the circuit when the voltage drops to zero, just as the energy of the coiled spring is released when the tension of the spring is relieved.

[To be continued.]

Central Electric Railway Association.

The regular meeting of the Central Electric Railway Association will be held at the Lima House, Lima, Ohio, on Thursday, November 19. A number of guests from Ohio, Kentucky, Michigan and Indiana have signified their intention of being present.

The Central Electric Traffic Association will hold a meeting at the same place on November 18.

PROTECTION OF ELECTRICAL CIRCUITS FROM LIGHTNING.[1]

BY E. E. F. CREIGHTON.

The problem of the design of apparatus for the protection of electrical circuits has been entirely different from the problem affecting the design of other electrical apparatus. When we start at the factory to design a motor, generator, electric lamp or anything of that kind we know what conditions must be fulfilled; we know that we have a certain potential to produce; we want to burn so many lamps on a circuit or produce so many horsepower in motors. On the other hand, until very recently, lightning arresters were built to protect against an unknown condition on the circuit. It was well known that there were induced strokes on the circuit from the discharges of cloud, but the nature of the surges was unknown.

During the last three years very extensive measurements, starting first in the laboratory and then finally carrying the methods to the line have been made of the conditions of lightning existing on power circuits. The details of these tests are too extensive to take up in the short time at my disposal. A few brief statements of results only will be presented.

Last summer two of us spent considerable time at the Animas Power and Water Company in Colorado, where they have vicious storms practically every day during the lightning season. The frequency of cloud lightning was measured and was found to be in the neighborhood of about 1,000,000 cycles per second. The frequency of discharge from an idle line was also taken and found to be about 3,000 cycles. When power is on and an accident to an insulator happens there is a frequency of recurrence which is usually about the same as the alternations of the generators, say 120 times per second.

It is possible to predetermine the number of amperes of lightning current for every volt of abnormal potential on the line.

We have made no tests on direct strokes of lightning, because it is so very difficult to get them; they occur infrequently, and when they do occur it is best to be out of the way. Our tests were on induced strokes. Occasionally we found potentials momentarily on the line as high as many hundreds of thousands of volts, between 300,000 and 500,000 volts.

The next factor measured was the quantity of electricity in the stroke. That of course varies with every cloud and with the relative position of the cloud and the line.

The most important factor was the duration of the lightning stroke. The ordinary lightning stroke had a measured duration of about 1-100 of a second; the menace is not in the actual duration of the stroke, but in its recurrence. Numerous cases were recorded where a stroke of lightning would be followed by seven successive strokes within a second. This has been the cause of some of the failures of the multi-gap arresters.

There are many cases of high-potential surges on the line. For the present analysis these can be resolved into four conditions. The first is the direct stroke of lightning. A direct stroke of lightning very seldom hits a line; it hits a tree or a building somewhere near, and on the line there is simply an induced stroke. A direct stroke usually goes to ground within that distance. The best protection to a line that can be given against a direct stroke is to install an overhead ground wire and ground it frequently. The overhead ground wire is usually unnecessary in cities, because the same kind of protection will be given by the overhanging trees and buildings.

The second kind of a lightning stroke is the induced lightning stroke, which comes from the cloud being over the line and inducing a charge on the line. This is a problem which is quite easy to take care of and which is well taken care of at the present time by the multi-gap arrester. The multi-gap arrester in its latest improvement has four paths to ground, so that it can take care of lightning of wide ranges of frequency and quantity of electricity. The only condition in this category of lightning the multi-gap arrester cannot always take care of is that of severe multiple strokes already mentioned.

The third condition on the line, and it is the most important and the hardest one to take care of, is due to an accidentally grounded phase—for example, the breaking of an insulator so that the arc can play from the line to the pin, say, or from the line to a green branch, or from the line over the bushing of a transformer to the case which is grounded. These are the three conditions usually met.

Every time the arc jumps from the line to ground conductor, and it does it every half cycle as a rule, there is a surge set up on the other phases of the system which will tend to make them discharge through the internal windings, bushings or insulators. In so doing the surge will cause a short-circuit of the generator and an interrupted service.

It is hazardous to the internal insulation of the apparatus to allow these surges play over the system. The hazard varies greatly on different systems. On high-tension systems some apparatus is destroyed by such surges within a second. On other systems the accidental arcs have existed for hours without causing any visible damage. In this case if there is a multi-gap arrester on the circuit and its gap length is small enough to spark it will discharge during the first surge. It puts out its own dynamic arc at the end of the half cycle of the generator wave, but again the generator potential rises in the opposite direction and starts the accidental arc again; the surge is re-established on the circuit again and the multi-gap arrester discharges. Now, the multi-gap arrester cannot be designed to carry the current continuously at any reasonable commercial cost; consequently, under these continuous surges the multi-gap arrester must necessarily be destroyed. The only lightning arrester that can take care of continuous surges is the aluminum arrester. Of that I will speak later.

The fourth condition requiring protection is one that has come up recently. It seems to occur mostly on motor circuits—for example, in a large building fed by direct current, where electric motors for elevators and other purposes are operated. If the load on that building becomes so great that a fuse blows, then the circuit of the building is disconnected from the main circuit, with the meter on the isolated side. Sometimes the motor fields discharge and raise the potential to such a high value as to destroy the meter. It is evident that if a heavy current is flowing through a motor and the circuit is suddenly broken the conditions are exactly the same thing as in an induction coil. The value of voltage from the electromagnetic kick depends on how quickly the arc is broken and how quickly the magnetism changes. The protection for this surge of potential is a direct-current type aluminum arrester.

Recapitulating, four kinds of lightning

[1] An address delivered before the Ohio Electric Light Association at Put-in-Bay, August 26, 1908. The author is assistant professor in electrical engineering at Union University, Schenectady, N. Y. His investigation of lightning phenomena under the leadership of Dr. C. P. Steinmetz has attracted wide attention. While an abstract of this address appeared in a recent issue of the Electrical Review, the present treatment is more comprehensive and was revised by Mr. Creighton for the Western Electrician.

potentials or surges that have to be met are: First, a direct stroke of lightning; second, an induced stroke from a cloud; third, an accidentally grounded phase, and fourth, the inductive kick from a direct-current motor circuit.

Just a few words about the aluminum arrester and the principle of its action. There are two forms now on the market, one for alternating current and the other for direct current. The alternating-current aluminum arrester consists of a series of cells made up of inverted cones, one setting inside of the other and separated by small fiber washers. The space between these cones is about half filled with electrolyte of good conductivity, then the whole mass is immersed in a tank of oil. The oil acts beneficially in two ways; first, it insulates the parts not immersed in the electrolyte; and second, it cools the cell so that the arrester may operate for a long time. The arrester being made up of multiple cells, its characteristics are the same as the characteristics of a single cell. The number of cells in an arrester is found by dividing the voltage by 300 volts.

The characteristic action of an aluminum cell is very similar to a lead storage battery on a direct-current system. If a storage battery floats on a 600-volt system, say, the battery will take the current until the voltage per cell rises to about 2.2 or 2.5 volts. At that time the current in the battery is reduced to almost nil by the counter electromotive force. However, if the voltage on the circuit is carried above 600 volts, a heavy dynamic current will flow through the battery. The value of this current will be found by dividing the excess voltage by the internal resistance of the battery. If the resistance of the battery is one-half ohm, there will be two amperes of current for every volt above 600, but no current at 600 volts. Thus a storage battery on a direct-current circuit is one of the best kind of lightning arresters for discharging low-frequency surges because it holds back the dynamic current and allows only the excess voltage to discharge through it.

An aluminum arrester acts very similarly. The aluminum plate is carried through a chemical process by which a film of microscopic thickness is formed on the surface. It is shown on the surface as an iridescent color, or a slight whitish appearance. This film bears much the same relation to the circuit as the counter-electromotive force does in the battery. Take two cells on a 600-volt, direct-current circuit, for example, the leakage of current will be about 0.001 of an ampere, but for every volt of pressure above 600 the cells will allow current to flow through them equal to the excess voltage, divided by the resistance of the electrolyte. Since the resistance is about one-half ohm, you can see that means about two amperes for every volt excess. By the time double voltage is reached over 1,000 amperes are flowing through that cell.

The aluminum cell acts just like a safety valve on a steam boiler. At normal pressure there is practically no discharge, but at abnormal pressure the electric valves open up—there are myriads of them on the surface of this aluminum plate—allowing the electricity to flow through. In a direct-current cell the ratio of the current between normal potential and double potential is about 1,000,000; in other words, the current increases from 0.001 ampere to 1,000 amperes.

There is still one important precaution to take when making the installation of these arresters: Make the arrester circuit as short and of as low inductance as possible, or the arrester will be ineffective for very high frequency discharges.

In the alternating-current lightning arresters made for voltages from 2,300 to 110,000 volts, a gap is placed in series, in order to prevent the wearing of the plates by the constant action of the alternating current. The alternating current wears the plates very much more rapidly than the direct current.

These alternating-current lightning arresters are designed to carry a discharge continuously for half an hour. If an accidental ground, due to a broken insulator or other cause, takes place and sets up continual surges, it is estimated that in a half hour the trouble may be removed. This may be done, first, by switching to an auxiliary line; second, by sending a man out to the trouble; third, by putting a metallic ground connection to the affected phase. It is the arc between the phase wire and ground that causes the surges of potential. The phase that is grounded can usually be located by looking at the lightning arresters. Of the three phases, the gap that does not arc is connected to the wire upon which the trouble exists.

In conclusion I wish to state what has been accomplished with these lightning arresters. The cone lightning arrester has been in operation for a number of years. The most conclusive experience has been obtained by the installation on the Animas Power and Water Company's line in Colorado, where they have eleven aluminum arresters. During the month of July last year, they had about ten storms, and twenty-two interruptions of service. I cannot give you, offhand, exact figures, but only approximate. This year, with the arresters on the circuit at nearly every station, they had eighteen storms, and no interruptions of service. They had one interruption of service during the month, which occurred at a station where they had no protection. They have thirty stations to protect there, and they did not have time to get all the arresters in. This one interruption at that time cannot be attributed to the lightning arresters.

In conclusion, the state of lightning arresters, as now designed, is such that we can predetermine beforehand just exactly what the lightning arrester will do. The discharge rate is tested by applying dynamic voltage. The characteristics of the usual lightning discharge have been measured and the arresters given a large margin of safety to meet the requirement. The records of what an arrester will do are available, the same as for motors of standard make.

Electricity in Japan.

Vice-Consul E. G. Babbitt, of Yokohama, transmits an article from a local newspaper on the development of the electric industry of Japan from which the following resume has been made:

"The authorized capital of electric undertakings in 1903, 28,500,000 yen ($14,193,000), of which 24,000,000 yen ($11,952,000) was paid up, had risen to 138,000,000 yen ($68,724,000) in 1907, of which 87,500,000 yen ($43,575,000) was paid up. The electric works undertaken chiefly represented lighting and tramways. The number of lights supplied in 1903, 365,000, had increased in 1907 to 859,143. Tokyo and Osaka require each 100,000 lights. Electric tramways show equal development. In 1903 the mileage was thirty-eight, which rose to 119 in 1907, and will be largely added to by construction during the present year."

After reciting the foregoing progressive electric undertakings the newspaper article concludes as follows: "It is to be specially noted that while the works have been making steady progress not a few of the companies are in serious financial straits."

Electrical Notes from Great Britain.

[From our British Correspondent.]

Beyond all possibility of doubt, when reviewers come to sum up the electrical doings of 1908 in the United Kingdom, they will describe the Manchester Electrical Exhibition, just closing, as the most important event of the year. With the great masses of the industrial workers interested in the very extensive textile and engineering industries of the Manchester and Lancashire districts, the show has been extremely popular; indeed, on Saturday afternoons and evenings, when these have put aside their factory and works attire, the too-small gangways in the exhibition hall have been filled to overflowing by large numbers of such employes who are not only interested in, but are anxious to be instructed in, the applications of electric power to the classes of machinery with which they are in everyday touch. This point is emphasized because the power side of the exhibition is by a long way its strongest. With the stimulation that the last year or two has given to electrical installation work in textile factories, it is but natural that a number of exhibits of electrically-driven looms and other machines of the same class should be of particular interest to the mill employe. Other motor applications include a goodly number of machine tools electrically driven. In the matter of power plant of fair size, the exhibition is very satisfactory, for there are a number of turbo-generator examples, including the Musgrave-Zoelly, the Howden-Zoelly, and the British Thomson-Houston Curtis vertical and horizontal types; other prime movers present are a British Westinghouse gas engine (150 horsepower), a Diesel oil engine by Mirrlees, Bickerton & Day, and steam and gas-driven sets of various makes, including a Crossley suction gas plant and engines. An electrically-operated hammer, numerous motor-driven pumps, and many other things might be enumerated to emphasize the importance of the show as a demonstration of modern electric-power generation and utilization, were it necessary.

The exhibition has, however also been affording, not only the Manchester man, but also all electrical engineers and traders who have been going into Manchester from near and from far, an excellent opportunity for seeing an admirable and varied display of the newest forms of electric lamps. Owing to the lack of natural illumination in the hall, a splendid opportunity was given to all the lamp makers to give very lengthy displays. The names hardly require stating here, but all the usual and well-known incandescent, carbon, metallic-filament, flame, and other lamps are shown—some of them very attractively, and altogether a striking effect was produced.

The substation supplying energy for lighting the buildings and supplying the wants of power users in all parts of the hall, occupied a central position and was an open affair, so that the spectator might see the installation at work, taking the high-pressure, 6,500-volt, three-phase current from the Corporation Stuart Street generating station and reducing and converting it for a 230-volt lighting system, and to 400 to 500 volts direct current for power. A 700-kilowatt Westinghouse rotary converter and an 800-kilowatt, three-phase, static transformer for same; a 600-kilowatt Bruce-Peebles three-bearing-type motor-converter; a 500-kilowatt General Electric two-bearing-type, induction motor-generator (each set being arranged for three-wire balancing), were serving for direct-current purposes. For alternating-current service there were three Westinghouse static transformers.

It goes without saying that no such impressive and educational exhibition could be held in the heart of an industrial district with so many power-driven textile and other factories not yet changed over to electricity, or with such large numbers of the gas-using resident, without the business of electricity supply and of electrical machinery supply being greatly benefited.

That there is a need for benefit of this kind to be brought to some departments of the industry at the present time appears from various signs, including some remarks offered by Mark Robinson to shareholders of Willans & Robinson, Limited, turbine makers. The Rugby company, whose experiences leading up to the development of the Willans turbine business have already been related in the ELECTRICAL REVIEW, complains that the times are very difficult and that the future is hard to foresee. Demand is small, competition is great, profits are cut to the lowest point. The company's best customers were the municipalities, and these, said Mr. Robinson, were restricting their enterprises, partly in deference to a public feeling which was widely spread, but partly, also, as regarded electric lighting, owing to the introduction of the metallic-filament lamp, which used so much less current than the old carbon lamps. Reduced cost to the consumer would doubtless be followed by a great extension of electric lighting, when more plant than ever would be wanted, but "for the present there was an undoubted check" upon the steam-turbine manufacturing business.

Turning now to the speech of John Kerr to shareholders in Dick, Kerr & Co., Limited, one of the foremost and most successful electrical-plant manufacturers and tramway contracting concerns in the United Kingdom, we find some further observations concerning the prevailing state of things industrially. The keen competition of the past two years has, according to Mr. Kerr, become accentuated, and he cannot see much likelihood of it becoming less keen. In addition to severe trading competition, the financial crisis in America had had its effect all over the world, making investors hesitate to enter into new enterprises. Further, owing to the financial crisis and the high bank rate, municipal borrowing had been considerably restricted. This, in view of the fact that the company was largely dependent upon the municipalities for one particular branch of its business, had had a serious effect upon its turnover. As the result of all this the company was devoting most of its energies to developing colonial and foreign electrical business, and a very large proportion of the machinery then under course of manufacture at its works at Preston was for abroad.

Having felt the transportation pulse of one of its districts for a sufficient time by means of motor omnibuses, the Municipal Corporation of Wolverhampton has arrived at the conclusion that a tramway is warranted, and it is going to lay down the Lorain surface-contact system (Lea Road and Penn Fields District) at a cost of something over $100,000. Coming at a time when surface-contact traction is not having things by any means all its own way, this decision is at least noteworthy, though the Wolverhampton Corporation has all its existing lines equipped on the Lorain principle. Folkestone, Sandgate and Hythe are three contiguous attractive seaside resorts on the southeast coast which have been the scene of endless controversy as to systems of electric traction. The National Electric Construction Company is interested in the proposed scheme, and it is reported that it is wanting to change over from its original idea of using the Dolter surface-contact system and employ instead the overhead trolley. The company, as was announced some months ago, had to take out its Dolter track at Musselburgh and resort to overhead-trolley equipment. There may, however, be more difficulty in securing the necessary local sanction for overhead wires in such a district as Folkestone or in Sandgate. Earl Radnor, the lord of the manor, who is the owner of the greater part of Folkestone, has resisted most strenuously hitherto any attempt to introduce overhead wires for tramways. That seems to be the reason why these popular places have to be so long without sufficient transportation accommodation for the vast multitudes of visitors who find their way there for holidays in the course of a year.

The "C. B." surface-contact system is being employed for some miles of track at Lincoln, as already stated. It is now said that tramway extensions costing between $100,000 and $125,000 are to be taken in hand there.

The Liverpool City Council may shortly decide to run cars on an electric trackless-trolley system to Broad Green Road.

The last few weeks have witnessed the reopening of many of the engineering and scientific societies after the summer vacation. J. E. Darbishire opened up for discussion at the Institution of Mechanical Engineers, in London, a subject whose importance is becoming increasingly recognized in recent years, namely, the repairs, renewals, deterioration and depreciation of plant and machinery. He remarked that in the systematization of the management details of an engineering establishment which had been a feature of recent years, the method of dealing with the wear and tear, repair and renewal, and depreciation of plant and machinery had strangely escaped attention. There seemed to be as many different ways of treating the question as there were engineers or accountants.

The Association of Engineers-in-Charge, a useful society of practical men which has grown in popularity during the last year or two, opened on October 14 with an address on "Smoke" by its president, James Swinburne. On the same evening, at University College, Prof. J. A. Fleming delivered a lecture, introducing a special course on the scientific principles of radio-telegraphy and radio-telephony. The Physical Society of London commenced with a visit to the National Physical Laboratory to witness a series of demonstrations of work in progress there. On October 15, A. F. Bennett discoursed on "Steam Engineering Progress" before the Rugby Engineering Society, whose membership consists largely of members of the staff of the British Thomson-Houston Company and Willans & Robinson, at Rugby, and of which society he is this session's president.

The arrangements of the Institution of Electrical Engineers for London meetings are not yet announced, but the Manchester section has got to work, Miles Walker, the chairman, delivering his address on October 23.

The Cleveland and Durham Electric Power Company has agreed with the Waste Heat and Gas Electrical Generating Stations Company to operate power stations erected by the latter company, at the works of the Weardale Steel, Coal and Coke Company at Tudhoe, Spennymoor, and of Sir Bernard Samuelson & Co., Newport, Middlesborough. Arrangements have also been made for supplying four new rolling mills that are under construction in the Cleveland district. There is now 20,105 horsepower connected with the system, as compared with 9,172 horsepower a year ago. A further 8,850 horsepower will be connected up shortly. In referring to this company's business, it will be fitting to mention that on October 3 many mining engineers journeyed to the works of Ernest Scott & Mountain, Limited, at Gateshead, to inspect a large main and tail haulage plant which is to go into the Loftus mines of Pease & Partners, to be driven by three-phase current obtained from the Cleveland Power Company's mains. The haulage gear has two drums six feet in diameter and thirty-two inches wide, running loose on an 11-inch diameter shaft between two bearings; a third bearing carrying the outer end of a shaft supporting the large spur wheel which is keyed to the drum shaft and is driven through double-reduction gearing by a 350-horsepower slip-ring, three-phase motor, designed for 2,750 volts and forty cycles. It runs at 345 revolutions per minute, and the rope speed of the drums is nine miles per hour. A further 350-horsepower, three-phase motor is being put in to drive an existing haulage by rope gearing.

The London electric power question has again been engaging the attention of politicians at Westminster. A debate on the London and District Electricity Supply Bill, which received so much attention some months ago, and was awaiting the further deliberation of another parliamentary committee, took place on October 19, when, by a majority, it was decided to insert in the bill a clause granting purchase powers for the undertaking to the London County Council, who may thus, in course of time, become the electric-power-supply authority for not only London, but a good many other places outside it as well. There was stout resistance offered on behalf of London and outside municipal authorities who have their own generating and distributing systems already, but, as stated, the result was the declaration of a principle in favor of ultimate London County Council control. The bill has farther to go yet before it will be out of the wood, and probably when it has passed all parliamentary stages it may have its greatest difficulty in getting the public to subscribe the capital it requires, at a reasonable price and at a low rate of interest.

ALBERT H. BRIDGE.

London, October 28.

Alabama Lighting and Traction Association Formed.

About thirty representatives from various cities of Alabama met at Montgomery and formed the Alabama Lighting and Traction Association. The call was extended by A. H. Ford, president of the Birmingham Railway, Light and Power Company, who was elected temporary chairman of the association. The purpose of the association is set forth to be to benefit the electric, gas and traction properties of the state, and the meetings will be addressed by members and others on technical subjects of value to the association. At a meeting to be held within a month the permanent organization will be effected and officers elected. F. K. Jackson of Mobile was made temporary secretary and treasurer.

MODERN SUBSTATION APPARATUS.[1]

BY E. W. ALLEN.

It is the purpose of this paper to list several sizes of synchronous converters, synchronous and induction-motor-driven, low-voltage direct-current generators, and compare their relative advantages and disadvantages with the object of determining which of the three types is best suited to the conditions usually found in sub-stations supplying direct current to a 125-250-volt three-wire bus and receiving current, first from a 6,600-volt, three-phase, twenty-five-cycle generating station, and second, from a generating station having the same type of generators but a frequency of sixty cycles per second.

SYNCHRONOUS CONVERTERS.

The synchronous converters, or, as they are more commonly termed, rotary converters, are equipped with regulating poles capable of giving a range of from 240 to 300 in the direct-current voltage. This means of controlling the direct-current voltage is radically different from anything heretofore employed and represents the latest advance in the art of manufacturing this particular class of apparatus. In any synchronous converter the direct-current voltage has a definite value or ratio with respect to the alternating current voltage impressed upon the collector rings, which can be varied within certain limits by changing the width of the pole arc. The function of the regulating pole is to vary the width of this arc, and hence the ratio of alternating to direct-current electromotive force by assisting or opposing the flux in the main pole. In other respects the converters are similar to standard machines. Three-phase air-blast transformers have been used in compiling these figures. The primary windings are provided with four two-and-one-half per cent taps, and the secondary windings are so arranged that a connection can be made for the neutral of a three-wire system.

SYNCHRONOUS MOTOR-GENERATOR SETS.

The motor-generator sets consist of a synchronous motor mounted on a common base, with and direct-connected to a commutating-pole shunt-wound generator. The motors are designed to operate at eighty per cent leading power factor, so there is available in each machine, in addition to sufficient capacity to drive its generator at full output, a margin of sixty per cent of its rated capacity for phase control. An amortisseur winding is placed over the revolving field to assist in starting and to relieve any tendency on the part of the motor to pulsate. The field winding of the motor is designed for excitation at 125 volts, and if current at this voltage is not available, exciters should preferably be direct connected to the sets. Their cost, however, is not included in the prices listed, and the cost of the complete set with exciter is from four to six per cent greater than the figures given in the table. The current output of the generators is based on 275 volts, but they will commutate this current successfully at any voltage between 240 and 300 volts.

INDUCTION MOTOR-GENERATOR SETS.

The induction motor-generator sets are in general similar to the synchronous motor-generator sets. The rotors of the induction machines are equipped with a definite three-phase, star-connected winding, the open end of each phase being connected to a collector ring mounted on the end of the shaft. An external resistance is placed in series with this winding to limit the flow of current and increase the torque when the motor is started. This resistance is short-circuited in successive steps by means of a controller, the last step being short-circuited when the motor reaches full speed. The generators are duplicates of those forming part of the synchronous motor sets previously described.

COMPARATIVE VALUES.

The synchronous motor-generator set has been selected as a basis for the comparisons made in Table I. The values for the synchronous converters and induction motor sets are expressed in percentage of the corresponding values in the synchronous motor set. The sign preceding a figure denotes whether it should be added or subtracted from the figure given on the synchronous motor.

TABLE I—COMPARATIVE EFFICIENCIES, PRICES, FLOOR SPACE AND WEIGHTS.

	25 Cycles.			60 Cycles.		
K. W. Capacity.	Syn. Mot. Gen. Set.	Ind. Mot. Gen. Set.	Syn. Convtr.	Syn. Mot. Gen. Set.	Ind. Mot. Gen. Set.	Syn. Convtr.
EFFICIENCIES.						
300 Full Load	84	+2.4%	+ 6.5%	86¾	—1.4%	+2.2%
¾ "	82½	+2.1%	+ 7.6%	85	—2.0%	+2.1%
½ "	77	+4.0%	+12.3%	81¾	—2.7%	+1.0%
500 Full "	85½	+2.3%	+ 6.1%	87¾	—8.5%	+1.4%
¾ "	83¾	+2.1%	+ 7.7%	86	—1.1%	+1.2%
½ "	79½	+3.8%	+11.0%	83	—2.7%	....
1000 Full "	87½	+ .3%	+ 4.8%	87¾	— .3%	....
¾ "	86	+ .6%	+ 5.2%	86	— .6%	....
½ "	82½	+1.7%	+ 9.4%	83	— .3%	....
2000 Full "	88½	+ .6%	+ 4.5%	88½	— .3%	....
¾ "	86¾	+ .3%	+ 5.7%	86½	— .3%	....
½ "	82¾	+2.4%	+ 9.3%	83	— .3%	....
PRICE PER K. W.						
300	$26.17	+ .6%	— 4.0%	$25.75	+ .3%	—3.0%
500	24.70	—1.4%	—11.7%	23.20	+ .9%	—2.0%
1000	20.25	—3.0%	— .5%	19.45	+2.0%	....
2000	19.10	—2.0%	+10.0%	18.10	+5.0%	....
FLOOR SPACE.						
300	80	Same as Syn. Mot. Gen. Set.	+13.7%	67	Same as Syn. Mot. Gen. Set.	+43%
500	122		+ 8.3%	110		+36%
1000	136		+25.0%	140		
2000	440		— 8.4%	435		
WEIGHTS.						
300	50000	—2.0%	—36.0%	48000	—2.0%	—16.7%
500	68000	—4.4%	—30.0%	65000	—4.6%	—15.4%
1000	98000	—8.1%	— 5.0%	92000	—3.3%	
2000	215000	—7.0%	— 2.3%	212000	—1.4%	

EFFICIENCY.

An analysis of the figures given in Table I will show that the twenty-five and sixty-cycle synchronous converters are superior in efficiency at all loads to either type of motor-generator set, the difference being particularly marked at light load on the twenty-five-cycle machine. The brush friction and windage constitute a relatively larger proportion of the losses in the sixty-cycle converter, and its efficiency

[1] Abstract of a paper read before the Association of Edison Illuminating Companies, Lenox, Mass., September 15-17.

at light load only exceeds that of the motor-generator set by a small amount. The induction motor set is more efficient than the synchronous motor set at twenty-five cycles but less efficient at sixty cycles.

PRICE PER KILOWATT.

With the single exception of the 2,000-kilowatt, twenty-five-cycle unit, the synchronous converters are less expensive in both frequencies than the motor-generator sets. In the larger sizes the twenty-five cycle induction motor sets are less expensive than either of the synchronous machines. The high cost of the 300-kilowatt, twenty-five-cycle induction-motor set is due to the external starting devices which constitute a relatively large proportion of the cost of the motor. The sixty-cycle synchronous motor-generator sets are less expensive in all sizes than the induction machines listed at this frequency.

WEIGHTS.

The weight of the motor-generator sets is, owing to the high speed, slightly less than that of the synchronous converters, with its accessories, the induction motor weighing less in both frequencies than the synchronous-motor set.

RELIABILITY.

Advocates of the induction motor anticipate trouble from "hunting" of the synchronous machines, but the cause of this trouble is a condition of the line or system to which the synchronous machine is connected, and can usually be found and overcome. Wide fluctuation in the voltage of the alternating-current supply has also been assigned as a source of trouble with the synchronous machines, but there is no very good reason why such conditions should exist, as the regulation of the supply voltage can be controlled within narrow limits by the judicious use of an automatic voltage regulator arranged to control the excitation of the generators in the main station. The excellent protection afforded by the use of speed-limiting devices, reverse-current relays and circuit-breakers practically eliminates the possibility of damage due to runaways or overloads.

VOLTAGE REGULATION.

Voltage regulation over wide ranges is a matter of great importance in the class of sub-stations considered by this paper. Edison three-wire systems require a range in voltage of at least 240 to 275 volts, and in many cases a considerably higher voltage than the last-named figure is required for charging storage batteries. Excellent results have in the past been obtained from shunt-wound generators, but it has been found necessary to add a large amount of extra shunt field copper and magnetic material to secure good operation over this range in voltage. The addition of commutating poles has made it possible to operate high-speed generators with excellent commutation at voltages considerably below normal, but they do not assist materially in reaching the higher ranges. It is the usual practice to base the current output on the highest voltage, and it has not been practicable to obtain appreciably higher voltages, even though the output was kept constant by a reduction of the current in proportion to the increase in voltage. With the synchronous converter equipped with regulating poles it is possible to obtain a wide range in voltage without materially increasing the cost over that required to give a lower range.

The excitation of a regulating-pole converter can be controlled by means of an automatic regulator, and the direct-current voltage kept constant even with wide variations in the voltage of the alternating-current supply. The regulator may also be adjusted to hold a constant load on the converter and cause storage batteries or other machines to carry fluctuations in the load beyond a predetermined amount.

PHASE CONTROL.

The synchronous motor-generator set is the logical choice for installation on a system carrying a low-power-factor load, as extra capacity for improving the power factor can be furnished at a small increase in the first cost. For example, a 1,250-kilovolt-ampere motor will drive at full output a 1,000-kilowatt generator and in addition deliver to the line 750 kilovolt-amperes for improving the power factor.

METHOD OF STARTING.

Storage batteries are installed in the majority of lighting sub-stations, and direct-current starting is to be recommended in such cases for all three classes of machines. If direct current cannot be obtained from such a source, a failure of the alternating-current supply will cause a complete shutdown of the sub-station and require the starting of at least one unit from the alternating-current side, after which direct current will be available for starting the remaining units. All of the machines described in this paper are admirably adapted for starting from the alternating-current side. The resistance in the secondary circuits of the induction machines limits the flow of current at starting to a value considerably less than that required at full load. Synchronous motors are started by means of starting compensators connected between the motor terminals and the line. Synchronous converters can be started from one-third and two-thirds taps on the secondary of their transformers. When motors are started in this manner it is not necessary to synchronize them with the line; consequently the machines may be very quickly started from rest and placed under load. Alternating-current starting motors possess a number of disadvantages without offering any particular advantages over the methods of starting described above and their use is not recommended.

Electric Scrubber for Ships' Hulls.

Many devices have been invented to clean a ship's fouled bottom without the necessity for docking, and perhaps the most effective of these was the old-fashioned hogging brush with which the submerged parts of the hull were scrubbed, but difficulty was always experienced in applying sufficient force to the brushes, writes the English correspondent of the *Scientific American*. Electromagnets mounted on the brush battens hold the bristles firmly against the iron or steel hull of the ship while the "mat" or gang of brushes is being dragged over the surface. The brushes are set at an angle on the principal working battens, while other brushes set square precede the magnet poles, affording them a clean surface on the hull to which to adhere. The pole pieces are rocker-shaped, being arranged to cant the brushes to secure a flicking action against the accumulated matter. The current to excite the adhesion magnets is supplied either from the ship itself or a special tender lying alongside, and the entire mat is dragged back and forth across the bottom of the hull by a steam winch. A tractive effort of about 3,000 pounds is required to drag the mat against the resistance interposed by the marine material and friction at the pole pieces. The gear is very simple, and several men from the ship's crew can clean a 4,000-ton ship in eight hours at an expense of $100, including cost of labor, current and power. An 18,000-ton battleship can be cleaned in twelve hours, it is said, and vessels scrubbed by this method are found to be entirely free from marine growths when examined in dry dock.

Some Large Telephone Cables.

A number of large telephone cables were made recently by the well-known cable manufacturers, British Insulated & Helsby Cables, Ltd. Fig. 1 shows an 800-pair cable made of such a size that it can be drawn into a standard three-inch pipe. Several miles of this cable are in use by the National Telephone Company of England and various colonial and foreign administrations. The conductors weigh ten pounds per mile. Each is insulated by a single layer of manila paper, applied spirally; the longitudinal method of wrapping with a whipping of thread is only employed for wires of forty pounds per mile and upward.

In the earlier telephone cables, says *Electrical Engineering* (London), two layers of paper were almost invariably employed, but it is now found that the single layer is sufficiently strong mechanically, and that, owing to the tighter laying up of the wires that is necessary if the thickness is increased by the second layer of paper, and the fact that the specific inductive capacity of paper is higher than that of air, the cable with the single layer of paper on each wire has a lower capacity and is therefore better for telephonic purposes, in addition to being cheaper.

The paper-insulated wires are laid up into pairs and then stranded, the center core having five pairs and each successive layer six more pairs than the previous one. The lead sheath is 125 mils in thickness, bringing the outside diameter and the whole cable to 2.625 inches. An average wire-to-wire capacity of 0.07 microfarad per mile is obtained and a maximum of 0.08 microfarad per mile. This is extremely low when it is considered how close the wires must be packed to enable 1,600 of them to be contained in a 2⅝-inch lead tube. The cable is usually supplied in lengths of 150 to 200 yards; its weight is about twenty tons per mile.

In Fig. 2 there is shown a section of a composite telegraph and telephone cable of a type referred to by Mr. F. Tremain in an instructive paper read before the Newcastle Local Section of the Institution of Electrical Engineers. Considerable quantities of this cable are in use by the British Post Office on its underground routes.

The cable contains fifteen pairs of 150-pound twin conductors, seven quadruple pairs of eight conductors, each weighing 100 pounds per mile, six pairs of 100-pound conductors; twenty-two single "screened" conductors weighing 200 pounds per mile, for telegraph purposes, and forty-two single-screened seventy-pound conductors—162 wires in all.

The telephone wires in the pairs and "quads" are insulated with manila paper, applied longitudinally, and secured by a whipping of string. A similar longitudinal paper forms the first wrapping of the screened telegraph conductors, but in this case it is covered with three more paper wrappings, laid spirally. The first two of the spiral wrappings are laid on so as to leave a helical air space, and the third forms a closed helix. Over this is a wrapping of copper tape three mils thick and three-eighths inch wide, with a thirty per cent overlap. The copper screening is to prevent inductive action between neighboring wires.

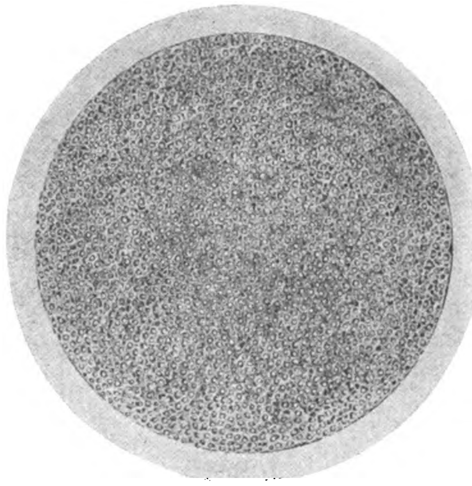


Fig. 1.—Eight-Hundred-Pair Lead-Covered Telephone Cable, Outside Diameter Two and One-quarter Inches.

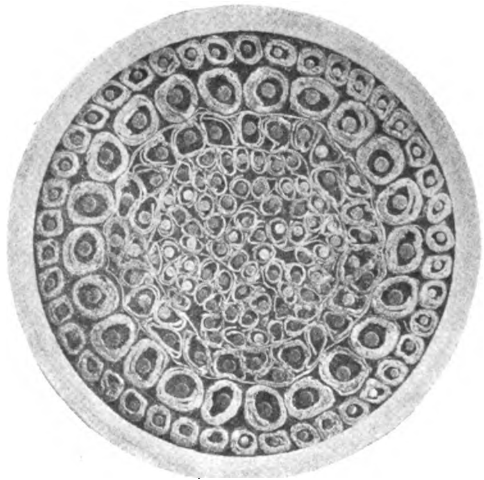


Fig. 2.—A Composite Telegraph and Telephone Cable Used by the British Post Office. Outside Diameter, Three and Three-quarter Inches.

The center core consists of one quad—four pairs of conductors laid round a jute core. Surrounding this are six more similar quadruple pairs. The interstices left between these six quads are filled up by the six ordinary pairs of 100-pound conductors as a "worming," making this layer circular. Over this comes a layer of twenty-two 200-pound single-screened conductors (each 350 mils diameter over all), and the outside layer is made up of the forty-two 70-pound single-screened conductors (each 225 mils diameter overall). The screened conductors have a capacity of about 0.125 microfarad per mile; the capacities of the seventy-pound and 200-pound conductors are practically the same, as the larger diameter of the latter is compensated by the greater distance between the wire and the screening. The 100-pound telephone conductors have an average wire-to-wire capacity of 0.08 microfarad per mile, and the 150-pound pairs 0.06 microfarad per mile.

It should be mentioned that the "wire-to wire" capacities quoted in this article represent the capacity between the two wires of a pair, assuming both to be insulated. The capacity of each wire, if its fellow is connected to the remaining wires and grounded, to form the second plate of the condenser, is, roughly, forty per cent higher.

As an additional precaution to prevent inductive effects between adjacent pairs of telephone wires, each of the four pairs of each quad is given a different "lay," varying from seven to twelve inches, and in laying up the pairs into the quadruple core a different lay, varying from twelve to eighteen inches, is taken in making each "quad." The lead sheathing is 160 mils thick, and the outside diameter over lead 3¾ inches, so that the cable can be drawn into a four-inch pipe. The cable weighs about thirty-four tons per mile, and is made in lengths of about 150 yards.

Annual Dinner of the Institution of Electrical Engineers of Great Britain.

On October 22 the Institution of Electrical Engineers of Great Britain held its annual dinner at the Hotel Cecil, London. About 400 members and guests filled the banquet hall to the utmost. The gathering was exceptionally brilliant, due to the presence of delegates from all the foremost nations of the world to the International Conference on Electrical Units and Standards and the International Electrotechnical Commission. Among the speakers were Hon. R. B. Haldane, Lord Alverstone, Prof. J. J. Thomson, Mr. G. Franklin, Prof. Sylvanus Thompson, Dr. E. Warburg, M. P. Boucheret, Dr. E. W. Stratton, Prof. G. Kapp and Mr. W. M. Mordey, president of the institution.

"Pioneer Work within the General Electric Company."

At Schenectady, October 29, about 400 members of the local section of the A. I. E. E. listened to a very interesting and instructive paper by Dr. E. W. Rice, Jr., vice-president of the General Electric Company, on "Pioneer Work within the General Electric Company." An abstract of his remarks is given below.

In introducing the speaker, the chairman, Mr. Ernest J. Berg, observed that at all times the names of four men will be conspicuous in the history of the Company—the founders, Prof. Elihu Thomson and Thomas A. Edison, for their researches and inventions, and to the same degree, the president, Mr. Coffin, whose executive ability is largely responsible for the prominent part the Company fills in the manufacturing world, and last, but, indeed, not the least, Dr. E. W. Rice, Jr., the speaker of the evening, who has been in a great measure responsible for the sound engineering and thorough manufacturing and business methods which have characterized even details.

Doctor Rice outlined the history of the organization from 1880 to 1885, and told how the present General Electric Company was formed by a consolidation of the Thomson-Houston and the Edison General Electric companies, each of which had resulted from the consolidation of a number of small companies. One of these, the American Electric Company, was formed to manufacture the electrical inventions of Profs. Elihu Thomson and Edwin J. Houston, of Philadelphia, and the speaker was connected with this company since its formation.

At that time the most prominent workers in the electrical field were Charles F. Brush, Edward Weston, Thomas A. Edison, William Hochausen and Hiram Maxim. Edison had just announced his invention of the incandescent lamp. In view of its low "light efficiency" (four watts per candle compared with one-half watt per candle in the case of the arc lamp), and especially on account of the large amount of copper necessary in 100-volt distribution, it was thought by those exploiting arc lighting that incandescent-lamp illumination would never be a formidable competitor of the arc lamp.

Excepting Edison, the rest of the inventors were working on arc lighting and had their own arc dynamos, lamps and "systems." The lamps were divided into two classes, one known as the "long arc" and the other as the "short arc." Brush was the exponent of the long-arc system, Weston of the short arc. In 1880 Brush had already succeeded in producing an arc dynamo capable of operating sixteen arc lamps on one circuit. These lamps consumed about ten "Webers" (amperes) at forty-five volts, whereas the current consumed by the "short arc" was from eighteen to twenty amperes at thirty volts. Since with the latter type a large percentage of the light came from the incandescent carbon and not from the arc itself, it is evident that the efficiency of the "short arc" was not favorable compared with that of the "long arc." The Brush machine can be considered as the prototype of the modern two-phase machine, whereas the Thomson-Houston machine was practically the present three-phase machine. In each type, of course, the coils were connected to commutator segments instead of to collector rings.

Professor Thomson invented many forms of arc lamps, but the type finally selected and sold in the early days was the "differential," which had series and shunt windings placed on separate magnets in distinction to the Brush lamp, where the series and shunt windings were on the same core.

Even in those days Professor Thomson realized that it was essential to work for high efficiency, and that therefore no artificial load should be used for the sake of regulation. The dynamo must be so made that the lamps would be stable and satisfactory, independent of the number in circuit. To accomplish this result he invented a very ingenious automatic regulator, and designed his machine in such a way that the armature reaction was very great compared with the magnetization of the field.

The first arc machine built at New Britain in 1880 was capable of operating four arc lamps, these lamps using about ten amperes at fifty-five volts. After that a number of larger machines were built and no serious difficulties were met with until it was attempted to operate from sixteen to twenty lamps from one commutator, an operation which was commercially necessary since the Brush machine operated with that number of lights.

After building a successful machine with two commutators Professor Thomson decided that this was too complicated and started serious work to overcome the flashing due to the greater lead. At the time of this effort he invented an ingenious blower arrangement which injected a stream of cool air between the brush and the leaving segment. By this expedient the machine operated quite as satisfactorily with twenty lamps as formerly with ten. The machine was commercial in every way and operated even with as many as fifty and sixty arc lamps from a single commutator.

The Paris Congress, which met in 1881, adopted the "C. G. S." system and confirmed the use of the electrical units "volt" and "ohm." It also gave the name of "ampere" to the unit of current, which had previously been known as the "Weber." The ampere meter, or ammeter, was not known until some time in 1882 or 1883. Professor Thomson constructed, about 1880, an instrument on the lines of the Deprez galvanometer, which on account of its mechanical construction was usually referred to as the "herring-bone" galvanometer. The instrument was calibrated by the silver and copper voltameter method.

Insulated copper wire could be bought at that time, but the quality and uniformity of cross section was not such as to insure uniformity of resistance. Double cotton-covered wire was not used until several years later.

Transmission circuits up to 1882 were of bare copper wire, and it was customary to fasten these copper wires to partitions and rafters by means of ordinary iron staples. It was considered quite an advance when porcelain insulators first were employed. Insulated wires were considered a real extravagance and only used after demanded by the underwriters of the mutual fire insurance companies of New England.

While it was known that dynamo-electric machines were reversible no regular commercial application of the principle was made until several years later. The pattern shop of the American Electric Company was, however, operated in 1880 by a five-light arc dynamo used as a motor and the current to operate this motor was furnished by an arc-light series dynamo driven from the main engine.

The efficiency of the electrical apparatus was considered of quite as much importance in those days as now, and Professor Thomson devised an ingenious method to determine the losses. He realized in 1880 quite fully the principles governing the distribution of magnetic flux in iron, although there were, of course, at the time no standard saturation curves or permeability curves available. It was perfectly well understood that the electromotive force of a dynamo was proportionate to the speed, the number of turns in the armature and the amount of magnetic flux.

It was recognized that the iron core of an armature traversed by an alternating magnetic flux was subject to Foucault or eddy currents, and precautions were taken to use oxidized iron and frequently insulated layers of iron wire in the armature structure. Laminated iron was not introduced until later.

About 1883 to 1884 arc-light circuits had been extended enough to attract the attention of lightning and a few burn-outs of lamps were experienced. This disturbed the commercial staff of the Company, but Professor Thomson had soon devised a scheme to protect apparatus against lightning. In connection with his work on various kinds of lightning arresters he invented the "magnetic blowout."

Professor Thomson had early realized the importance of alternating current, and indeed had built a self-exciting alternator in 1879. He saw the inherent possibilities of the transformer, which at that time was called an induction coil, but he did not immediately push its use, since he felt that there would always be a certain danger if the low-potential winding were accidentally connected to the high-potential side. To overcome this he invented the grounding shield and advised a grounded secondary system. A number of patents on alternating-current distribution by transformers were issued to him about that time.

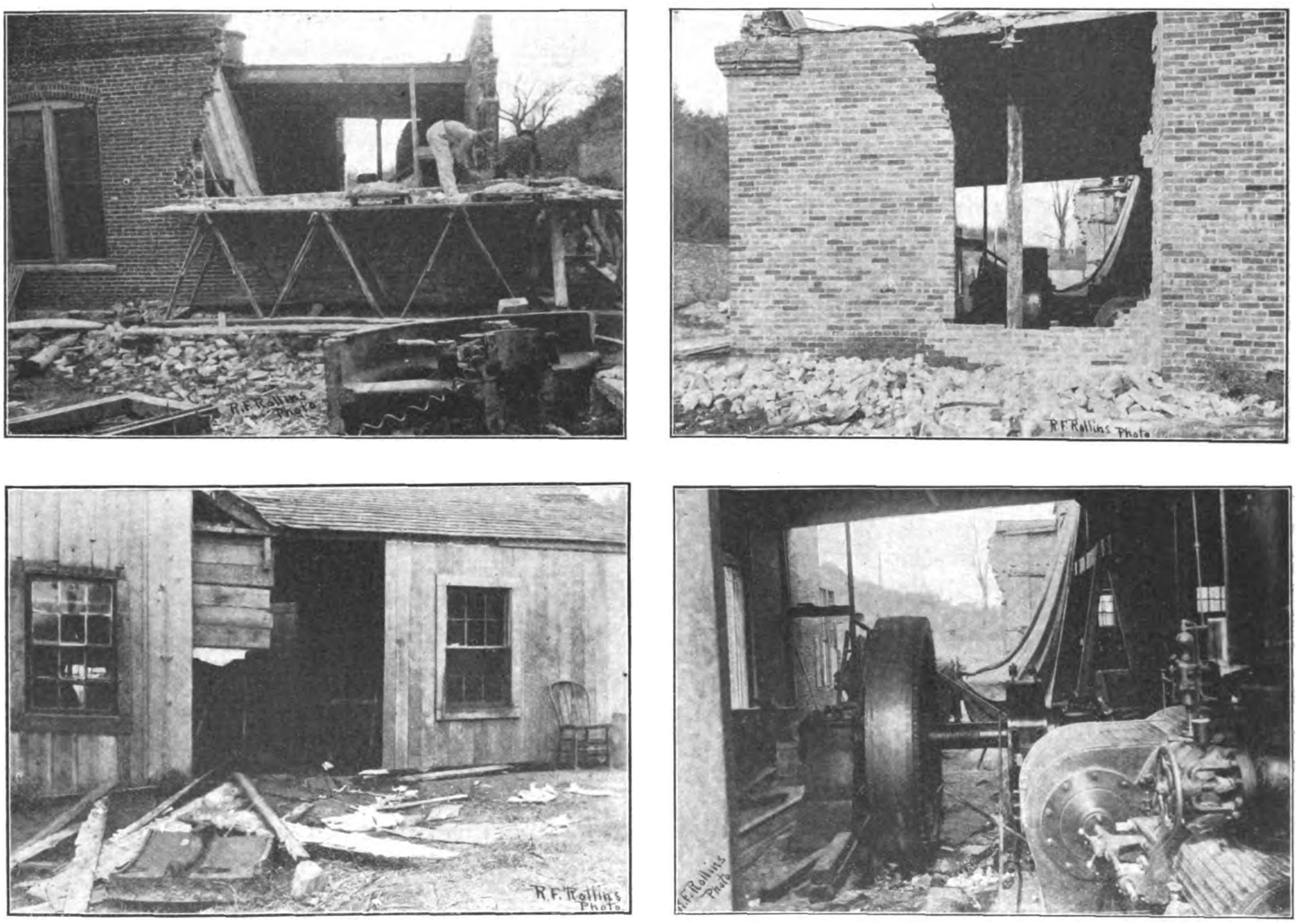
It was while experimenting with electric welding that he invented the so-called repulsion motor, which only within the last few years has been commercially appreciated and now promises to be a formidable alternating-current competitor to the direct-current motor for railway work.

Doctor Rice's paper was discussed by W. S. Andrews, who gave some very interesting information about the early developments in the Edison Company, and by Doctor Steinmetz, who told about the developments in the Eichmeyer Company and the Thomson-Houston Company at Lynn, Mass.

An Electric-Plant Flywheel Accident.

Several weeks ago the big flywheel at the plant of the Keokuk Electric Railway and Power Company, Keokuk, Iowa, burst asunder, partially destroying the building and working a great deal of other destruction. The accident effected the complete isolation of the city as far as the electric lighting was concerned, and was responsible for one sad result, the death of the night engineer. The illustrations herewith are published because of their interest as showing the extent of the damage caused by an accident of this nature. Masses of iron, some of them weighing 1,200 pounds, were carried a distance of 400 feet, and great holes were torn in the north and south walls of the power plant. Inside the station a considerable confusion of machinery resulted.

In the group picture herewith, the one in the upper left-hand corner shows the north end of the power house, with a part of the broken wheel lying in the foreground. The picture alongside shows the south end of the power house. The others show some of the contributory damage.



VIEWS SHOWING THE DAMAGE CAUSED BY THE BURSTING OF A RUNAWAY FLYWHEEL.

THE CONSTRUCTION AND MEASUREMENT OF HIGH RESISTANCE.[1]

By Howard L. Bronson.

The study of the passage of electricity through gases and its application to the measurement of the phenomena of radioactivity has required us to extend our field of accurate electrical measurements. During the past ten years we have become very familiar with the fact that X-rays, ultra-violet light and many substances, such as uranium, radium and thorium ionize the gas in their immediate vicinity —that is, the gas becomes electrically conducting. If the gas between two parallel plates is subjected to a constant source of ionization and one plate is connected to the positive pole of a battery, the other pole of which is to earth and the other plate is connected to an electrometer, then the electrometer will receive a positive charge, showing that an electric current is passing between the two plates. The magnitude of these ionization currents varies from 1-1,000,000,000,000,000 ampere up to currents which can be measured with a sensitive galvanometer. The accurate measurement of the smallest of these currents is by no means an easy task, but the problem is much complicated by the fact that in a large part of radio-active measurements the active matter, and, therefore, the current, is not constant, but continually changes, and sometimes very rapidly. For example, the emanation from thorium decays to half value in little less than one minute. Thus, if we have in a testing vessel a current of 1-100,000,000 ampere, due entirely to thorium emanation and suddenly cut off the emanation, the current will fall to 1-1,000 of its value in ten minutes.

The problem, as presented, is to get an instantaneaus measurement of very small currents. The apparatus must, at the same time, be capable of a considerable range of measurement without serious readjustment. The purpose of this paper is to describe a method which theoretically fulfills these requirements, and which, for many kinds of radio-active measurements, the writer has found to give better results practically than the methods in more common use. It will be seen that this method depends entirely on our ability to make and measure resistances which are sufficiently large and at the same time constant.

As far as the writer is aware, all the older methods for the measurement of these very small currents involve the direct measurement of the change of potential of some system of known capacity. The electroscope is probably the most sensitive instrument for this purpose, as it can be made with a capacity as small as one electrostatic unit, and a change of potential of five volts per hour can be measured. The electrometer, while not quite so sensitive, can measure currents over a much wider range by the introduction of external capacity into the system. A subdivided condenser is very convenient for this purpose.

The use of either of these instruments for the accurate measurement of currents involves many difficulties. The chief difficulty in their use for certain radio-active measurements is that a single observation requires considerable time, during which the current may have changed very greatly. Among the other difficulties may be mentioned:

(1) Changes in the sensitiveness of the instruments.

(2) Lag of the electrometer or gold leaf behind the changing potential, unless its rate of change is very slow.

(3) The accurate measurement of small capacities which have to be redetermined every time a new testing vessel is used.

(4) The long time necessary for the measurement of the natural leak.

In fact, we can say that this method is practically impossible for rapidly changing currents and that it is in all cases inconveniently slow.

The principle of the "constant deflection method," which is described below, is very simple and was first suggested by Rutherford. If one pair of quadrants of an electrometer is connected to earth, Fig. 1, and the other pair is not only connected to the testing vessel, but also to earth, through a very high resistance, it is easily seen that any current in the testing vessel will charge the quadrants until the discharge current through the high resistance is equal to the current in the testing vessel. (This latter current is not diminished by the rise of potential of the quadrants, because the voltage on the testing vessel is always high enough to produce practical saturation.) In this case the current is proportional to the potential on the quadrants—that is, to the deflection of the needle. If the sensitiveness of the electrometer and the actual value of the high resistances are known, then we have at once an absolute measure of the ionization current in the testing vessel. Further, by placing some form of potentiometer between the standard high resistance and the earth, the range over which we can measure currents can be made very large.

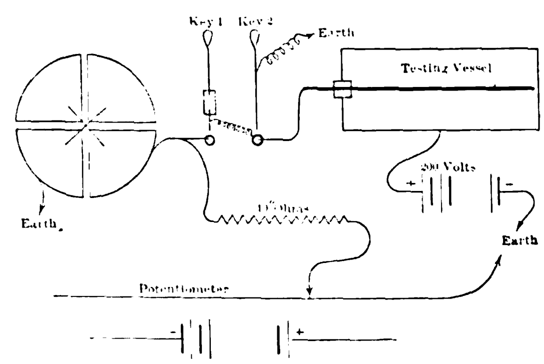


FIG. 1.—MEASUREMENT OF HIGH RESISTANCES.

The advantages of this method are obvious; deflections are independent of the capacity, and testing vessels may, therefore, be interchanged without error, measurements can be made over a wide range without difficulty, and observations can be taken instantaneously and in as rapid succession as desirable.

This method has also several practical advantages. In the rate methods, if the current due to the natural ionization and the conduction across the insulators is small, then it takes a long time to measure it; if it is large, then it may become a considerable fraction of the current to be measured and reduces the accuracy of the measurement. In the constant deflection method, small currents are as quickly measured as large ones, and a considerable amount of insulation leakage introduces no considerable error in the results. When desirable this can be practically eliminated by keeping the electrometer quadrants at zero by means of a potentiometer. By referring to Fig. 1 it will be seen that there are two keys between the testing ves-

[1] A condensation, in part, of a paper on "The Construction and Accurate Measurement of Resistances of the Order of One Hundred Thousand Megohms," presented before the meeting of the American Electrochemical Society at Albany, N. Y., April 30, 1908, by the author, a member of the faculty of McGill University, Montreal.

sel and the electrometer. When both keys are closed the testing vessel and the electrometer quadrants are connected to earth: when key 2 is open the earth connection is broken and the testing vessel is connected to the electrometer; when key 1 is open the electrometer is disconnected from the testing vessel, but remains connected to earth through the high-resistance standard. The reading obtained in this way is the true zero and eliminates certain contact potential differences which have always been found to exist in all very high-resistance standards. This zero can be checked at any time during the course of an experiment. Before any active material is placed in the testing vessel the natural leak is obtained by taking a reading with key 2 open and substracting from this the true zero. This reading is just as quickly taken as any other, and it is evident that its magnitude practically does not affect the accuracy of the measurement to be made with this vessel. It can thus be seen that the method is simpler, more accurate and better suited for nearly all kinds of ionization measurements than the older methods.

The problem then resolves itself into finding out how to make and preserve permanent high resistances of the order of 100,000,000,000 ohms. The great difficulty in doing this is probably the reason that this method has not come into more general use. Very early in the study of this subject it was found possible to get such resistances as large as the above by means of fine carbon lines on ebonite or ground glass, or by means of amyl alcohol or zylol in long capillary tubes. Measurements of ionization currents with these resistances as standards compared favorably with those obtained by the rate methods. There was always, however, considerable variation and uncertainty in all these resistances. The carbon line seemed to have practically its entire resistance at one point and to be merely a

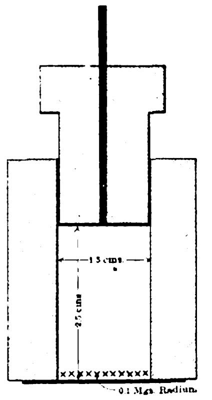


FIG. 2.—STANDARD TESTING VESSEL FOR MEASURING HIGH RESISTANCE.

case of bad contact, which was bound to be very uncertain and subject to all kinds of external conditions. The liquid resistances have very large temperature coefficients and seemed to be subject to a variable polarization. In both classes of resistances there was necessarily present a considerable amount of insulating or dielectric material. The absorption due to this is a function both of the time and temperature. Its effect is to make the apparent resistance less for a time. It may continue for some hours, and is necessarily a very uncertain factor.

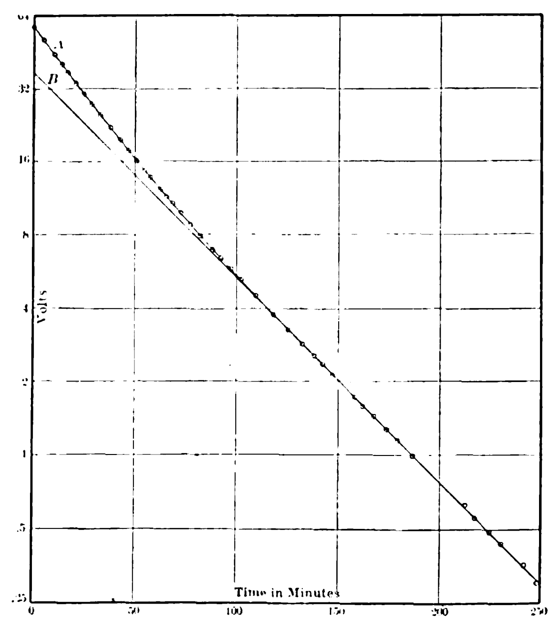


FIG. 3.—MEASUREMENT OF HIGH RESISTANCE.

All of these high resistances proved so satisfactory that Professor Rutherford suggested the possibility of using an ionized gas for this purpose. He had previously shown that the ionization current, through a gas subject to a constant source of ionization, was approximately proportional to the potential difference between the plates when this potential was small. The writer has used this principle successfully for the past three years and is satisfied that it gives as accurate results as any of the rate methods. It is also much less troublesome when it is once arranged and is adapted to measurements for which the other methods are unsuited.

The standard testing vessel, as it is called, has gone through quite an evolution during the past three years. The one at present in use is shown in Fig. 2. The shaded portion is ebonite, the electrodes are of aluminum, and the active material consists of about a tenth of a milligram of radium bromide. In general, the relation between the ionization current in such a vessel and the potential difference between the plates is not linear, but depends upon the nature of the active material used, the kind and amount of insulation and the distance between the plates. However, it is generally possible so to adjust the distance between the plates that a linear relation will exist for a considerable range of potential. Nevertheless, it is necessary to get a calibration curve for every such vessel. This can only be done by some form of the rate method which must ultimately be the basis of all such measurements. However, in the case of a calibration curve the rate method is used under the most advantageous conditions.

Even under these favorable conditions there are many difficulties which are not easily overcome. This is not surprising when it is remembered that the standard testing vessel has a resistance from ten to 100 times as great as the values usually given for the resistance of condensers. In calibrating the standard the condenser is put in place of the testing vessel of Fig. 1 and the system is charged through the standard vessel.

In order to eliminate as far as possible any leakage from the electrometer and condenser the average potential during the time of charging is kept above zero and the total change of potential of the system is never more than 0.2 volt. The error due to absorption by the ebonite of the standard is not very large and can be largely eliminated by applying the potential to the standard a few minutes before taking a measurement. In order to calibrate the standard over a considerable range of voltage, for example, from 100 to 0.1 volt, and at the same time not have too great a change in the rate of movement of the electrometer needle. It is necessary to change the capacity of the system. The accurate comparison of these capacities offers the greatest difficulty to the calibration. The writer used a subdivided mica condenser, the sections having capacities from 0.5 to 0.001 microfarad. Several methods used in calibrating this condenser gave very concordant results for the larger sections, but gave values for the smaller sections which differed in some cases by more than ten per cent from one another. There is the added difficulty in the use of these small capacities that the potential on the standard is also small. Thus, with one volt on the standard a change of 0.2 volt in the potential of the quadrants will change the potential on the standard by twenty per cent.

If we have some radio-active material whose rate of decay has been accurately determined, we can use this rate of decay as a means of calibration. The active deposit from actinum is probably the best substance for this purpose, as its rate of decay has been carefully determined by a number of observers and their results agree very well. The following are some of the best values of the time taken for it to decay to half-value:

Godlewski	36 minutes
Meyer and Schweidler	35.8 minutes
Hahn and Lochur	36.4 minutes
Debeirne	36 minutes

If we take 36 minutes as the mean value it cannot be far from the truth.

In Fig. 3, curve *A* represents the logarithmic decay curve of the active deposit of actinum, as measured by one of the standard vessels. The ordinates represent time in minutes and the abscisse the lag of the voltages on the standard. The straight line *B* represents the relative value of the ionization current at the different times, on the assumption that the active matter decayed to half-value in thirty minutes. If the current through the standard vessel were proportional to the potential difference between its plates, then curve *A* would coincide with *B*. It is evident, from the figure, that the potential increases more rapidly than the current; that is, the apparent resistance of the standard begins to increase when its voltage rises above five volts. The ratio of the abscissæ of curves *A* and *B* at any time is a measure of the resistance of the standard vessel for that voltage. If we thus compare the resistance at twenty, forty and sixty volts, we find that their ratio to be 1 : 1.16 : 1.28. In order to verify these values the actual current through the standard for the voltages was measured by the condenser and rate method. The actual resistances were found to be 0.971×10^{11}, 1.14×10 and 1.25×10^{11}. The ratio of these resistances is 1 :1.17 : 1.28. We thus see that the two methods agree when fairly large voltages and capacities can be used. For the smaller currents the use of a decaying radio-active substance is much the best method.

The results given in this paper would suggest the possibility of making of standard vessels similar to the one here described, and preserving them as permanent high-resistance standards. They would have a much higher resistance than any standards with which the writer is acquainted and ought to remain constant over a long period. They would be found very useful for insulation testing or any very high-resistance measurements.

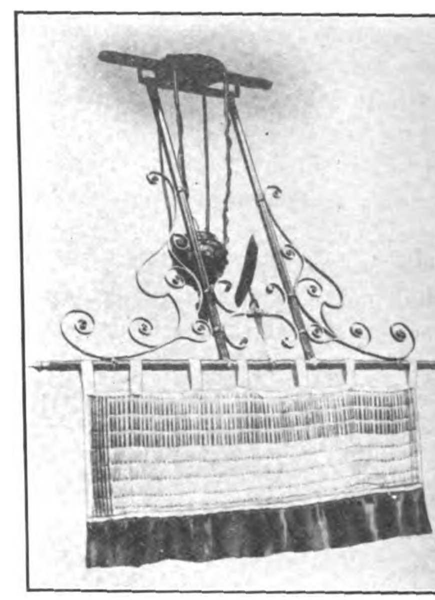
Since writing the above a paper by G. W. Stewart on "A Satisfactory Form of High Resistance" appeared in the April number of the Physical Review. The resistances with which he experimented were not over three megohms, and the results which he obtained with these, such as constancy for all voltages and permanency, would not necessarily apply to resistances 100 times as large, even if similarly constructed. The writer's experience has been that all the difficulties increase very rapidly as the resistances are made larger.

A Motor-Driven Punkah.

The punkah wallah is known to every traveler in the East, and has frequently been described in the literature concerning the eastern peoples. The punkah is considered indispensable in the torrid climate, both as a means of securing a draft of air and in keeping insects from disturbing the sleeper. The native servant continually jerks the rope connected with a swinging curtain which hangs from the ceiling. Frequently the native dozes, and the sleeper is then disturbed.

An electrically-driven punkah has been invented, and although this is not the first of its kind, it is said to give satisfaction because it substitutes for the peculiar jerk which is given by the native, and in which the previously-devised mechanically-driven punkahs were lacking, a similar mechanical movement. The satisfactory service which the hand-worked punkah gives is due to a turn of the fan that the native effects by jerking the rope at each turn. In order to obtain a flick of the curtain similar to that given to the hand-worked fans, the inventors of the new electrically-driven punkah have devised an ingenious piece of mechanism.

A horizontal spindle is made to revolve by an electric motor, and against this spindle there is pressed by means of a spring, a leather-covered, lath-shaped piece attached to the fan. The motion of the spindle makes the attachment move over as far as the length of its surface, and the impetus carries the attachment and the punkah a considerable distance from the spindle. As soon as the lath-shaped attachment comes back to the revolving spindle in the return swing, an extra impetus is suddenly imparted to the swing of the punkah, which gives the requisite flick.



ELECTRIC PUNKAH.

Long-Distance Submarine Telephony.

According to an English newspaper, telephone communication has been opened up between Genoa, Italy, and Buenos Ayres in South America over the submarine cable system connecting them. The preliminary tests are said to be a successful demonstration of an invention by Captain Anzalone, an officer of the Italian army. After working for some time in France, he made a number of trials of submarine telephony across the Straits of Messina. The secret of his method is not disclosed, but its success is strongly asserted.

Electrical Smelting of Iron.

To the Editor of the Electrical Review:

I note your remarks in editorial of August 15, re my estimate of cost of production of pig iron at the plant of the Noble Electric Steel Company at Heroult, Cal. In order to show how conservative the estimate is I will explain some of the details.

The figure of $1.75 per ton for iron ore is quite reasonable, for the mine is only two miles back of the smelter and is open quarry. The limestone is also open cut and $1 is ample for its cost. The andesite is even closer.

The figure of $10 per ton for charcoal is very high, for we have a plant installed to conserve the by-products, and the manager of the by-products says that he can deliver the charcoal to the smelter at no cost to the smelter.

The figure of 0.31 kilowatt-year per ton of iron produced was based on the run of a small furnace in which the losses were inordinately high and which only ran for ten days. The energy for heating up the furnace is quite an appreciable percentage of the total current used, when such a short period is taken account of. A furnace of about two tons capacity per diem has been run for thirty-five days and shows that the energy can be kept to 0.31 kilowatt-year without any trouble if the furnace is kept running at all continuously.

The labor cost figures high, for operations are done by hand in a small furnace which would be done mechanically in a large furnace. Two furnaces of this size could just as well be run with the same amount of labor.

Eliminating the charcoal would make a price of $9.65, and adding the $2.50 per ton for incidentals would give $12.15. Figuring in two furnaces would reduce the figure to $11.20. Thus it seems to me that my estimate of $16.14 per ton is well within reason. That this cost of production is commercial is due to the fact that pig iron is worth $28 per ton on the Pacific Coast. With a freight rate of $2 per ton to San Francisco, it seems as if $25 per ton f. o. b. Heroult is practicable.

As to size of units it is my opinion that as soon as a fifteen-ton furnace using 1,500 kilowatts can be operated commercially that larger furnaces using larger blocks of power will be put into operation. With the advent of the larger units will come mechanical power feeding and other labor-saving devices, which will tend to keep the cost of production to a point at which the electrical furnace can be entirely successful in the localities adapted to its use.

C. F. Elwell,
Electrical Engineer for Noble Electric Steel Company.

San Francisco, Cal., October 24, 1908.

The Windmill as a Prime Mover.

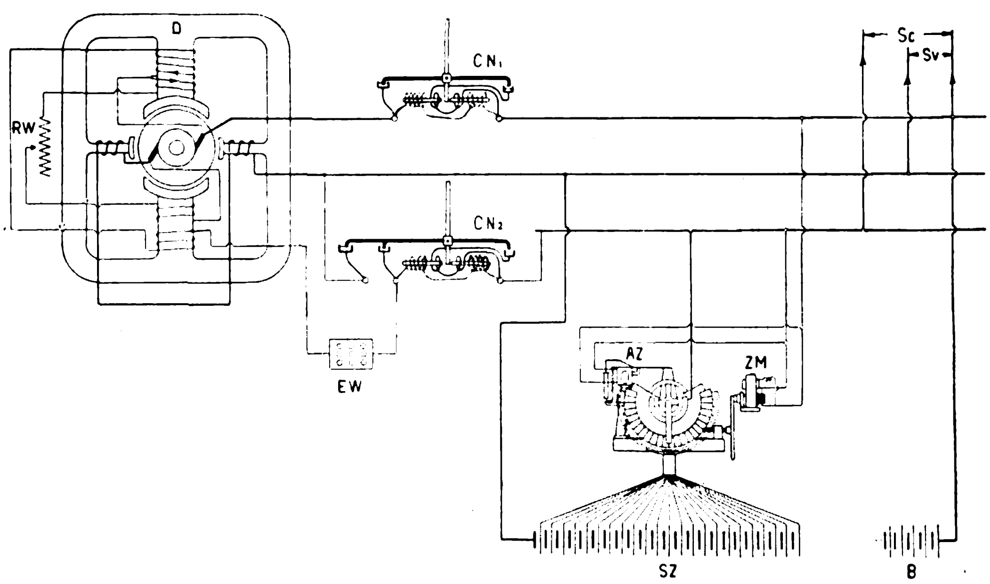
The advantage of utilizing the force of the wind lies in the fact, that this source of power does not cost anything and the upkeep is very low. As the output of a windmill plant is naturally small, the electric current can be used for lighting, agricultural purposes, or other small industries. For such consumption, it would probably not pay to install a private or isolated plant run by some other source of energy, and right here it must be borne in mind that the smaller the plant, the greater the comparative cost of attendance, and because the windmill runs intermittently, the generator outfit must operate automatically.

The vanes of the sweeps or wheels must be so arranged, that they can accommodate themselves to the pressure of the wind, and the other everyday features found in air motors are the same as used for operating pumps, churns, etc.

The ordinary equipment would be a direct-current dynamo, a storage battery and two automatic regulators. By means of the latter, the storage battery is maintained at its normal voltage and capacity. The excitation of the generator is controlled automatically. During operation, the storage battery is fed by the generator, except when there is a demand for power, and it is then used to assist the generator.

After the storage battery becomes fully charged it is automatically cut out, until needed, when it is thrown on the line. When there is no load and the battery is out, the generator is free to run idle.

In certain sections of the country, the period of calm covers about ten per cent of the year, and in order to have a reserve supply, a benzine motor may be advantageously installed as an emergency power source. Several such installations have been successful in operation for some time. The accompanying illustration shows the wiring diagram of units from three to thirty horsepower capacity, with automatic regulating devices as installed by the Oerlikon Company of Switzerland. The references are as follows: D, dynamo; R W, field rheostat; C N_1 and C N_2, automatic switches, combined system of Thury and La Cour; E W, rheostat; A Z, automatic cell switch; Z M, motor for cell switch; S Z, end cells; B, storage battery; Sv, variable pressure mains; Sc, constant pressure mains.



THE WINDMILL AS A PRIME MOVER—DIAGRAM OF CIRCUIT CONNECTIONS.

The American Trade Press Association.

At the annual meeting of the American Trade Press Association, held in New York city on November 6, the following officers were elected for the ensuing year: President, Franklin Webster, *Insurance Press;* first vice-president, W. H. Boardman, *Railroad Gazette;* second vice-president, John C. Oswald, *American Printer;* third vice-president, H. M. Swetland, *The Automobile;* secretary-treasurer, L. J. Montgomery; all of New York, N. Y. E. C. Brown, *Progressive Age,* New York, N. Y., was elected a director to serve four years.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

AIRSHIPS AND WIRELESS TELEGRAPHY.

Wireless telegraphy tests have been made between the balloon Condor, which ascended in the neighborhood of Brussels, and a station erected in the tower of the Brussels Palace of Justice. Morse signals sent from the Eiffel Tower, in Paris, were also clearly received by the balloon. That the German Airship Battalion has made extensive experiments with wireless telegraphy has been already recorded. The apparatus used were furnished by the Telefunken Gesellschaft. Several years ago Professor Hergesell of Strassburg, made some telemechanical experiments with unmanned registering balloons. Attached to the same were small receiving stations which, upon the arrival of the electric waves, actuated a valve and caused the balloons to fall. Each balloon was attuned to a certain wave-length. Thus, it was possible for the vessel, from which the balloons were sent up, to bring down any one of them at will, while the others remained in the air. The experiment was successful up to a distance of ten nautical miles, and wireless communication between flying balloons and land stations was at that time already considered possible. But at the airship trials this year it was feared that, if wireless apparatus were taken on board, sparks might be generated, which would cause serious consequences by exploding the gas. However, recently it seems to have become possible to remove this danger and to guarantee a safe wireless communication between balloons.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), October 22.*

SOME NOTES ON TWENTY-FIVE-VOLT WIRING.

While the twenty-five or fifty-volt metal-filament lamp has not yet come into extensive use, it has a decided advantage over the more common 110-volt tungsten and tantalum lamps on account of its thicker and shorter and therefore more rugged filament for the same candlepower. This feature, combined with the fact that the low-voltage lamps can be run at a higher efficiency, will repay the cost of a small loss in the transformer. In rewiring a building or in designing a new installation four kinds of transformers may be used. To compare their relative advantages it is desirable to assume a maximum load of 1,000 watts on the secondary, i. e., twenty-five volts and forty amperes, the primary voltage being 200. The first type considered is a single-coil transformer with seven uniformly-spaced taps, which, in conjunction with the outside wires, lead to eight equally-loaded, twenty-five-volt branch circuits. The no-load and full-load losses would each be about two per cent and the maximum transformer loss occurs when only half the circuits are loaded, the loss being then five and three-fourths per cent. Voltage regulation is perfect at any balanced load. At half load the voltage drop is greatest (about one per cent). Although each circuit is twenty-five volts, there may be 200 volts between different circuit wires, which must be provided for in the layout of the panel-boards and distributing system. On account of the difficulty of dividing the circuits evenly, the balancer transformer just described is not so convenient as the auto-transformer, which has only one twenty-five-volt circuit. In this case the losses would range from two to nearly five per cent from no load to full load and the greatest voltage variation would be three and three-fourths per cent. If wired up without special care, there may be 200 volts between the lamp-circuit wires and ground. Where a simpler and cheaper wiring system is desired, which will at the same time be entirely independent of the primary circuit, a regular double-coil transformer with twenty-five-volt secondary is necessary. These advantages are so valuable that they may outweigh the increased cost and losses of the transformer as well as its poorer regulation. An additional and very marked advantage of this transformer is that it permits the use of concentric wiring with grounded outside metallic return. This wiring should be the cheapest form of wiring, it is said, because it saves half the insulated wire, half the fuses, and secures absolute immunity from shock or leakage currents. By using a three-wire secondary the cost and losses of the transformer are diminished, each circuit consisting of a three-conductor tube with two insulated wires in a metallic tube acting as the neutral or grounded return. The lights are connected between the tube and one of the insulated wires. This system has the advantages of fifty-volt distribution with the desirable feature that no part of the secondary circuits is more than twenty-five volts above ground. Either of these concentric wires if made of flexible tubing is regarded as the final solution of the cheap-wiring problem. They are safe, easily fixed, inconspicuous, not easily damaged, and at the same time the cheapest to install. Some slight modifications of existing wiring rules may be necessary to carry this system out. For private lighting plants where storage batteries are used, the twenty-five-volt system enables the number of batteries to be reduced, thus reducing both initial and maintenance costs. Wiring lamps in series, to enable twenty-five-volt units to be used, is increasing, especially for wiring up chandeliers and lamp clusters, which can be readily changed from parallel to series-wiring. By using specially shunted lamps for such fixtures, the breakage of one lamp does not interfere with the remainder of the series.—*Abstracted from Electrical Engineering (London), October 29.*

UTILIZATION OF COKE DUST FOR THE PRODUCTION OF POWER GAS.

An advance is to be recorded in the utilization of cheap refuse fuel. The production of coke in smelters and gas works is attended by a loss of three to ten per cent in the form of dust, which in Germany amounts to about 700,000 tons a year. The smoke chamber refuse of locomotives, which amounts to about 200,000 tons a year in Germany, also belongs in this class of refuse fuel. The price obtained for the same, if at all salable, is about eighteen marks for ten tons. Finally there is a large quantity of anthracite dust produced at the mines. All this fuel material which so far could be burned only with difficulty and incompletely on account of the formation of slag, can now be utilized in the new Nuremberg fine-coal generator, which has been put on the market by the Maschinen Fabrik Augsburg-Nuernberg after several years of experimentation, with perfect ease, economy and reliability of operation. A seventy-two-hour test was made with one of these generators and a 200-horsepower gas engine under widely varying loads. The average fuel consumption was only 0.63 kilogramme per horsepower-hour under a small load, including all losses, firing-up and cleaning. This corresponds to an hourly fuel cost of only 0.1 to 0.4 pfennig (one-quarter to one cent) per horsepower. A new source of power of extraordinary economy has thus been created by these generators, primarily for such industries as coal and anthracite mines, gas works and railway power stations, which may themselves use this low-priced fuel. The municipal gas works of Munich and Berlin have already been induced by these economic advantages to furnish their new power stations with coke-dust power equipments of 800 to 1,000 horsepower each, which will be installed by the above firm.—*Translated and abstracted from the Journal fuer Gasbeleuchtung (Munich), October 17.*

THE FORMATION OF NITRIC OXIDE IN THE HIGH-TENSION ARC.

Professors F. Haber and A. Koenig here give some results of their investigations of this subject. In a previous article they endeavored to demonstrate that while the formation of nitric oxide in high-tension arcs can be conducted so that it is a purely thermal phenomenon, this procedure is not at all commendable theoretically. Their method of operation was, therefore, in a direction opposite to that followed formerly. In old experiments an effort was made to heat the gaseous conducting space to the highest possible temperature and then to cool it as rapidly as possible, while they attempted to cool the gaseous conducting space during the passage of the current, so that an extremely high temperature did not exist at all. At an extremely high temperature the primary electrical effects are masked by the accompanying thermal manifestations. With the method of operation employed these manifestations did not take place. The experiments were carried out with nitrogen-oxygen mixtures, but although relatively good results were obtained, they were too far removed from the quantitative transformation of nitrogen and oxygen into nitric oxide. The supposition was expressed, that it might be a question here of an electric equilibrium, which supposition the authors have confirmed by further experiments. Identical results are obtained when starting with nitric oxide as when starting with nitrogen-oxygen mixtures. The results are dependent upon the conditions of the electrical experiment. Thus the same stationary condition is reached from both directions. This condition has been named the electric equilibrium, as distinguished from the thermal equilibrium. While the position of the thermal equilibrium of the three gases, nitrogen, oxygen and nitric oxide, is distinguished only by effects of temperature and mass, the authors define the electric equilibrium as one for which, in stationary condition, a certain expenditure of electrical energy in a unit of time is also required, the amount depending on the extent of the deviation from the thermal condition of equilibrium. If we indicate by K_t the constant of equilibrium, in the ordinary sense, thus

$$K_t = \frac{(NO)}{(N_2)^{1/2}\,(O_2)^{1/2}}$$

and designate by $K_e = \dfrac{(NO')}{(N_2')^{1/2}\,(O_2')^{1/2}}$ the relation of combination upon the expenditure of a certain amount of electrical energy, dependent on the conditions of the experiment, then under the assumption of equal temperature in both cases the performance will be $R\,T\ln\dfrac{K_e}{K_t}$, a measure of the displacement of the electrical equilibrium with reference to the nitric oxide molecule. Evidently K_e may be smaller as well as larger than K_t, in the proportion as the thrust of the ions benefits the formation or decomposition of the nitric oxide. If the latter should be the case, one would have to endeavor to cover the electrical by the thermal effects. But if the opposite is the case—and this is the view of Professors Haber and Koenig—then the thermal effects must be repressed in order to allow the electrical effects to predominate. The relation of the thermal to the electrical effects depends on the rapidity with which the (formation and) decomposition of nitric oxide at the temperature of the experiment takes place in a non-electrical way. Two extreme cases offer themselves for consideration. When dealing with a temperature region in which the rapidity of (formation and) decomposition of the nitric oxide is practically zero, then the position of the electric equilibrium indicated by the constant K_e will entirely depend on the measure with which the electron thrust affects the formation and decomposition of nitric oxide. If, on the other hand, we are in a temperature region, in which the nitric oxide decomposes with extreme rapidity, then there cannot be any appreciable difference between the electrical and thermal equilibrium, that is, between the constants K_e and K_t, because every electrically produced increase of nitric oxide will disappear instantly again. It follows from this, that the thermal can be repressed in favor of the electrical effects only when the operation is carried on in temperature regions, in which the rapidity of decomposition of nitric oxide is still comparatively small. The authors have proved by experiments, that under the conditions of operation employed by them the nitric oxide is indeed decomposed with measurable slowness in the conducting path; this fact forming an essential basis for their former result, which was arrived at by calculation, that in their cooled high-tension arc the temperature of 3,000 degrees Centigrade is not reached. The farther we descend with the temperature, the more we are insured against the thermal decomposition of nitric oxide. But it seems, according to all that may be learned from technical literature in this respect, that the expenditure of electrical work for the production of gas ionization increases considerably by thrust, if we descend with the temperature below white heat. There must thus be a most favorable temperature region, which is defined above by the rapidity of decomposition of the nitric oxide, and below by the high ionizing effects. The authors then describe their experiments undertaken for the purpose of determining this "most favorable region," giving tables of the results obtained, and conclude: "The most important result of this work is, that the unusually high proportion of nearly ten per cent of nitric oxide was obtained, when air was used, and fourteen and one-half per cent from mixtures of nitrogen and oxygen in equal parts, and this at temperatures in the discharge gap at most in the hundreds, but not thousands of degrees above the fusion point of platinum—that is, in a temperature region in which the decomposition of nitric acid was still comparatively slow. The electrical character of the nitric oxide equilibrium observed by us in the high-tension arc thus appears to be demonstrated."—*Translated and abstracted from Zeitschrift fuer Elektrochemie (Halle), October 9.*

INDUSTRIAL SECTION

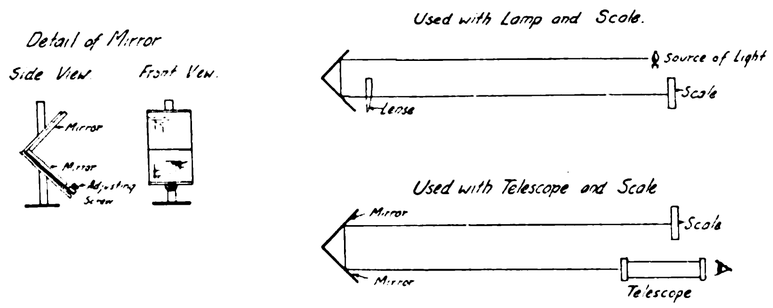
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Anti-Vibration Device for D'Arsonval Galvanometers.

In many places, such as factories, shops and laboratories, where galvanometers are used, the shaking is so great that it produces vibrations of the coil that make an accurate scale reading impossible. These vibrations are of two classes; those about the vertical axis of the coil, and those about the horizontal axis. The first are quickly damped by the current itself, but the latter must be stopped mechanically. Up to this time practically the only satisfactory remedy for this trouble has been in the expensive Julius suspension, which is hung from the ceiling, and supports the whole galvanometer.

In contrast to this large and cumbersome affair is the small attachment recently brought out by the Leeds & Northrup Company, of Philadelphia. This device consists of a small, light framework weighing about 0.4 gramme, which is fixed rigidly to the moving system of the galvanometer. By means of this, the horizontal vibrations are quickly damped.

As an adjunct to this, to be used where the vibrations are unusually severe, there has been devised a new form of reflecting mirror, as illustrated herewith. This absolutely eliminates to the eye, any oscillations about the horizontal axis that the coil may take on. In fact, the system may be tilted backward and forward, or the arm and scale raised and lowered several inches, without disturbing the scale image in the telescope.



ANTI-VIBRATION DEVICE FOR D'ARSONVAL GALVANOMETERS.

These anti-vibration devices may be attached to any galvanometer with a suspension of four inches or over, and are suitable for use with a telescope or a lamp and scale.

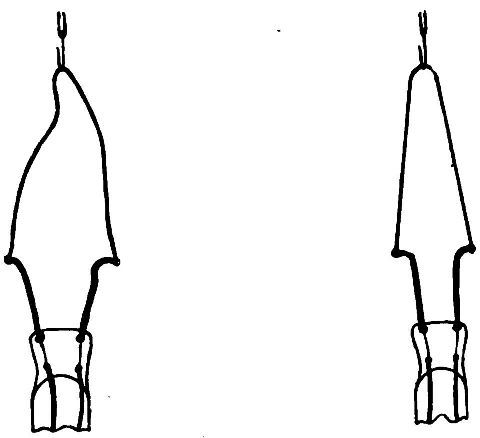
Severe Lightning Test on Tungsten Street Lamps at Hackettstown, N. J.

During a severe lightning storm in Hackettstown last July, the series incandescent line was struck, the discharge passing through thirty-three series tungsten lamps. The filaments were slightly curled as is shown by the illustration, but the lamps did not burn out. On investigation it was found that the film cut-outs in the sockets were punctured, and when new films were installed, the lamps lighted up again, the tungsten lamps withstanding the shock without breaking. It is doubtful whether a carbon-filament lamp would have withstood this severe shock. This same stroke of lightning burned out three transformers, then jumped to a private house, ripping off a door sill, and passed into the ground through a steam radiator, knocking unconscious a woman who was standing nearby.

The following extract of a letter from Mr. P. Louis Smith, superintendent of the Hackettstown Electric Light Company, regarding the occurrence, is of interest:

"You will note the twisting of the filament of the first sample I sent you, also the second sample which we found a few days later, the filament still intact, only loose from the anchor. This lamp was at the end of a loop about 500 feet long, branching from our main street to a side street. The lightning here was so severe that it struck our lines in four or five places, thus following our wires in several directions at the same moment. The top of one transformer was thrown 200 feet from where it hung on a pole, and the second sample street lamp I sent you was on the next pole to this particular transformer—another severe test.

"We have 123 tungsten lamps on our street circuit, thirty-three were put out temporarily because of the mica disc taking care of the shock. When new discs were installed the lamps burned all right. The lamps have burned to date (August 18) about 150 hours since they were twisted by the lightning, making a total of about 1,400 hours since their installation. We are very pleased with these results.



TUNGSTEN FILAMENTS AFTER LIGHTNING DISCHARGE.

"Last year we had a severe lightning storm here and it burned out fifteen carbon lamps and melted the sockets completely. Thus our change has almost been paid for in obtaining such good results from the new sockets and lamps."

A New Type of Reflector Distribution.

The new "intensive" type Holophane high-efficiency reflector, recently designed for tungsten lamps, introduces an entirely new type of light distribution.

The primary purpose for which this reflector was designed is that of illuminating evenly a large surface by means of distributed units placed in the form of squares. This system is used commonly in department stores, restaurants, hotels and club lobbies, large offices, assembly rooms, halls of moderate dimensions, council chambers, court rooms, etc., where the lights are hung above the plane of illumination.

When distributed units are employed, the lighting problems are all essentially the same, variations being due to architectural restrictions and the quantity of illumination desired. The point always at issue is to secure uniformity of illumination. While this problem was solved more successfully by the original bowl-type Holophane reflectors designed for Gem lamps than by any other equipment in the market, it was felt that an improvement should be made.

In designing the intensive type of reflector, a typical installation was planned,

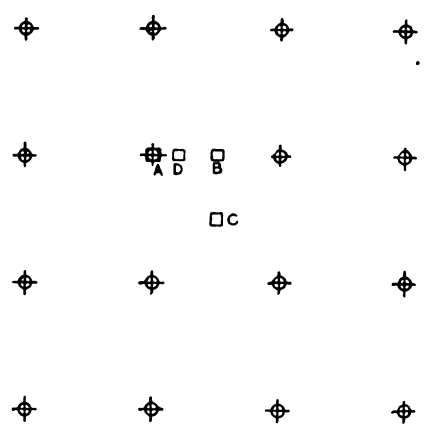


FIG. 1.—TYPICAL PLAN OF DISTRIBUTED UNIT SYSTEM.

as indicated in Fig. 1, in which the circle-cross symbol represents the lights (which may extend indefinitely in any direction), and the square symbols, points which would represent an average of the entire space illuminated.

By patient and exhaustive calculation there was determined a photometric curve which gives the same illumination at all

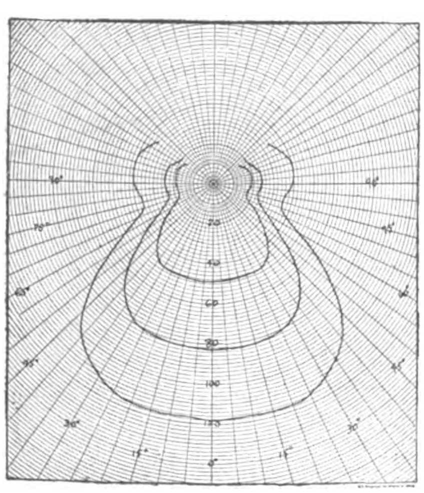


FIG. 2.—CHARACTERISTIC PHOTOMETRIC CURVES OF INTENSIVE REFLECTORS, THE VALUES INDICATED BEING APPROXIMATE ONLY.

these points, taking into consideration all the units in the installation. This curve (Fig. 2) is the basis of the intensive reflector, which not only gives even illumination in such service, but it gives approximately such a result despite reasonable variations in placement; that is to say, where architectural limitations preclude placing the lights at exactly the proper distances apart in proportion to their height from the floor, such moderate variation in placing will not appreciably affect the uniformity of illumination.

The successful use of this reflector does not call for any considerable knowledge of illuminating engineering. The desired light intensity in foot-candles having been determined, one employs the "lumens-per-watt" method of approximating the wattage required in a given room. This simple method was devised by Messrs. Cravath and Lansingh and presented by them before the Illuminating Engineering Society's recent convention at Philadelphia. With the required wattage known, it is only a matter of dividing this amount by the wattage of the tungsten lamps when it is desired to ascertain the number of lamps required in the installation. These lamps, equipped with proper size Holophane intensive reflectors, are installed as nearly as possible in the form of squares, their height above the plane of illumination being four-fifths of their distance apart. The distribution of the intensive Holophane reflector is so carefully calculated that anyone following the above simple rules cannot well avoid securing satisfactory results.

A Compound for Repairing Iron and Steel.

Great expense is incurred in replacing machinery parts, engine cylinders, castings, radiators, boilers, and other iron and steel objects which have become useless because of cracks, spongy spots, sand holes or blow holes, and which could be saved were it possible to repair defects in the metal. Under the name "Leak-No Metallic Compound" the H. W. Johns-Manville Company, New York, has placed on the market a compound resembling powdered iron. When mixed with water, and applied like putty to defects in iron or steel articles, the manufacturers claim that it metallizes and becomes a permanent part of the article to which it is applied. In color it very much resembles iron when hard.

The manufacturers evince their faith in this material by offering to refund the purchase price in case it fails to stop an ordinary leak in anything made of iron or steel against any pressure of oil, steam, gas, air, ammonia or water, and to stand any heat or chemicals that iron will stand, when applied according to directions. This it considers is a liberal offer, and enables anybody to test this material without expense, if it does not make good.

Useful Properties of Logarithmic Paper.

A useful form of co-ordinate paper for plotting curves, in which the variable occurs in some power other than the first, is the so-called logarithmic cross-section paper whose divisions are proportional to the logarithms of the numbers expressing the distances to the origin instead of being proportional to the numbers themselves, as in the case of the ordinary equi-spaced rectangular co-ordinates. The rulings of the logarithmic scale are disposed similarly to the divisions of a slide rule, and, indeed, the ordinary slide-rule operations can be performed by the use of two sheets of logarithmic paper properly placed.

The peculiar and useful feature of paper divided according to the logarithmic scale is the property by which curves of any exponential degree become straight lines when plotted to this scale. Thus, it becomes possible to locate any two points on a curve, and with a straight-edge to draw in the curve at once without determining any intermediate positions. On logarithmic paper the parabola, for instance, becomes a pair of straight lines of definite slope arranged as a V with the vertex at the origin.

Absolute or empirical formulæ involving integral or fractional exponents may be quickly plotted after determining any two points, and from the line representing the curve any certain values may be obtained by reference to the co-ordinates.

A logarithmic paper which has the advantage of a graduation from ten to 10,000 has been placed upon the market by Mr. J. Norman Jensen, a civil engineer, 797 N. Leavitt Street, Chicago. The diagram is ten inches square and comprises, in fact, four complete logarithmic sheets. Among the more common uses to which this paper may be put with advantage, may be enumerated the following calculations: Powers and roots of any and all indices; bending moment, shearing stress or deflection of beams in terms of span or load; moments of inertia and radii of gyration in terms of a linear dimension; circumferences and diameter of circles in terms of their radii or diameter; sizes of tie bars, struts, shafts, etc., in terms of linear dimension or inverse, etc., etc.

The diagram is printed in a neutral tint, permitting of ready photo reproduction and blue printing. The paper is of good quality bond, which may be roughly handled and on which erasers may be used, and is thin enough to admit of blue printing readily.

A New Lamp-Testing Wattmeter.

A practical demonstration of the high efficiency of the new metallic-filament incandescent lamps will often aid in their introduction, particularly with prospective customers to whom seeing is believing. All that is necessary to make such a test is a simple indicator that will show the relative watt consumption of metallic and carbon-filament lamps, and for this pur-

TYPE L, 125-WATT, LAMP-TESTING WATT INDICATOR.

pose the lamp-testing watt indicator, here described, has been designed by the General Electric Company, Schenectady, N. Y. This instrument should prove especially valuable in introducing the new 25-watt tungsten lamp, although this is not essentially the only use to which it can be put, and many other conditions may arise where it will be found of immediate service, and where a larger and less compact apparatus would be at a disadvantage. In addition to its utility, it possesses the merits of accuracy in operation, facility of reading, and attractive appearance.

This watt indicator is constructed on the Thomson inclined-coil principle, and has a scale marked directly in watts, at different voltage values. The moving element is mounted in jeweled bearings. The case consists of a single aluminum-alloy casting, on each side of which is a brass dome. At the top there is an Edison screw plug, and at the bottom a lamp receptacle.

Although the lamp-testing wattmeter is intended for use with Edison sockets and lamps equipped with the Edison base, an adapter can be supplied, permitting its use with either the Thomson-Houston or Westinghouse socket or lamp base.

To use the instrument, the plug is screwed into a lamp socket, and the lamp to be tested is inserted in the receptacle at the bottom of the instrument. The pointer will then indicate the watts consumed by the lamp. The plug end of the instrument is equipped with a spring-contact end, permitting an extra turn so that the scale may always be in full view.

The instrument is provided with a multiple scale, allowing direct readings when used on 100, 105, 110, 115 and 120 volts. For intermediate voltages readings may be interpolated. The capacity of the winding is one and one-half amperes, and the maximum scale marking is 125 watts. The size of the instrument is such that it can be conveniently carried in the pocket.

A Weight Computer for Structural Shapes.

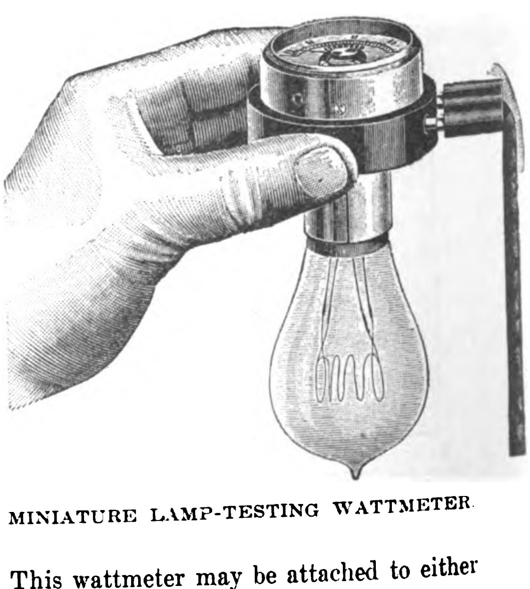
The calculations required to be made by a structural engineer in designing any bridge, roof truss or other steel structure are quite laborious. To make this work more rapid and less irksome, a number of calculating machines have been developed. The simple slide rule is one of the most common. A useful and convenient adaptation of the slide rule for the determination of weights of structural shapes has been brought out by the Edge Computer Sales Agency, St. Paul Building, New York, N. Y. The Edge computer consists of two discs, one rotating above the other. Each disc has its circumference marked off with logarithmic scales representing the dimensions of the various shapes in feet and inches and the resultant weight in pounds. In determining the weight of a plate the upper disc is turned until the thickness of the plate required corresponds with the required width on the lower scale. The weight of any length of that plate is then seen on the lower disc opposite the length. For computing the weights of angle-irons a similar simple operation is necessary. In the same way the weight of any length of a beam, channel iron or other structural shape, whose weight per foot is known, can be readily computed without reference to any tables or books, and with an accuracy much higher than is required for most practical purposes.

Important Order for the Crocker-Wheeler Company.

One of the most important orders recently booked in the electrical field is that for about 2,500 horsepower of induction motors for the Clark Thread Company, in Newark, N. J., which has been secured by the Crocker-Wheeler Company, of Ampere, N. J. The order is of considerable size, but its chief importance is because of the fact that it is the beginning of the electrification of these mills, which are probably the most extensive in the United States. The mill has been driven by several steam engines, and this purchase of induction motors is the first step in electric drive. The order was awarded to the Crocker-Wheeler Company after a thorough investigation extending over a period of ten months, which demonstrated that the Crocker-Wheeler engineers knew how to solve the intricate electrical problems met with in textile work. The motors are wound for 5,500 volts, sixty cycles, three-phase, and will range in capacity from twenty-five to 150 horsepower each.

A Miniature Wattmeter.

The accompanying illustration shows a miniature wattmeter for incandescent-lamp testing which has been placed on the market by the Robert Instrument Company, 56 Shelby street, Detroit, Mich.



MINIATURE LAMP-TESTING WATTMETER.

This wattmeter may be attached to either direct or alternating-current circuits, within the range of the wattage and voltage calibration of the instrument (150 watts at 118 volts). The attaching plug, cord and connector are furnished with each instrument. The maker claims that the meter is particularly adapted for testing the efficiency of tungsten lamps.

A Motor-Operated Time Switch

A non-arcing time switch for closing and opening a circuit at predetermined times has been invented by Bernard Tropp of New York city and patented in this country. It is entirely automatic and requires only rewinding of the clock mechanism controlling it.

This clock controls two contact devices, each operated once every twenty-four hours, for completing a circuit through a small electric motor, which mechanically actuates a switch in the lamp circuit. The motor runs long enough to actuate the lamp switch and then automatically switches itself out of the branch circuit. There are also manually operated switches for cutting out the contact devices at the clock momentarily, and permitting the motor to be set in motion independently of the clock, for turning on or off the lights.

In the accompanying drawings of the device, Fig. 1 is a plan of the device, and Fig. 2 is a side elevation thereof.

The clock (1) has a wheel (2) which makes one rotation in twenty-hour hours. The arbor of this wheel is connected with an aligned metal shaft (4) through a block (5) of insulating material. As the shaft conveniently forms a part of the motor circuit, this block interposes between the shaft and the metal of the clock mechanism, and thus avoids risk of a shock to one winding the clock.

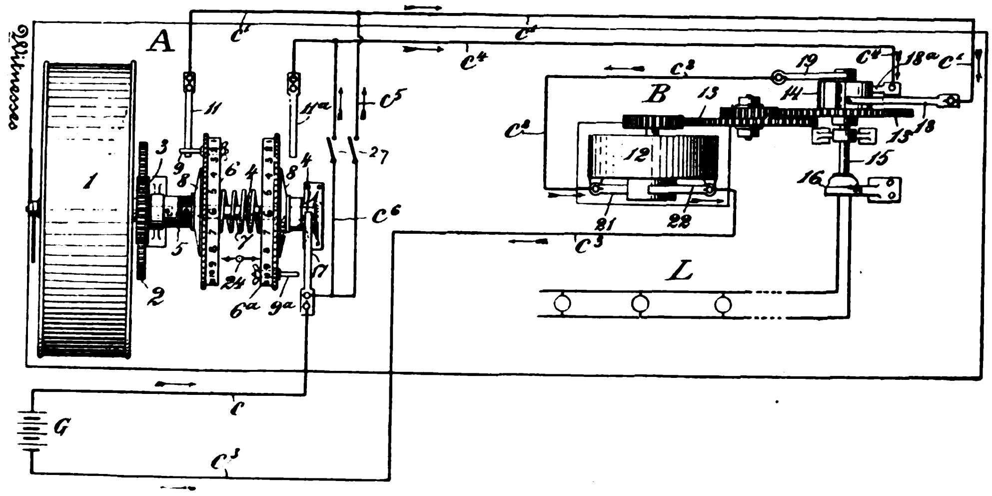


FIG. 1.—DIAGRAM OF CONNECTIONS, TROPP AUTOMATIC TIME SWITCH.

Mounted on the shaft are two like contact wheels (6) and (6^a). These are driven frictionally with the shaft, being pressed outward by a spring (7) against collars (8) on the shaft. These wheels are provided, respectively, each with a contact stud (9) (9^a), and, for purposes of angular adjustment, the studs are mounted in curved slots in the contact wheels. There are two light spring terminals (11) and (11^a) in the paths of the respective studs.

The motor section of the apparatus comprises a small electric motor (12) which drives, through a reducing train of gears, a rotary circuit-breaker (14) on a shaft (15), which forms the operating spindle of a rotating switch (16) in the lamp circuit (L). A high-speed motor is essential to the proper operation of the switch shown, which may be of the well-known kind which operates at each quarter of a rotation of the spindle to alternately close and break the lamp circuit. The shaft carries two oppositely disposed and laterally projecting spring blades of metal which are connected electrically and which, in one position, connect the wire terminals of the lamp circuit electrically. When the shaft is turned a quarter way round, the blades are moved out of contact with the wire terminals, and the lamp circuit thus broken.

The motor circuit may be supplied with electric energy from any source, as a battery (G). The current goes to a brush (17) bearing on the shaft (4), through the shaft to the wheel (6) and stud (9) to the spring terminal (11), and thence to a brush (18), which is in contact with the circuit-breaker (14). From this device the current is taken off by a brush (19) and carried to one of the brushes (21) of the motor, thence through the motor to the other brush thereof, and thence to the other pole of the source (G). As the wheels (6) (6^a) are constantly (though slowly) rotating, when the stud (9) contacts with the spring terminal (11) the circuit will be completed through the motor and the latter, through the gear train, will set the circuit-breaker (14) to rotating. This operates the switch (16) to turn on the current to the light circuit.

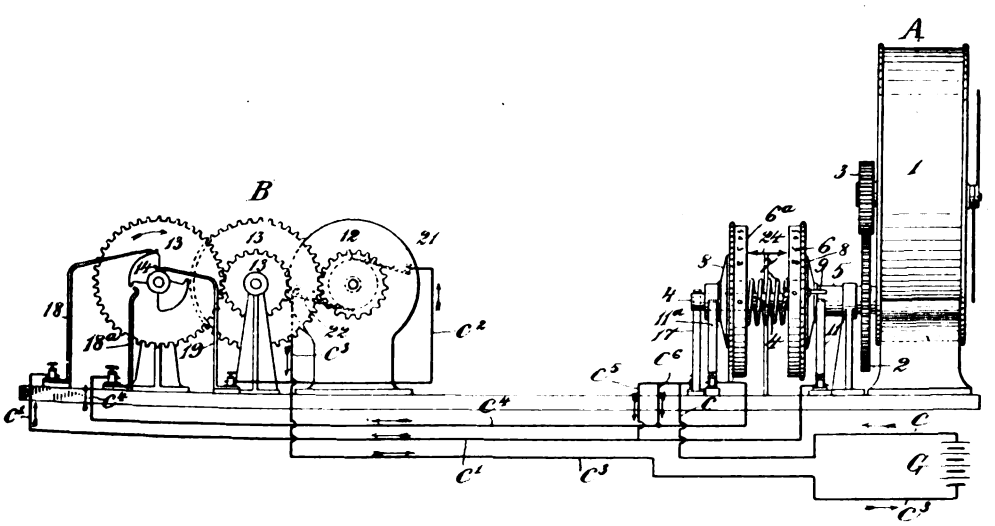


FIG. 2.—DIAGRAM OF CONNECTIONS, TROPP AUTOMATIC TIME SWITCH.

The device, which has been called a rotating circuit-breaker, is here shown as a wheel or cylinder of metal with two opposite quadrants cut out or removed; as it rotates the brush (18) remains in contact until the device makes a quarter of a complete rotation, when the brush falls or passes off and the circuit through the motor is thereby broken. The lights being now turned on and the motor at rest, the lights will remain turned on until the stud (9^a) on the wheel (6^a) shall come in contact with the spring terminal (11^a), when the current will flow to a brush (18^a), which will now be in contact with a segment of the circuit-breaker and thence through the motor as before. The motor is thus set in motion and turns off the lights, the circuit through the motor being broken when the brush (18^a) passes off from the segment of the breaker. There will always be one of the brushes (18) or (18ª) in contact with the breaker.

As stated, the wheels (6) (6ª) are free to be rotated by hand on the shaft so as to permit of setting the device for turning on and off the lights at certain hours; and, to facilitate this, there are hour graduations on the rims or peripheries of the wheels and a double-ended indicator or pointer (24) mounted on the base.

With the construction shown the switch (16) is rotative, but any other form of switch may be employed in the light circuit, as for example a knife-switch operated by a link or rod, which couples the arm of the switch to a crank on the rotary circuit-breaker. This device is semi-circular instead of quadrantal, as it requires a half rotation thereof to operate the switch for breaking the circuit through the motor.

In order that the circuit through the motor may be closed by hand at any time independently of the clock, switches for this purpose are provided, in branch circuits about the terminals (11) (11ª). It will be noted that, in the functions of the device, the motor circuit is branched, and the clock mechanism operates to close a break first in one branch and then in the other, alternately, and the motor acts, through the current changer, to break the supplying or active branch of the motor circuit and at the same time to close a break in the inactive branch. The clock mechanism completes the motor circuit through the branch closed at the switch or circuit-changer. The lamp circuit is wholly independent of the motor circuit in the electrical sense. They may be supplied from the same source or from different generators.

Bristol's Electric Time Recorder.

A new electric time recorder, designed to meet the demand for a simple and practical instrument to record automatically the occurrence and duration of certain operations such as the starting and stopping of machines, the opening and closing of valves, the duration of runs, the passing of trains, etc., has been brought out by the Bristol Company, Waterbury, Conn. With this instrument it is possible to record a number of different operations on the same chart, while the recorder may be located at a distance from the points at which the operations occur.

The use of these new Bristol recorders to indicate when the machines were started and stopped, how long they remained idle, and when they were started again is shown in Fig. 1, which is a reproduction of the record chart showing complete twenty-four-hour records of operation of two paper machines. This record shows the time and duration of each break and also the time required to wash the felts and put on new wires.

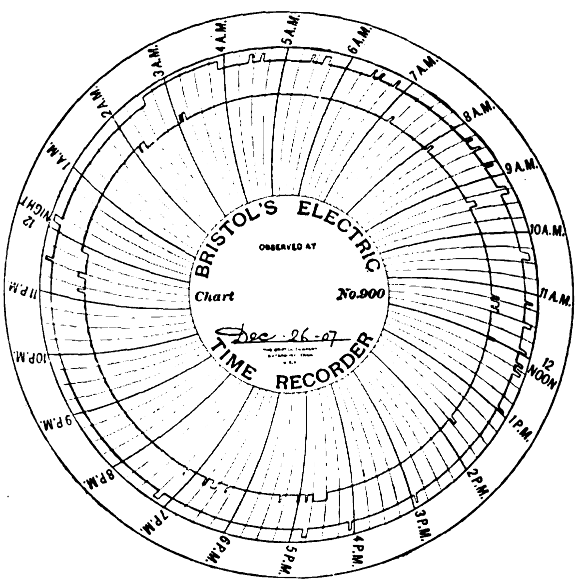


FIG. 1.—REPRODUCTION OF CHART MADE WITH BRISTOL'S ELECTRIC TIME RECORDER.

A recorder arranged to report operations at six different points is shown in Fig. 2. Each of the six pens of this instrument makes an independent record, continuously and automatically, and in this way six different operations may be recorded on the same chart. Each pen is actuated by an independent electromagnet and battery circuit, so arranged that closing the circuit causes the pen to move transversely on the chart.

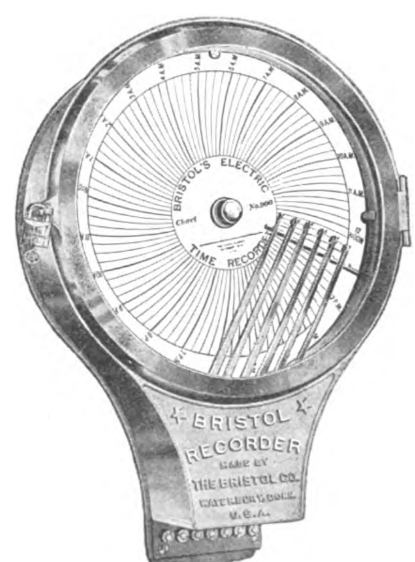


FIG. 2.—BRISTOL'S ELECTRIC TIME RECORDER.

Binding posts are provided at the base of the recorder, to which the small lead wires are attached. These wires may be of almost any length, as it is only necessary to have the operation to be recorded open or close the circuit whenever the motion occurs. These recorders are usually operated by a battery circuit, but any convenient circuit may be employed by the insertion of suitable lamps or other resistance to reduce the potential.

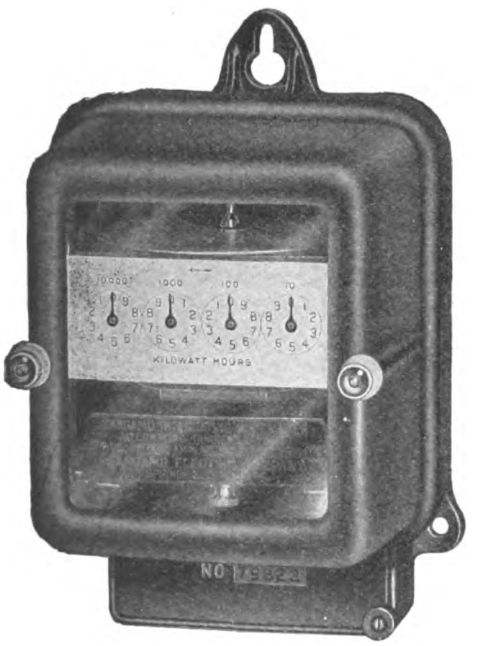
Electric-Lighting Data.

G. W. Armstrong, western manager of the Excello Arc Lamp Company, has begun the publication of an admirable series of bulletins designed to promote the understanding of the vital principles of flaming-arc-lamp operation and use, in order that prospective purchasers may be better able to judge of the merits of the various flaming arc lamps on the market. It is also purposed to furnish the electrical engineer with such data as may assist him in the selection and design of lighting installations. The collected issues of this bulletin, which is designated as "Excello Light," will form a textbook on the flaming arc lamp and its relation to illuminating engineering.

Mr. Armstrong is able to render valuable service to electrical and illuminating engineering through the medium of these bulletins, as only those data which are secured from the working out of actual, practical installations will be used in preparing the copy matter for each issue.

New Sangamo Wattmeters.

The Sangamo Electric Company, Springfield, Ill., has placed on the market two new types of its mercury wattmeters, designated as the Type D, direct current, and the Type F, alternating current. In October, 1904, the company offered its first mercury meter motor. This was adapted for direct current only, and embodied in its construction fundamental features which led the way to the further development of the Type D direct-current meter, which was put on the market a year later. The Type D meter, with a few detail improvements in construction, is the present very successful direct-current meter, and has attained a position of prominence as an accurate and efficient direct-current watt-hour meter.

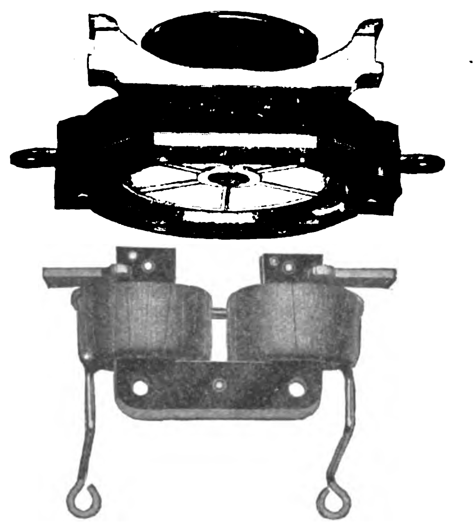


SERVICE TYPE SANGAMO METER, WITH NEW STYLE PRESSED STEEL CASE, FULL GLASS FRONT.

Following the general lines of construction and mode of operation of the Type D direct-current meter, the first alternating-current meter was brought out in the spring of 1906. Immediately following this meter the first transformer-type alternating-current meter, based on a principle entirely new, was developed. The company is now able to announce its perfected alternating-current watt-hour meter, the Type F.

The mercury meter consists essentially of a cylinder or disc-like motor element partly or entirely submerged in mercury, so that current can be led in and out from this element by the mercury acting as a contact maker, fixed metallic contacts being set in the walls of the chamber containing the mercury and the disc. The reaction of current passing radially or diametrically across the armature with a magnetic field properly set with respect to the armature will cause rotation, and this may be proportional to ampere-hours or watt-hours, and is available for either direct or alternating-current measurements.

When operated on direct current the main current, or a proportional part thereof, passes directly through the armature of the motor element. The poles of the field magnet are excited by a shunt coil. In the alternating-current meter the laminated field magnet is energized by a series winding, and the armature carries a large volume of current derived from a small potential transformer inside the motor, whose primary is connected across the line like the shunt coil of an induction meter. This transformer occupies the space back of the laminated magnet and its supporting bracket in such position that its heavy secondary winding can be conveniently and firmly connected



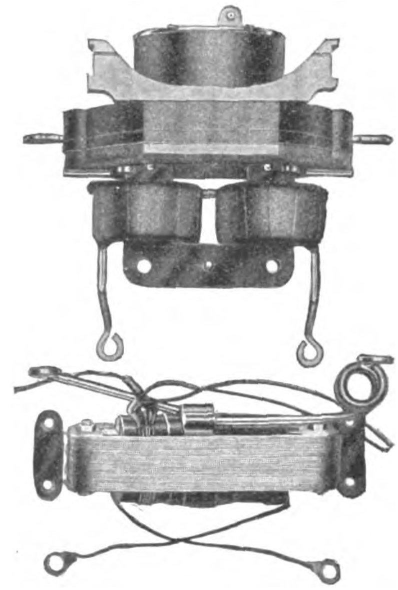
TYPE F MOTOR ELEMENT, ASSEMBLED, AND ALTERNATING-CURRENT LAMINATED MAGNET WITH SERIES COILS.

to the heavy copper contact ears of the disc chamber, while its small primary cables are in a position for connection to the binding posts below.

The armature or rotating element is made with a central dome or float, so that the total displacement when immersed in mercury is sufficient to buoy up the entire rotating system, including the damping disc outside of the mercury chamber, so that the difference between the true weight of the rotating system and this buoyancy effect is only about one-tenth of an ounce, this being, therefore, the effective weight or pressure upward against the top bearing jewel.

An improved light-load adjustment enables absolute zero of adjustment, no matter whether a meter is operated at normal voltage or at double voltage, as it is principally dependent upon the differential action between two small cable leads passing once in opposite directions around the laminated magnet in the alternating-current meter. The position of a clamp slider to the right or left causes relatively greater or less compensating current through the two windings, obtaining either a forward or slightly backward effect on no load by the slight initial magnetization given to the laminated magnet.

The curve of the Type F meter, on account of the improved construction of the series magnetic circuit, is straight from lightest loads to heavy overload, and as minimum initial compensation is required, the accuracy of the meter on wide range in voltage is exceptional. At one-tenth load the meter shows a variation not to exceed one-half to one per cent for



TYPE F MOTOR ELEMENT WITH LAMINATED MAGNET AND TRANSFORMER.

twenty per cent change in voltage from normal, and shows no error at half load or full load on the same change in voltage.

The Type F meter is practically independent of frequency without recalibration, as it shows no difference between sixty and twenty cycles, and an error of about one and one-half per cent at 133 cycles. It is also but little affected by change in temperature, a variation from normal accuracy of less than one per cent being caused by a change of thirty degrees Fahrenheit. The construction of the meter gives high torque—over fifty millimeter-grammes at full load, although with a shunt loss of but one and one-half watts at sixty cycles and two and one-half watts at twenty-five cycles, 110 volts. The potential drop between the series binding posts is about 0.4 of a volt in the five and ten-ampere meters, and less in the meters of larger capacities up to 150 amperes.

At present the greatest demand has been for meters with pressed-glass cases, but for special purposes cast-iron cases have been provided. The new Type F case has sides formed of pressed sheet-steel, and the front is of extra heavy double-strength glass, held in the case with screw clips, and cemented so as to be water and dust-tight. Beginning with December 1, the standard meter will be furnished with this new steel combination case.

All alternating-current meters up to and including 100 amperes capacity are provided with four binding posts, so that all direct-current meters, except those having 500-volt circuits, are similarly arranged in sizes up to eighty amperes. The alternating-current primary meters, when not of the switchboard type, have four posts arranged to use with current and potential transformers. All alternating-current meters larger than 100 amperes, and direct-current meters larger than eighty amperes, and direct-current meters of all capacities in the 500-volt type, have three binding posts—two series and one shunt.

The meter is nine and one-half inches high over the hanging lug and connecting box, six inches wide, and five inches deep, and weighs eleven pounds complete with the new steel combination case.

Large Industrial Orders of Electrical Machinery.

Continued evidence of returning industrial activity in various parts of the country is afforded by the mention of some of the recent orders taken by a large western manufacturer of electrical machinery, which will prove of especial interest at this time.

In Wisconsin, where authorities estimate there goes to waste at least 2,000,000 horsepower in unused waterpowers, large developments have recently been undertaken. Among the important hydraulic-turbine plants of this section contracted for with the Allis-Chalmers Company, Milwaukee, Wis., is that of the Northern Hydro-Electric Company, on the Peshtigo River. The initial installation will consist of five horizontal twin turbines, having each a capacity of 1,500 horsepower, or an aggregate of 7,500 horsepower, direct-connected to 1,000-kilowatt alternating-current generators, with exciter units of 400 kilowatts, combined capacity, all the machinery being of the Allis-Chalmers Company's build. This plant, which is near that of the Wausau Street Railway Company, now being equipped with hydro-electric units by the Allis-Chalmers Company, will be second in industrial importance for the "head-of-the-lakes country" only to the Great Northern Power Company's immense development, where 40,000 horsepower in Allis-Chalmers turbines—the largest single Francis wheels in the world—are in operation. The current generated on the Peshtigo River will be transmitted to Green Bay and neighboring towns, to be used for the operation of the street-railway system, commercial lighting and manufacturing purposes. Other large orders placed with the same company for hydroelectric plants include irrigation projects and central stations for power distribution in the Middle West, the plans of which have not yet been made public. Four noteworthy machines now being shipped from the Allis-Chalmers Company's works at West Allis are two 6,500-kilowatt generators of the waterwheel type for the Niagara Falls Hydraulic Power and Manufacturing Company, Niagara Falls, N. Y., and two of 2,500-kilowatt capacity for the Cazadero station of the Portland (Ore) Railway, Light and Power Company. These machines, which are designed for twenty-five and thirty-three cycles and speeds of 300 and 333 revolutions per minute, respectively, have recently shown some notable results on shop tests.

Among purchases of the steam turbines built by Allis-Chalmers Company are a 3,250-kilowatt machine, for the Pacific Mills at Lawrence, Mass., where already three of these turbines and generators are in service; several units of 1,000-kilowatts capacity for the Cleveland, Southwestern & Columbus Railway and the city of Nashville, Tenn., and a number of 500-kilowatt machines for the Webster & Southbridge Gas and Electric Company, the city of Danville, Va.; Pennsylvania Power Company; the city of Dunkirk, N. Y.; Willamette Valley Company, and the city of Frankfort, Ind. In addition to the main units these orders include exciters, power transformers, lighting transformers, condensers, circulating pumps, switchboards, etc., making complete power-plant equipments for the generation and distribution of alternating current.

The Industrial Lumber Company, Beaumont, Tex., is preparing to install two engine-type generators of 450 kilowatts capacity, with seventeen induction motors; the Johnson Chair Company of Chicago has bought a 500-kilowatt generator driven by a cross-compound engine; the city of Waverly, Iowa, recently ordered a belted unit of 225 kilowatts, and the American Sugar Refining Company has contracted for a 500-kilowatt generator driven by a high-duty engine.

The Allis-Chalmers Company has also received orders for a number of hoisting motors and engines, and for some very large pumping engines.

Ward Leonard Laboratory Rheostat.

The Ward Leonard Electric Company, Bronxville, N. Y., has designed a line of rheostats for laboratory service. The illustration shows a fifty-six-ampere capacity rheostat. The resistance portion is 10 inches by 12 inches by 15 inches, overall. The face-plate or controlling portion is only 14 inches by 8 inches. The controlling portion can be mounted on the test-table or inside the cover of a desk.

WARD-LEONARD LABORATORY RHEOSTAT

The resistance portion can be mounted on the side wall out of the way. There are but two wiring connections per switch from the resistance to the face-plate.

This rheostat can be used upon direct-current or alternating-current circuits as a non-inductive, zero-temperature-coefficient resistance. It is designed to give one-tenth-ampere divisions from one-tenth ampere to fifty-six amperes. Each switch is marked with the number of amperes that will flow when it only is closed. By closing the switches singly or in parallel, any desired load is obtained. Each resistance with its controlling switch is designed to be connected across the full line volts. As each resistance is designed to carry the full amperes that can be made to pass through it by the full line volts, burn-outs are impossible. The resistance elements are built up of Ward Leonard enameled resistance units. They are fireproof, strong, light, and are thoroughly protected against mechanical, electrical and chemical depreciation.

Current Electrical News

CONTINENTAL EUROPE.

PARIS, OCTOBER 24.—Since the telephone fire in Paris, the department has been taking active measures in order to set matters right in the shortest possible time. At present the temporary exchange is between the burned building and the Central Postoffice, and it has two floors for installing the apparatus. At present there are about a hundred connections a day made by the use of a number of small boards which have been placed in the building. The department ordered the new large multiple boards on September 26, at a cost of about $1,000,000. The contract stipulates that they are to be delivered by December 11, under a penalty of $1,200 for each day's delay. When the new boards are installed about 4,000 subscribers can be connected per day, so that the whole number of subscribers will have the use of their telephones within a week or so, according to the present outlook. In general, the manufacturers require fifteen months or two years to build multiple boards of this kind, but as in this case they are to be finished within two and one-half months, it will be seen that every effort is being made to finish the temporary exchange.

An important enterprise in Austria-Hungary is an electric railway in the region of Budapest, known as the Vacz-Budapest-Gödöllaer line. It is a suburban road in general, and a ninety-year concession for the line has been lately granted to a local firm known as the Electrical Enterprise Company. The road will make connection with the state railroad depot, and it will probably be run on the single-phase, high-tension system, should this prove to be suitable. The overhead line will be worked at 3,000 volts, using a number of safety devices. Four electric locomotives are to be used on the line, as well as a number of motor cars.

At Martigny, where the valley of the Dranse River joins that of the Rhone, there is a hydraulic plant of large size which has been erected quite recently. It is operated by the Société d'Electrochemie, which has a capital of $1,000,000, and now controls six hydraulic plants in Switzerland and France for manufacturing carbide and other chemical products. There is an extensive carbide works at Martigny in connection with the turbine plant. The latter now has installed nearly 15,000 horsepower in alternators and direct-current generators. One part of the outfit consists of five 750-kilowatt Thury generators, which furnish energy at 150 or 300 volts for the electrolytic work, the current in this case being 5,000 amperes or less for each machine. There are also installed three 2,500-horsepower, three-phase alternators which supply current over a 10,000-volt power line to a second carbide plant lying a few miles off and operated by the same company, also to a carbide works in the same region, which is owned by the Swiss Nitrous Product Company. A set of small generators develops current for the local tramway line.

Current for the Martigny-Chatelard electric road is furnished from a hydraulic plant which is located at Vernayaz, in the Rhone Valley. This plant is most unique, and there is certainly not another one like it in the county. It is placed high up in the side of the mountain at a point lying above the celebrated waterfall of the Pissevache. The latter springs from the abrupt mountain slope and falls in a cascade into the valley, being more than 200 feet in height. The hydraulic plant is placed in a chamber cut out of the solid rock in the side of the gorge, which lies above the fall, and the penstocks lead to a point which is much higher up in the mountain, where the water supply is secured. After passing by the turbines the water is returned to the cascade below, so as not to interfere with the appearance of the latter. In the plant there are installed six turbine groups which supply the current for the Martigny-Chatelard electric road and also for a large carbide works which is located at Vernayaz. The latter plant is controlled by the Stächelin Company, which also owns a carbide works in another point along the Rhone Valley at Aproz. For this second works a separate hydraulic plant is used.

Recently I had occasion to visit the work upon the Lötschberg tunnel at the south end. The scope of this great undertaking is perhaps not as generally known as it should be, but in fact the work ranks but little below that of the Simplon. The object of the tunnel is to run directly through the mountains of the Bernese Oberland, and thus to give a direct route from the north to the south of Switzerland. The new railroad section, which will be electrically operated, connects with the Federal railroad on the north side of the mountains at Frutigen and enters the tunnel near Kandersteg, coming out at the south end near Goppenstein. The tunnel is 13.7 kilometers in length (8.5 miles), and the south end lies about 12 miles from the north end of the Simplon Tunnel, the latter being further along the Rhone Valley. A very extensive plant is being erected at the south end of the Lötschberg Tunnel, and there are from 1,200 to 1,500 workmen employed in the enterprise. At present the rock-drilling is being carried on at the rate of forty feet per day by compressed-air drills. The power plant at the tunnel receives current from a distant turbine station, and there are now four three-phase motors which drive the air compressors. The plant has a capacity of 1,200 horsepower for the compressors alone, using motors of the Alioth system.

A. DE C.

GREAT BRITAIN.

LONDON, OCTOBER 30.—At the first annual meeting of the Victoria Falls Power Company today some interesting statements were made with regard to the prospects and policy of the company. It was made quite clear that it is not the intention to start upon the erection of an overhead transmission line from Victoria Falls to the Transvaal at an early date. In fact, it was plainly indicated that the company's chief consulting engineer, Mr. Ralph D. Mershon, of New York, was still of the opinion that the limits of voltage at which such transmissions can be operated have by no means been reached, and that in the meantime it is cheaper to continue to supply from a steam-driven station than to make use of the water power. Further, the company's engineers seem to have been agreeably surprised at the cheapness with which production can be carried on by coal in the Transvaal, the results having been lower than the estimates. There is a single possibility that remains, however, by which the station may be built at the Falls: it is by the centralization of industries in the immediate neighborhood, a development which the company is trying hard to bring into existence.

A definite step forward has now been made with the London electric power bills, for in the House of Commons on Monday the committee which will soon commence consideration of the bulk supply scheme was instructed to include the name of the London County Council as the purchasing authority. The government has given its consent to this bill on the requirement that certain modifications are made, and it is certain that if the promoters can see their way to accept these, the bill will go forward.

The meetings of the International Conference on Electrical Units and Standards have now been concluded and the final report of the technical committee is in preparation. The International Electrotechnical Commission, which has been created as the result of the St. Louis Congress of 1904, has also met this week and named Prof. Elihu Thomson president. As the International Conference is in favor of appointing a permanent committee, with much the same objects as the Electrotechnical Commission, there appears the possibility that some scheme of combination will have to be evolved in order to avoid duplication of work.

With the approach of the absorption of the National Telephone Company by the state, the directors have concluded that it will not pay them to continue to carry out construction work which will not be in productive use during the next three years. In consequence, a large number of employes are being dismissed and the matter has been the subject of discussion in the House of Commons.

The City of London Corporation at this late day is sending a deputation to the Continent to inspect various systems of street lighting. At present the city of London is lighted by a mixture of ancient and modern electric arc lamps and a few types of gas lighting.

The British Westinghouse Company has just received an order for the equipment of a large power station for the Buenos Ayres & Pacific Railway Company in connection with the public lighting of Bahia Blanca, Argentine Republic. J. F. C. Snell of London is the consulting engineer. G.

EASTERN CANADA.

OTTAWA, NOVEMBER 7.—English capitalists are promoting the organization of a company for the institution of a motor-bus service in the city of Toronto, to compete with the Toronto Street Railway. The proposed capital of the company is $2,000,000. Fifty motor buses will be built, each with accommodation for thirty-six passengers, and regular routes of service will be arranged.

The first sod for the construction of the Niagara Falls transmission lines of the Ontario hydro-electric power commission will be turned on November 18. It is planned to make the occasion a ceremonial one. The construction work will start near the city of Toronto.

The city of Brantford, Ont., will vote on the question of entering into a contract with the Hydro-Electric Commission in January next. Offers from the commission and from the Cataract Power Company of Hamilton were considered, and although the latter concern underbid the commission, nevertheless, in some particulars, the conditions the company stipulated were deemed disadvantageous.

The Ottawa Electric Railway Company has been experimenting with some pay-as-you-enter cars. They have proved so satisfactory to the company and the public that the company will adopt this style of car on its principal streets in the near future.

The Montreal Light, Heat and Power Company has refused to renew the street-lighting contract with the city at the current rate. The company claims that it is losing money on the present contract price, which is $60 per lamp. The company is demanding $75 per lamp.

The Montreal Street Railway Company's annual report shows that the road, during the last year, carried 90,746,032 passengers, the average earnings per passenger being 3.96 cents. There were, however, 30,343,113 transfers issued, so that in reality 121,089,145 passengers were carried, thus reducing the earnings per passenger to 2.97 cents. The earnings were $3,677,432, as compared with $2,220,787 five years ago. The total number of shareholders is 1,526. Hon. L. J. Forget was re-elected president, and W. G. Ross, managing director.

Very encouraging results have been reported at Canadian Pacific Railway headquarters, from the experiments that have been made with a view to the introduction of electricity as a motive power for the operation of trains in the mountain section of the system. The electrification of the whole mountain section, which is upward of 600 miles in length, may be undertaken in the near future, but, while the tests are satisfactory, they have not gone far enough yet to justify a large expenditure.

A project under way aims to connect Ottawa with Morrisburg by electric railway. This includes the building of a new line from Morrisburg to a point on the present Ottawa and New York Railway, and the adoption of electricity as a motive power on the entire line, which will include about twenty miles of the present Ottawa and New York system. The enterprise is being promoted by J. Wesley Allison of Morrisburg. It is given out that the necessary capital for the project is guaranteed, and that there only remains the surveying of about fifty miles of country and the granting of a charter by the government of Canada to allow building operations to begin immediately. The total length of the new electric line will be about seventy-five miles. W.

WESTERN CANADA.

WINNIPEG, NOVEMBER 7.—The first construction work on the civic power plant at Lac du Bonnet, being built by the city of Winnipeg, has been commenced, and it is expected all the excavating for the plant proper will be completed this fall. The tramway, bridges and several other works in connection with the plant have been finished. It is believed that the power plant at Lac du Bonnet will mean the removal of a number of eastern Canadian manufacturers to Winnipeg.

According to statements by officials, a part of the New Westminster-Chilliwac line of the British Columbia Electric Street Railroad Company will be in operation between New Westminster and Cloverdale by the end of the year.

The City Council of Port Arthur, Ontario, has canceled the contract recently made with the Kaministiqua Power Company of Fort William, Ont., for the supply of 400 horsepower for civic purposes. It is alleged that when the company had secured the contract it was used to influence the Ontario government in order to obtain power privileges at Dog Lake Falls. Port Arthur, through J. J. Carrick, mayor, canceled the contract, as the city had been endeavoring to secure power rights at the same falls.

The capital stock of the Russell Telephone Company has been increased from $5,000 to $25,000 for the purpose of building a number of extensions. The head office of the company is at Russell, Man.

The municipal authorities at Port Arthur, Ont., have raised the telephone rates from $1 and $2 per month to $1.25 and $2.50 per month for residence and business telephones, respectively, explaining that this was found necessary to meet the expenses of the department. The City Council has asked the telephone commissioners at Fort William to raise their rates to the same figure.

Five hundred men are now at work on the power dam near Fort Francis, Ont., for the Backus-Brooks syndicate, and Mr. Richardson, the general superintendent, expects to have the dam completed before the end of the year.

The Oxbow Telephone Company, Oxbow, Sask., announces that a number of extensions to the system will be made.

Telephones are becoming very popular in the farming communities of Manitoba, and already this season the government has installed over 1,200 farmers' phones, in addition to some 1,800 new connections in cities and towns. There are still a large number of applications for telephones on hand, many of which will not be installed until next spring. The Manitoba Telephone Commission is now busy preparing requisitions for supplies for 1909, which will be a very busy season, as the government has decided upon the construction of a large number of rural and long-distance lines. Among the items required for next year are 25,000 poles, tenders for which are now being called. Orrin F. French is chief engineer to the commission, with headquarters at Winnipeg, Man.

This year the employes of the British Columbia Electric Street Railroad Company will receive $40,000 under the pension system inaugurated by the company in 1903. Each employe who has been with the company for a year up to July 1, 1908, will receive $66.78, irrespective of his position with the company. The sum divisible is one-third of the balance available for dividend paying after four per cent has been paid on the common stock. As showing the growth of the company, it may be mentioned that the former bonuses were: 1903, $25; 1904, $35; 1905, $40; 1906, $45; 1907, $63, and 1908, $66.78. At the annual meeting of the company held in London, England, on November 4, a dividend of eight per cent was declared on ordinary stock. R.

IMPORTANT DEVELOPMENTS.

TO ELECTRIFY MOUNTAIN RAILROAD IN PERU—The Peruvian Corporation has decided to electrify the Central Railroad of Peru, which connects Callao with Oroya in the mountains. This will make possible a great increase in the traffic handled.

NEW TRANSFORMER HOUSE FOR CANADIAN NIAGARA POWER COMPANY—The new transformer house of the Canadian Niagara Power Company is completed and the installation of the three gigantic transformers having been finished last week, increased the output from 20,000 horsepower to 32,000 horse-power. The new structure is an addition to the old transformer house, and the machines that have been placed therein will be put in operation early in November with the new transmission line which has just been strung to Fort Erie, where it crosses to a point near Ferry Street, Buffalo.

SOUTHERN PACIFIC RAILROAD PREPARES TO ELECTRIFY—The Southern Pacific Railroad Company is making preparations for changing its motive power from steam to electricity, and orders for much of the equipment have already been filed. It is the intention to crowd the installation of this equipment as fast as possible. The company is already commencing the erection of a large power plant near the tidal canal at Fruitvale, and will install several substations at other points suitable to the distribution of power for the different suburban lines. The Berkeley end of the electrification is expected to cost $2,000,000.

RECEIVERS FOR HUDSON RIVER COMPANIES—As receivers for the Hudson River Electric Power Company against which bankruptcy proceedings have been begun, as noted last week, Judge Ray has appointed Charles W. Andrews, of Syracuse; George W. Dunn, of Binghamton, and Milton Delano, of Canastota, N. Y. The corporation was organized in 1903, and controls the Hudson River Water Power Company, Hudson River Electric Company and Hudson River Power Transmission Company, together with various sub-companies owned by the latter two, supplying central and eastern New York State with power. The authorized capital stock was $10,000,000, of which $5,390,000 was issued. The total funded debt of the corporation, according to its last statement, was $9,683,500. Net earnings for 1907 were $486,200. Messrs. Andrews, Dunn and Delano were required to give bonds in the amount of $100,000 each as receivers.

OPERATION OF WISCONSIN'S NEW UTILITY LAW DISTRIBUTES CORPORATION TAXES—The Wisconsin State Tax Commission, acting as a state board of assessment of street-railway companies, has announced the assessment of these properties, under the new law enacted by the last legislature, providing for taxing these public utilities according to the ad-valorem system by the State Tax Commission rather than under the license-fee system locally. Heretofore these companies were assessed locally and twelve per cent of the tax was turned over to the state and eighty-eight per cent retained locally. Under the new law the State Tax Commission makes the assessment, the state collects the tax and distributes eighty-five per cent thereof among the localities through which the railway line runs, the local distribution being made in proportion to the earnings of the line in each locality. Twenty-four companies are assessed and taxed under this system. The total of the preliminary assessment of these properties was $36,098,000, and the total tax levied is $390,637.75.

COLORADO POWER COMPANY WINS LONG-CONTESTED SITE—The Denver Power and Irrigation Company has won a fight of several years' duration for the right to a mammoth irrigation and power site in the South Platte Canyon, extending from Eagle Rock to a point above Decker's summer resort, a distance of fourteen miles, and the estimated cost of which is $10,000,000. The Two Forks Reservoir Company, backed by C. P. Allen and J. E. Maloney, and the High Line Reservoir Company, backed by W. E. Bates, filed on the same stretch of territory as did the Denver company and half a dozen railroad companies. The dispute as to who was entitled to the right-of-way was decided by Fred Dennett, commissioner of the general land office, and has been received in full by the Denver government land office, and the interested parties. The sites all start where the north and south forks of the Platte join, thirty-one miles from Denver, at the town of South Platte. The Denver Power and Irrigation Company has spent about $100,000 in the preliminary work.

LOWER CABLE MESSAGE RATE URGED BY CHAMPION OF TWO-CENT TRANSATLANTIC POSTAGE—The first stage in the campaign for the reduction of the world's cable rate will be reached next week, when the earl of Jersey will preside at a meeting called to consider ways and means by which adequate support may be given to the movement for cheaper rates in international electric communication. The moving spirit in the project, John Henniker Heaton, whose efforts were largely responsible for the two-cent postal tariff between America and Great Britain, says in the course of time a rate of two cents a word will obtain for cable messages. His proposition is that the British and American governments jointly acquire the property rights of the existing cable companies at a fair valuation and thereby establish a common state monopoly of cable communication. At present, Heaton says, the cable-carrying capacity amounts to 300,000,000 words, and only 250,000,000 are sent at twenty-four cents a word. If the cables were owned by the state and employed to their full capacity, he declares, it would be possible to establish a tariff of two cents a word.

GREAT WESTERN POWER COMPANY TO SELL THROUGH PACIFIC GAS AND ELECTRIC COMPANY—The Great Western Power Company has reached an agreement with the Pacific Gas and Electric Company by which the power company will not retail its product, but will sell directly to the distributing company. The territory served by the two companies extends from the northern part of California to Santa Cruz. It is understood that the new company will not compete in towns or cities of northern or central California until it is more firmly established. The contract with the Pacific Gas and Electric Company is temporary, but may ultimately result in a merger of the two organizations. The Great Western is at present endeavoring to secure a franchise to operate in Sacramento. The Pacific Gas and Electric Company is the parent corporation of thirty concerns, including the California Gas and Electric and the San Francisco Gas and Electric. The Pacific company operates in twenty-nine counties in the state, supplies current to twelve electric railroads and sells power to forty-three different cities and towns in California. It controls all the business about the bay cities and the greater part of the business in the north.

ELECTRIC LIGHTING.

GREENVILLE, KY.—The Greenville Light and Water Company will extend its lighting circuits, having voted to offer $12,000 in bonds.

MONDOVI, WIS.—The Mondovi Milling Company and the Mondovi Electric Light Company have consolidated and will build a new electric-light plant.

GOLIAD, TEX.—Joel and Jasper Shaper have purchased the interests of the Goliad Water and Light Company and will conduct the company in the future.

GADSDEN, ALA.—A franchise has been granted to the Etowah Light and Power Company, Attalla, Ala., to furnish electricity for commercial purposes.

FEDERALSBURG, MD.—The Idlewild Electric Light and Power Company, incorporated to develop waterpower properties, has effected permanent organization, with John F. Disharoon, J. B. Wright and E. E. Goslin as directors.

KNOXVILLE, TENN.—The permanent illumination of Gay street, after the design of recent temporary carnival lighting, has been urged by a committee of local merchants, which proposes to put three or four arches across the street in every square.

ELECTRIC RAILWAYS.

GREEN BAY, WIS.—The Bay Shore Street Railway Company has been incorporated by Fred A. Rahr and others.

FRANKFORT, KY.—An interurban line from Frankfort to Lawrenceburg is the next electric traction line planned for the Bluegrass district.

SAGINAW, MICH.—Electric cars will be running between Saginaw and Detroit by January 1, officials of the Flint and Saginaw Electric Railway declare.

JACKSONVILLE, ILL.—Construction work will soon begin on the Alton, Jacksonville & Peoria electric line. Four miles of the road is completed near Alton.

SPOTTSYLVANIA, VA.—A conference has been held by business men looking to the formation of a joint stock company, whose object is to build an electric-railway line to run from Fredericksburg to Spottsylvania and from there to Mineral City, in Louisa County. This railway would pass through a section of the country rich in minerals.

PERSONAL MENTION.

CHANCELLOR JAMES R. DAY, of Syracuse University, sailed for Europe last Saturday on the Königin Louise.

MR. W. G. MELOON is to assume the management of the Twin State Gas and Electric Company, of Dover, N. H.

MR. S. J. DUNCAN, who has been superintendent of the Northwestern Electric Heat and Power Company, at Kearney, Neb., has resigned and will take up new work in Oklahoma.

MR. E. W. McCLENNAN, formerly manager for the Bell Telephone Company at Orillia, Ont., has been appointed traffic manager, with headquarters at Winnipeg, for the Manitoba Telephone Commission.

MR. R. E. HUNT, who had been superintendent of railway service for the Utah Light and Railway Company, at Salt Lake City, Utah, has been promoted to the position of assistant general manager of the company.

MR. ROBERT HOWES, formerly with the Washington Waterpower Company of Spokane, is at Vancouver, B. C., to superintend the construction of the Chilliwac branch of the British Columbia Electric Street Railroad Company.

MR. HARRY D. CRANSTON, a graduate of the electrical engineering department of the Ohio State University, has accepted a position as superintendent of the municipal electric-lighting and waterworks plants of Rockwood, Tenn.

MR. HERBERT E. PLASS, general manager of the Howard Miniature Lamp Company, Newark, N. J., is stopping in Chicago on his return from a trip to the Pacific Coast, in company with E. H. Haughton, manager of the Chicago Bryan-Marsh Company.

MR. H. P. JAMES, formerly electrical engineer for the Bryant Electric Company, has taken a position as sales manager for a new line of push-button specialties recently placed on the market by the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis.

MR. OREN ROOT, manager of the Metropolitan street-railway system, New York city, married Miss Ada De Acosta on the afternoon of November 5, at the bride's home in New York. The Rev. Father Patrick Daly, of Poughkeepsie, N. Y., performed the ceremony.

MR. J. D. DOWNER, who was for a number of years in the service of the subscription department of the Western Electrician, has become sales manager for the Kimble Electric Company, 617 West Adams Street, Chicago, manufacturer of variable-speed, single-phase, alternating-current motors.

DR and MRS. LEE DeFOREST returned from Europe on the steamship Lusitania, reaching New York October 30, after a trip on the Continent, during which France, Italy, Germany and England were visited on business in connection with Dr. DeForest's wireless telegraph and telephone interests.

CHARLES H. FISH, agent for fifteen years for the Cocheco Cotton Mills, at Dover, N. H., has resigned and will accept a position of responsibility, it is understood, with the American Telephone and Telegraph Company. He is a brother of Frederick P. Fish, former president of the telephone company.

MESSRS. E. A. ENNIS and E. J. NELSON, formerly with the Mergenthaler Linotype Company as chief clerk and assistant chief clerk, respectively, have formed a business association as factory systematizers and cost men at 173 York Street, Jersey City, N. J., under the firm name of Ennis & Nelson.

MR. WILLIAM P. BAILEY, who has been superintendent of the Michigan City division of the Chicago, South Bend & Northern Indiana Electric Railway, has tendered his resignation and will return to the employ of the Terre Haute, Indianapolis & Eastern Railway, making his headquarters at Indianapolis.

PROF. F. B. BADT, president of F. B. Badt & Co., 1504 Monadnock Block, has returned from New York city, where he had gone for a couple of weeks to visit his home offices and works, viz., the Weston Electrical Instrument Company, Waverly Park, Newark, N. J., and the Ward Leonard Electric Company, Bronxville, N. Y. It is understood that he closed some new selling agencies, one of which is for the well-known "Stave" flaming arc lamp. He expects a brisk business in 1909 and is preparing to meet this enlarged demand. Professor Badt has entirely recovered from his recent illnesses, his health now seems to be all that can be desired, and his many friends are glad to see him back in Chicago.

MR. HUGH A. BROWN has resigned from the Crocker-Wheeler Company, manufacturers and electrical engineers, to whose Chicago office he had been attached for several years. He now takes up the work of sales manager for the Rockaway Coaster Company of Cincinnati, in which he has a substantial interest.

DR. CHARLES WILLIAM ELIOT, president of Harvard University, has resigned, his resignation to take effect on May 19 next. The announcement of the resignation was made at a special meeting of the Board of Overseers. It is stated that the board with the utmost difficulty arrived at the conclusion that a proper regard for the president's wishes required it to relieve him of the arduous duties of his office. Charles William Eliot was born in Boston, Mass., March 20, 1834. His father was Samuel A. Eliot, for many years treasurer of Harvard University, and several times mayor of Boston. Dr. Eliot entered Harvard at the age of fifteen, and was graduated in 1853. Shortly after his graduation he returned to the college, where he spent nine years in various offices of instruction. From 1864 until 1865 he was abroad, making a particular study of foreign methods of education. While abroad he was elected professor of analytical chemistry and metallurgy in the Massachusetts Institute of Technology. He returned to Europe in 1867 again, studying educational subjects. Two years later he was called to the presidency of Harvard University. This was the first time that a layman had been called to head the institution, and his inaugural address, based upon the highest ideals of nonsectarian education, was received with astonishment.

NEW MANUFACTURING COMPANIES.

BOSTON, MASS.—The Edwin C. Lewis Company has been incorporated with a capital stock of $75,000 to manufacture electrical apparatus. E. C. Lewis is president and treasurer.

THE BROWNRIGG & STEVENSON COMPANY, New York, has incorporated with a capital stock of $10,000, as steam and electrical engineers and general contractors. The members of the firm are C. Maxwell Stevenson and M. Wilson, 29 Broadway, and Robert E. Samuels, 229 Broadway, New York.

THE IOWA CONSTRUCTION COMPANY, Eldora, Iowa, has been incorporated by Henry S. Osborne and others, with a capital stock of $10,000, to construct railways between Waterloo, Perry and Ames.

NEW YORK, N. Y.—The Excelsior Storage Battery Company, New York, N. Y., has been incorporated with a capital stock of $10,000. The directors are Philip Hornwitz, Bella Robins and Aaron A. Feinberg, New York, N. Y.

NIAGARA FALLS, ONTARIO—The American Electric Furnace Company, which has built a plant in this city, has been incorporated as a Canadian company, the provisional directors being Thomas Rawlands, W. H. McGuire, F. W. Griffiths, Alice L. Johnson and Charles S. Peaslee. The company manufactures certain kinds of electric furnaces, which are used for smelting, concentrating and refining ores and metals. The company has branches in Norway and England and in the United States. The Canadian company is capitalized at $50,000.

THE AMERICAN ELECTRIC SMELTING AND ENGINEERING COMPANY has been incorporated in St. Louis, Mo., with a capital stock of $50,000, in Chicago. The principal incorporator is Albert E. Greene of Chicago, who is a graduate of the Massachusetts Institute of Technology and has devoted his attention to electric furnaces, perfecting one which the company will manufacture and place on the market.

NEW PUBLICATIONS.

"THE MODIFICATION OF ILLINOIS COAL BY LOW TEMPERATURE DISTILLATION," by S. W. Parr and C. K. Francis, has been issued in pamphlet form as a bulletin of the University of Illinois at Urbana. The paper is a report of a series of experiments carried on by the chemical department of the university since 1902 for the purpose of effecting a chemical change in the ordinary coals of Illinois, such as to modify or prevent the production of smoke.

OBITUARIES.

MR. ARTHUR W. SHELTON, president of the Rhinelander Power Company and the White River Power Company of Ashland, Wis., died at Rhinelander, November 1. Mr. Shelton was a wraduate of Wisconsin University of the class of 1883 and was prominently identified with leading manufacturing interests, in addition to his connection with the electrical power industry.

MR. HENRY A. BUTTERS, a wealthy capitalist, prominently identified with the construction of a number of electric railways in the Pacific Coast, who died, as announced last week, at Berkeley, Cal., of acute congestion of the lungs, was a personal friend of the late Cecil Rhodes and his partner in several mining enterprises, the builder of the first electric tramways in South Africa, Switzerland, Mexico and South America and the president and founder of the Northern Electric Company of California.

MR. C. E. TRUMP, president of the Novelty Electric Company, of Philadelphia, and one of the pioneer electrical men of the country, died suddenly from affectation of the heart at his residence in Germantown, Philadelphia, Pa., Friday, November 6. Mr. Trump had been suffering slightly for a few months from muscular disturbances of the heart, but no dangerous symptoms had developed, and his sudden death came as a great shock to his family and friends. His funeral occurred from his late residence Monday, November 9, a number of friends from New York city attending the ceremonies. Mr. Trump was prominent in electrical circles in Philadelphia, and a regular attendant of many of the National conventions. He was one of the first to enter the field of electrical supplies and manufacturing, and has been quite successful in this line. His son, Mr. C. N. Trump, will continue as the active head of the company.

PROF. WILLIAM EDWARD AYRTON, the British electrical engineer and physicist, died in London, November 8, at the age of sixty-one years. Born in 1847, young Ayrton gained numerous prizes during his earlier schooling, and in 1867 received with honors the degree of B. A. It was while in the Indian Telegraph Service that he was sent to study electrical engineering with the late Lord Kelvin, and later became electrical superintendent of the government telegraph department. In 1872 he was in charge of the manufacture of the Great Western telegraph cable at Micham, representing the engineers, Lord Kelvin and Prof. Fleeming Jenkin. Until 1879 Professor Ayrton occupied the chair of natural philosophy and telegraphy at the Imperial College of Engineering, Japan, which was then the largest English-speaking technical school in existence. Later he was professor of applied physics at the London Technical College, the Central Technical College, South Kensington, and the City and Guilds of London Institute, of which last he also became dean. Professor Ayrton was elected a fellow of the Royal Society in 1881 and is a past-president of the Physical Society and Institution of Electrical Engineers. He visited the United States in 1893 as one of the British delegates to the Electrical Congress at Chicago. Professor Ayrton was a joint author in the invention of well-known ammeters, voltmeters, wattmeters, the ohmmeter, dispersion photometer, dynamometer and secohmmeter and the system of automatic electric transport known as "telpherage." More than one hundred papers by Professor Ayrton have been published in the proceedings of various learned scientific societies. These are on a variety of subjects ranging from abstract scientific topics to the practical uses of gas and steam engines and electric motors.

ELECTRICAL SECURITIES.

Immediately following the election there was apparent a considerable advance in activity, and with reports of the resumption of full-time operations in many industrial quarters, where for the past six months there has been considerable depression, the market rallied and put on an air of prosperous expectancy. While from many directions it was indicated prior to the election that the result had been anticipated by the improvement which had been brought about within the last two or three months, this hardly seems to be the case.

The regular quarterly guaranteed dividend of 1¼ per cent on the stock of the American Telegraph and Cable Company will be paid December 1. Books close November 15, and reopen December 2.

ELECTRICAL SECURITIES FOR THE WEEK ENDED NOVEMBER 7.

New York:	*Closing.*
Allis-Chalmers common	13¼
Allis-Chalmers preferred	45⅛
Brooklyn Rapid Transit	52½
Consolidated Gas	145½
General Electric	153¾
Interborough-Metropolitan common	10⅛
Interborough-Metropolitan preferred	30¼
Kings County Electric	125
Mackay Companies (Postal Telegraph and Cables) common	75½
Mackay Companies (Postal Telegraph and Cables) preferred	70
Manhattan Elevated	139⅛
Metropolitan Street Railway	24
New York & New Jersey Telephone	114
Western Union	63
Westinghouse Mfg. Company	91

At the annual meeting of the Allis-Chalmers Company, K. K. Knapp was elected a director, succeeding J. F. Neave. Other directors were re-elected.

At a meeting of the trustees of the Mackay Companies, H. V. Meredith, of the Bank of Montreal, Montreal, was elected a trustee. In view of the large holdings of Mackay Companies' shares, preferred and common, held throughout Canada, it was felt that Montreal should be represented on the board of trustees. The Mackay Companies have now two representatives in Canada, Mr. Meredith and R. T. Smith, of the firm of Osler & Hammond, Toronto.

Boston:	*Closing.*
American Telephone and Telegraph	129½
Edison Electric Illuminating	247
Massachusetts Electric	57¾
New England Telephone	124
Western Telephone and Telegraph preferred	70
Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	39
Electric Storage Battery preferred	39
Philadelphia Electric	12
Philadelphia Rapid Transit	22½
United Gas Improvement	89¼
Chicago:	*Closing.*
Chicago Telephone	125
Commonwealth Edison	108
Metropolitan Elevated preferred	42⅛
National Carbon common	72½
National Carbon preferred	111

Metropolitan and South Side Elevated traffic last month showed the largest decrease this year. Northwestern Elevated's gain was very small. The total for the three was 11,867,623 passengers or a loss of 301,478, though 1,260,000 more than September.

TELEPHONE AND TELEGRAPH.

HOLLIS, OKLA.—The Hollis Telephone Company has been incorporated with a capital stock of $20,000.

HOLLAND, TEX.—The Rural Telephone Company, of Holland, has been chartered by J. H. Edwards and others.

KANSAS, OKLA.—The Northeast Oklahoma Telephone Company has been incorporated by D. L. Bird and others.

PARADISE, ARK.—The Paradise & Raymond City Telephone Company has been incorporated with a capital of $20,000.

DELHI, LA.—The West Carroll Telephone and Improvement Company has been incorporated with a capital of $10,000.

WEIMAR, TEX.—Farmers living south of Weimar have joined forces and are building a telephone line to connect their farms with the local exchange.

STRAUSSTOWN, PA.—The Womelsdorf and Rehrersburg Rural Telephone Company, organized with $5,000 capital, will construct lines reaching Mt. Ætna, Millersburg, Rehrersburg, Host, Krick's Mill, Bernville, Strausstown and North Heidelburg. A. M. Miller, Stroudsburg, is president of the company.

PLYMOUTH, MICH.—The Wayne County Telephone Company, a $50,000 corporation, has filed articles of association. Of the authorized capital, $28,000 has been paid in cash. The directors of the company, all residents of Plymouth, are headed by Edward C. Hough.

INDUSTRIAL ITEMS.

THE PACIFIC ELECTRIC HEATING COMPANY, Ontario, Cal., in the October issue of "Hot Points," calls attention to a number of interesting features concerning electric heating and cooking devices.

ROSSITER, MACGOVERN & COMPANY, New York, dealers in electrical machinery, have issued their October stock list, which catalogues an extensive stock of electrical machinery, boilers, engines, dynamos and motors.

THE MURPHY ELECTRICITY RECTIFIER COMPANY, Rochester, N. Y., has prepared working drawings and specifications, upon which bids will be received for the manufacture of its apparatus. These specifications will be furnished upon application.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, Philadelphia, Pa., has removed its New York office to the Hudson Terminal buildings, Church Street. Hereafter this office will be in charge of G. M. Dyott, formerly of the company's Pittsburg office.

THE CLARENCE VREDENBURG COMPANY, specialist in advertising, Monadnock Block, Chicago, has mailed to its friends copies of a handsome calendar of a subject appropriate to electric lighting. The calendar sheets will be useful from the present month until April, 1909.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a twenty-page circular devoted to a description of direct and alternating-current vibratory massage motors. Literature is also being distributed by the company describing the Samson strand or messenger wire grip and a new adjustable telephone bracket.

THE GREGORY ELECTRIC COMPANY, Chicago, Ill., supplements its regular bargain sheet for November, listing a large stock of generators, motors, engines, lamps, transformers, switchboards and supplies, with a dealers' list of machines offered as received without being overhauled, at special bargains and for immediate delivery.

THE PETTINGELL-ANDREWS COMPANY, Boston, Mass., has recently published a new catalogue of ignition specialties for internal-combustion engines. This covers spark coils for automobile and motor-boat service, spark plugs, spark indicators, switches and batteries, most of which are made by the Jacobson-Brandow Company, Pittsfield, Mass., for which it is the exclusive selling agent.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., is distributing a bulletin covering its laboratory rheostats showing a fifty-six-ampere size, giving ampere divisions from 0.1 to fifty-six amperes, which, it is declared, cannot be so manipulated as to cause a "burn-out." This bulletin contains H. Ward Leonard's table of equivalent values of electrical and mechanical units.

THE NERNST LAMP COMPANY, Pittsburg, Pa., in the October issue of "The Glower," describes an interesting installation of Nernst lamps in Seattle, Wash. Visitors to the Alaska-Yukon-Pacific Exposition, soon to be held in that city, will find many fine examples of Nernst illumination. There are more than 13,000 glower units in use in Seattle, and new installations are being made every day.

THE COLUMBIA METER COMPANY, Indianapolis, Ind., announces that, owing to the increased demand for Columbia meters, it has been found necessary to seek more commodious quarters, removing its plant to Tenth and Canal streets, where it has excellent facilities to enable all orders to be filled promptly. The company has just issued a new bulletin, which it will send to any address upon request.

THE DAYTON ELECTRICAL MANUFACTURING COMPANY, Dayton, Ohio, sustained a loss of nearly $40,000, largely covered by insurance, when the two upper stories of its factory were burned and its offices drenched with water. Fortunately a large stock of finished material was on hand, stored in a part of the building not affected by the fire, and the company was able to fill orders promptly. An immediate plan of action was formulated as soon as the fire was under control, the offices were moved by the following afternoon and the factory will be working to its full extent within a few days. The company announces that it is in a position to ship anything in its line promptly, and, despite the fire, finds itself in excellent condition.

CONSOLIDATED RAILWAY, LIGHTING AND REFRIGERATING COMPANY stockholders are invited by a committee, consisting of Isaac L. Rice, A. G. Fromuth and J. L. Watson, to participate in the reorganization of that company. Pamphlets containing a copy of the agreement may be obtained on application to the Manhattan Trust Company, No. 20 Wall Street, who will receive deposits until and including December 1. The committee may be addressed at No. 5 Nassau Street, New York.

THE RIDGWAY DYNAMO AND ENGINE COMPANY, Ridgway, N. J., builders of automatic engines and dynamo-electric machinery, announces that its Philadelphia office has been moved from the Girard Building to 1017 Witherspoon Building. The office has been placed under the management of Mr. Robert S. Beecher. The company reports that, with its additional lines of side-crank engines and the rapidly improving business conditions throughout the country, the prospects are bright for a largely increased volume of orders during the coming season.

THE SCHULTZ BELTING COMPANY, St. Louis, Mo., has sold to the Roswell Electric Light and Power Company 110 feet of thirty-two-inch, three-ply driving belt. The company is also shipping a thirty-five-inch, three-ply belt for a 500-horsepower mine haulage at Johannesburg, South Africa. The Rosario de Santa Equipment Company, of Argentine Republic, has ordered an eighteen-inch double belt, for driving in one of its mills. The company has also made a shipment of 6,500 feet of miscellaneous belting and a large three-ply belt to Moscow, Russia.

THE HORNBERGER TRANSFORMER COMPANY, Lafayette, Ind., has been incorporated recently, and is composed of local business men. The company has leased, and is negotiating for, the purchase of a factory building located at Fifteenth and Elizabeth streets. All of the accounts receivable of the Lafayette Electrical Manufacturing Company have been purchased, and the manufacture of Hornberger transformers will be continued under the management of William H. Hornberger. Mr. Hornberger has been ill for about a year, but now is almost fully recovered. The company believes that the excellent record established for this well-known make of transformers will be fully maintained, and the new factory is being equipped throughout with modern machinery and improved facilities for turning out large quantities of a high-grade product.

LEGAL NOTES.

NEGLIGENCE IN CROSSING CITY RAILWAY TRACK—Whether failure to look and listen before attempting to cross an interurban street-car track laid along the public highway is negligence, is held, in Chicago & Joliet Electric Railway Company vs. Wanic, 230 Ill. 530, 82 N. E. 821, 15 L. R. A. (N. S.) 1167, to be a question for the jury.

CONTRIBUTORY NEGLIGENCE—One engaged in unloading a wagon, with his body in the path of passing street cars, and who for five or ten minutes fails to look or listen for an approaching car, is held, in Volosko vs. Interurban Street Railway Company, 190 N. Y. 206, 82 N. E. 1090, 15 L. R. A. (N. S.) 1117, to be negligent as a matter of law.

COMPANY LIABILITY IN MAINTAINING SERVICE—One who slips and falls upon a street crossing rendered slippery by oil applied by a trolley company to its tracks to facilitate rounding a curve is held, in Slater vs. North Jersey Street Railway Company (N. J. Err. & App.), 69 Atl. 163, 15 L. R. A. (N. S.) 840, to be entitled to recover for injuries received.

FAILURE TO ANNOUNCE LONG-DISTANCE TELEPHONE CALL—The negligent failure of a telephone company to summon an addressee to receive a long-distance message offering employment is held, in McLeod vs. Pacific States Telephone and Telegraph Company (Or.), 94 Pac. 568, 15 L. R. A. (N. S.) 810, to render the company liable for the loss thereby occasioned.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the Second Issue of Each Month.)

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, Walker Electric Company, Twenty-third and Noble streets, Philadelphia, Pa. Next meeting, January, 1909.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Cosmos Club, Washington, D. C. Annual meeting, Baltimore, Md., January, 1909.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Dr. J. W. Richards, Bethlehem, Pa.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, 352 Willis Avenue, New York, N. Y.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary Dr. Richard Moldenke, Watchung, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN INSTITUTE OF MINING ENGINEERS. Secretary, Rossiter W. Raymond, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th Street, New York, N. Y.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN RAY SOCIETY. Secretary, Dr. G. C. Johnson, 514 Bijou Building, Pittsburg, Pa. Annual meeting, New York, N. Y., December 28-30.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Forty-seventh Street, New York, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 29 West Thirty-ninth Street, New York, N. Y. Annual meeting, New York city, December 1-4.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, A. P. Folwell, 239 West Thirty-ninth Street, New York, N. Y.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, H. E. Weeks, secretary and treasurer Tri-City Railway Company, Davenport, Iowa.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION. Secretary, B. B. Davis, claim agent Columbus Railway and Light Company, Columbus, Ohio.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, J. W. Corning, electrical engineer Boston Elevated Railway Company, Boston, Mass.

AMERICAN STREET AND INTERURBAN RAILWAY TRANSPORTATION AND TRAFFIC ASSOCIATION.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION. Secretary, George B. Keegan, 2321 Park Row Building, New York, N. Y.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, J. E. Cowles, superintendent of lighting Hot Springs Light and Railway Company, Hot Springs, Ark.

ARKANSAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

ASSOCIATION OF CAR-LIGHTING ENGINEERS. Secretary, G. B. Colegrove, Illinois Central Railroad. First annual meeting, Chicago, Ill., November 16.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, D. L. Huntington, second vice-president and manager Washington Water Power Company, Spokane, Wash.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington Street, Newton, Mass.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Wisconsin Central Railway, Milwaukee, Wis.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION. Secretary, L. E. W. Pioda, Oak and Broderick streets, San Francisco, Cal.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Canada.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Acton Burrows, 33 Melinda Street, Toronto, Ontario.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, W. F. Milholland, secretary and treasurer Indianapolis Traction and Terminal Company, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. C. Lawler, Colorado Springs, Colo.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, F. W. Poole, Bridgeport, Conn.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 7 Water Street, Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine Street, St. Louis, Mo.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago, Ill.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA, LIMITED. Secretary, William R. Stanley, Royal Insurance Building, Montreal, Canada.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, Cal., first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York, N. Y. Board of directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau Street, New York, N. Y.

ENGINEERS' CLUB OF PHILADELPHIA. Secretary, H. G. Perring, 1317 Spruce Street, Philadelphia, Pa.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt Street, New York, N. Y.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. A. Camp, Henry, Ill.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Van Rensselaer Lansingh, Engineering Societies Building, 33 West Thirty-ninth Street, New York, N. Y.

INDEPENDENT TELEPHONE ASSOCIATION OF TEXAS AND LOUISIANA. Secretary, C. A. Shock, Sherman, Tex.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. S. Norton, Indianapolis, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ward, Grand Rapids, Mich. Secretary's office, Monadnock Building, Chicago, Ill. Annual convention, Chicago, Ill., December 1-3.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Iowa.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Iowa.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

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MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MICHIGAN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. A. Burch, Battle Creek, Mich.

MILWAUKEE SOCIETY OF ENGINEERS. Secretary, W. Fay Martin, 456 Broadway, Milwaukee, Wis.

MISSOURI ELECTRIC LIGHT, GAS AND STREET RAILWAY ASSOCIATION. Secretary, Claude L. Clary, Sikeston Electric Light and Power Company, Sikeston, Mo.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, George W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee Street, Utica, N. Y.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago, Ill.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, John F. Gilchrist, Commonwealth Edison Company, Chicago, Ill.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb.

NEBRASKA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. E. Mattison, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 60 State Street, Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass. Meetings held on fourth Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 West Thirty-ninth Street, New York, N. Y.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Temporary secretary, J. D. Crary, Aberdeen, Wash.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, R. N. Kimball, Kenosha, Wis. Annual meeting, Milwaukee, Wis., January, 1909.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, O. O. Welsheimer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Ballard, Cleveland, Ohio.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

OLD TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, Frank J. Scherrer, New York, N. Y.

ORDER OF THE REJUVENATED SONS OF JOVE. Mercury, C. B. Roulet, Dallas, Tex.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. S. Smith, Towanda, Pa.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION, Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa. Next annual meeting, Louisville, Ky., October 12-14, 1909.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

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SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, J. A. Myler, Jr., 608 Juanita Building, Dallas, Tex.

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TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

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WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 382 Ohio Street, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION. Secretary, Clement C. Smith, president Columbia Construction Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

ALABAMA LIGHTING AND TRACTION ASSOCIATION. Temporary secretary, F. K. Jackson, Mobile, Ala.

DATES AHEAD.

Association of Car-Lighting Engineers. First annual meeting, Chicago, Ill., November 16.

National Society for the Promotion of Industrial Education. Annual meeting, Atlanta, Ga., November 19-21.

International Independent Telephone Association. Annual convention, Chicago, Ill., December 1-3.

American Society of Mechanical Engineers. Annual meeting, New York city, December 1-4.

American Roentgen Ray Society. Annual meeting, New York city, December 28-30.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

American Association for the Advancement of Science. Annual meeting, Baltimore, Md., January, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) November 3, 1908.

902,553. RAILWAY-SIGNALING APPARATUS. Edward R. Brodton, Mobile, Ala., assignor to George H. Fonde and Ernest E. Wagar, Mobile, Ala. Filed November 19, 1907. A wireless-telegraph railway-signal system.

902,554. INDICATOR. George Brown, Sarnia, Ontario, Canada, assignor to Brown Automatic Indicator Company, Port Huron, Mich. Filed May 18, 1907. A controller has a co-operating and a selected contact, and means operating upon an over-movement for reversing a motor and for cutting it out again before the co-operating contact is returned to the selected contact.

902,569. DETECTOR. Cornelius D. Ehret, Ardmore, Pa., assignor to International Telegraph Construction Company. Filed July 29, 1905. A wave-responsive device for a wireless signaling system consists of a two-fluid primary cell.

902,588. ROTOR CONSTRUCTION. Charles E. Lord, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. Filed June 22, 1905. A revolving field has wedge-shaped field coils whose sides are radial with respect to the shaft.

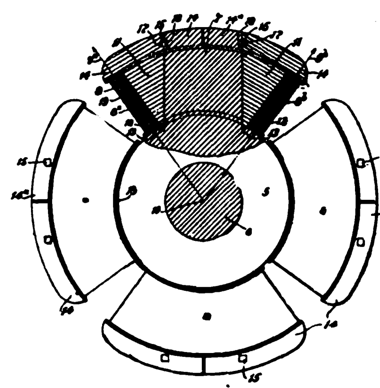
902,600. VALVE-CONTROLLING APPARATUS. William B. D. Penniman, Baltimore, Md. Filed June 23, 1905. An electric motor operates the valve mechanism in both directions and an automatic switch controls the direction of the current through the motor.

902,607. METHOD FOR PRODUCING NITRIC OXIDE. Isaiah L. Roberts, New York, N. Y. Filed February 20, 1907. The method consists in subjecting a mixture of nitrogen and oxygen to an electric arc containing chromium.

902,613. RECEIVING APPARATUS. Harry Shoemaker, Jersey City, N. J., assignor to International Telegraph Construction Company. Filed January 20, 1906. In a wireless signaling system a wave detector consists of a pair of primary cells of minute power connected in opposition to each other.

902,621. MOTOR-CONTROL SYSTEM. Emmett W. Stull, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed August 27, 1906. A controller for commutating-pole motors is arranged to connect resistances in series with the motors or in shunt with their field magnets.

902,624. ELECTROMAGNET. Burton W. Sweet, Cleveland, Ohio, assignor to Century Telephone Construction Company, Buffalo, N. Y. Filed May 19, 1906. A telephone drop magnet with self-restoring jack.



902,588.—ROTOR CONSTRUCTION.

902,628. TROLLEY WHEEL. Lewis J. Tetlow, Chicopee Falls, Mass., assignor to New England Trolley Wheel Company, Holyoke, Mass. Filed January 2, 1908. The hub of the wheel has a chamber containing bearing discs and lubricating material forming the spaces between the discs.

902,630. ELECTRIC SIGNALING APPARATUS. Nelson M. Watson, Detroit, Mich., assignor to John Henry Carstens, Detroit, Mich. Filed May 21, 1906. In combination with the throttle and reversing levers of an engine is a battery circuit, including an alarm and a number of indicating signals.

902,637. FLUID-PRESSURE SYSTEM. Bert Aikman, Chicago, Ill., assignor to National Brake and Electric Company, Milwaukee, Wis. Filed May 27, 1907. The pressure in a motor-driven compressed-air system regulates the speed of the motor.

902,641. TELEPHONE SUBSTATION SET. Jules A. Birsfield, Chicago, Ill., assignor to Alfred Stromberg, Chicago, Ill. Filed November 20, 1906. Attached to the inner surface of the door is a sheet of metal upon which are formed projections to serve as one element of a hinge, as lugs for retaining a condenser, and as lugs for mounting a spring latch for holding the door closed.

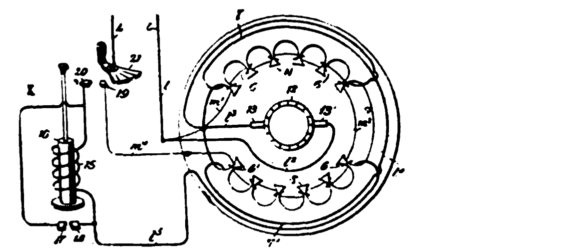
902,642. TRANSMITTER HINGE. Jules A. Birfield, Chicago, Ill., assignor to Alfred Stromberg, Chicago, Ill. Filed March 28, 1907. A ball-and-socket hinge for adjusting the transmitter.

902,681. STORAGE BATERY. David P. Berry, Chicago, Ill., assignor to William Morrison, Chicago, Ill., and M. A. Lumbard, Des Moines, Iowa. Filed January 2, 1904. Renewed March 18, 1908. The battery comprises an upright copper cell, an alkaline electrolyte, a vertical negative element surrounded by a positive element made of concentric cylinders of copper-wire gauze with an interposed layer of prepared copper and cadmium oxide.

902,715. TELEPHONE-EXCHANGE SYSTEM. Elmer R. Corwin, Chicago, Ill., assignor to Monarch Telephone Manufacturing Company. Filed December 12, 1904. Circuits for the supervisory relay and lamps are described.

902,720. SINGLE-PHASE COMMUTATOR MOTOR. George W. Euker, Boston, Mass., assignor to Diehl Manufacturing Company. Filed August 20, 1907. A field magnet having a pair of consequent poles, each of which is symmetrically subdivided, has series windings for each pole and separate serially-connected windings for each of the subdivisions.

902,741. WARP STOP-MOTION FOR LOOMS. Frederic E. Kip, Montclair, N. J. Filed July 27, 1907. A closing drop for an electrical stop-motion.

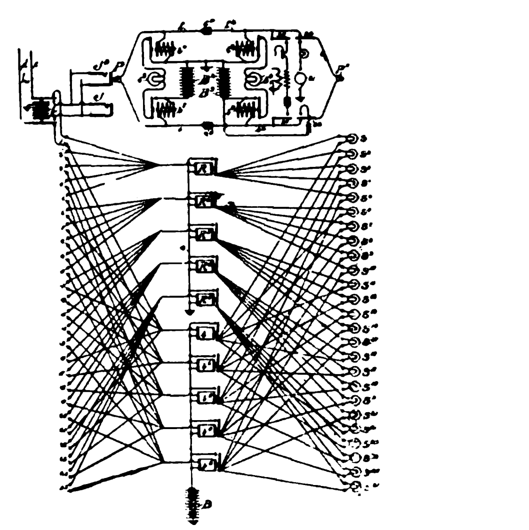


902,720.—SINGLE-PHASE COMMUTATOR MOTOR.

902,753. BULLET PROBE. George E. Marshall, Aguilar, Colo. Filed May 8, 1907. A flexible insulated tube has two complemental probe members at one end adapted to form electrodes, and a low-voltage incandescent lamp in series with a battery.

902,755. ELECTROLYTE FOR ELECTROPLATING. Otto Meyer, Richmond, Va. Filed March 22, 1907. A solution of chloride of copper and chlorides of other metals in alcohol.

902,773. MAGNET FOR TELEGRAPHONES. Harve R. Stuart, Wheeling, W. Va. Filed March 2, 1908. A recording magnet in the form of a solenoid with a recording wire passing axially through the same.



902,930.—TELEPHONE SYSTEM.

902,777. SYSTEM OF ELECTRICAL DISTRIBUTION. Joseph H. Tracy, Philadelphia, Pa. Filed March 19, 1908. Combined with a storage battery is a booster with special windings for regulating the charge and discharge of the battery with fluctuations in the combined alternating and direct-current excitation.

902,781. BALL-BEARING TROLLEY WHEEL AND HARP. Stephen Tully, Jr., Philadelphia, Pa. Filed February 27, 1908. The wheel has a spherical central portion provided with unbroken, smooth, outer bearing surfaces.

902,782 and 902,783. IGNITION SYSTEM FOR EXPLOSION ENGINES. Richard Varley, Englewood, N. J., assignor to the Autocoil Company. Filed October 1, 1906. A cam and vibrator mechanism for opening and closing the primary circuit.

902,792. TYPE-PRINTING TELEGRAPH APPARATUS. Gustaf A. M. Agrell, Stockholm, Sweden. Filed January 8, 1908. An electric type-printing apparatus has a movable type wheel and a number of wheel-operating members.

902,798. INTERMITTENT ILLUMINATING SYSTEM. Francis B. Badt, Chicago, Ill. Filed August 9, 1905. A flasher operated by a solenoid and thermostat.

902,834. CONTROLLER. William D. Pomeroy, Norwood, Ohio, and Edwin C. Wright, Newport, Ky., assignors to the Bullock Electric Company. Filed August 4, 1903. Renewed February 21, 1907. Deflectors are arranged between the contacts of the controller cylinder.

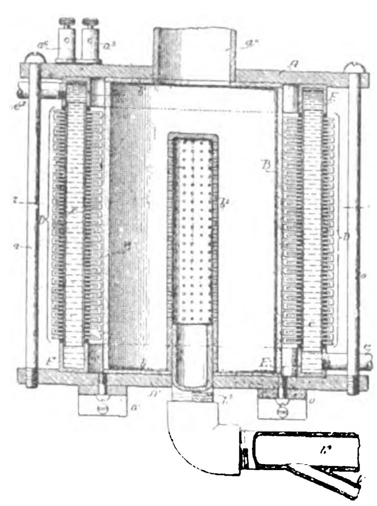
902,851. ELECTRIC-GENERATION SYSTEM. Fred R. Babcock, Chicago, Ill. Filed March 23, 1907. A combination of a generator, storage battery, and regulating devices for charging the battery from a source of power whose speed varies considerably.

902,857. LINT-REMOVER FOR ELECTRICAL WARP STOP-MOTIONS. Edmond Champagne, Jr., Albion, R. I. Filed May 6, 1908. Combined with the contact roll are circuit-closing means and a roll for wiping the contact roll.

902,892. METHOD OF AND APPARATUS FOR ELECTROPLATING. George A. Lutz, Plainfield, N. J., assignor to American Circular Loom Company, Portland, Me. Filed June 27, 1908. The method of plating the interior and exterior of a hollow article consists in simultaneously passing a current through anodes within and without the article and causing the current to flow longer through the outer anode.

902,930. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed December 19, 1902. In connection with a number of telephone lines are line relays, the total number of which is less than the number of lines.

902,936. HEAT-CONTROLLING APPARATUS. Michael J. Brierty, Chicago, Ill. Filed January 20, 1908. An electromagnetically-controlled motor drives a shaft through a train of gears.



903,116.—PYRO-ELECTRIC GENERATOR.

902,960. ELECTRIC-LIGHT FIXTURE. John H. Goehst, Chicago, Ill. Filed February 13, 1908. To the base of the chandelier stem is attached a support through the perforations of which the sockets extend.

902,962. PUSH-BUTTON FOR ELECTRIC SWITCHES. Gilbert W. Goodbridge, Bridgeport, Conn., assignor to the Perkins Electric Switch Manufacturing Company, Bridgeport, Conn. Filed July 24, 1908. A sheet-metal button-head is fastened to a stem having a tubular head.

902,975. STORAGE BATTERY. Simon Lake, Bridgeport, Conn. Filed July 6, 1907. Each battery plate consists of two rectangular grids united at their tops and provided on both sides with a number of recesses containing active material.

902,985. CONTROLLER FOR MOTOR TRACTION CARS. William C. Mayo, El Paso, Tex., assignor to George E. Briggs, Barstow, Tex., and to John Houlehan, El Paso, Tex. Filed February 24, 1908. The movement of the controller arm in one direction governs the electric motors; the movement in the other direction governs the electrically-controlled brakes.

902,990. ARC LAMP. Richard P. Myers, Walthamstow, England. Filed July 22, 1907. In this arc lamp there is a thermally-expansible metal strip arranged in series with the arc.

903,076. AUTOMATIC FIRE-ALARM SYSTEM. Charles J. Fox, London, England. Filed August 3, 1906. A combined service electric-bell system and an automatic fire-alarm system has a service-bell circuit, a thermostat circuit and a corridor-bell circuit.

903,090. DYNAMOMETER FOR EXPLOSION ENGINES. Nevil M. Hopkins, Washington, D. C. Filed February 12, 1908. A fitting on the cylinder carries the gas igniter and a thermocouple, the latter being connected to an external electric indicator.

903,116. PYRO-ELECTRIC GENERATOR. George J. Vokel, Philadelphia, Pa. Filed January 15, 1908. A number of thermoelectric couples are arranged in sets, the inner ends being heated and the middle portions cooled through a set of vertical conduits.

903,130. BINDING POST. Charles Cuno, Meriden, Conn., assignor to Connecticut Auto Engineering Corporation, Meriden, Conn. Original application filed September 19, 1906. Divided and this application filed November 11, 1907. A threaded binding post with washer and nut.

903,141. SOCKET FOR INCANDESCENT ELECTRIC LAMPS. George B. McBean, Chicago, Ill., assignor to Mechanical and Electrical Manufacturing Company, Chicago, Ill. Filed May 18, 1907. An attaching base contains a shell to which is fastened a button provided with a shoulder that interlocks with the corresponding hole in the shell.

903,152. COMBINED FIRE-ALARM AND EXTINGUISHING SYSTEM. Charles E. Buell, North Plainfield, N. J., assignor to General Fire Extinguisher Company, New York, N. Y. Filed May 10, 1900. Combined with a sprinkler system is a telephone circuit and means for sending different signals over this circuit.

903,153. COMBINED TELEPHONE AND FIRE-ALARM SYSTEM. Charles E. Buell, North Plainfield, N. J., assignor to General Fire Extinguisher Company. Originally filed May 10, 1900. Divided and this application filed April 9, 1901. A modification of No. 903,152.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired November 10, 1908:

462,681. ELECTRIC CONDUCTOR. J. A. Barrett, Brooklyn, N. Y.

462,688. ELECTRIC-RAILWAY SYSTEM. H. C. Camp, St. Paul, Minn.

462,696. ICE-CREAM FREEZER. T. B. Garretson and W. E. Thatcher, Oskaloosa, Iowa.

462,698. ELECTRIC ARC LAMP. J. E. Giles, Hazleton, Pa.

462,741. POLICE-SIGNAL TELEGRAPH SYSTEM. C. A. Rolfe, Chicago, Ill.

462,751. ELECTRIC-RAILWAY MOTOR. C. J. Van Depoele, Lynn, Mass.

462,756. CARBON HOLDER FOR ARC LAMPS. J. J. Wood, Brooklyn, N. Y.

462,793. ELECTRIC CAR BRAKE. J. D. Collier and J. P. Miller, Woodville, Tex.

462,794. ELECTRICAL CONNECTION AND SIGNAL FOR RAILWAY CARS. J. D. Collier and J. P. Miller, Woodville, Tex.

462,807. ELECTRIC CAR COUPLING. J. D. Collier and J. K. P. Miller, Woodville, Tex.

462,808. POLICE-SIGNAL SYSTEM. N. B. Cregier, Chicago, Ill.

462,813. SIGNAL SYSTEM FOR TELEPHONE PAY STATIONS. Wm. Gray, Hartford, Conn.

462,835. ELECTRICAL INDICATOR FOR ELEVATORS. C. G. Armstrong, Chicago, Ill.

462,850. ELECTRIC CIRCUIT-CLOSING AND BREAKING DEVICE FOR RAILWAY TRACKS. T. H. Patenall, Rahway, N. J.

462,881. ARMATURE FOR DYNAMO-ELECTRIC GENERATORS. S. H. Short, Cleveland, Ohio.

462,882. ARMATURE FOR DYNAMO-ELECTRIC MACHINES. S. H. Short, Cleveland, Ohio.

462,901. DUPLEX AND QUADRUPLEX TELEGRAPHY. F. W. Jones, New York, N. Y.

462,973. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES. E. Thomson and Wm. O. Wakefield, Lynn, Mass.

463,001. ELECTRICAL ANNUNCIATOR. J. B. Smith, Manchester, N. H.

463,020. ELECTRICAL RAILWAY SYSTEM. G. T. Woods, New York, N. Y.

463,024. REVERSIBLE ELECTRIC TROLLEY. J. W. Bates and C. E. Blake, Minneapolis, Minn.

463,079. ELECTRIC CONDUCTOR. C. T. Snedekor, New York, N. Y.

463,086. ELECTRIC SAFETY CUT-OUT DEVICE. A. G. Waterhouse, Hartford, Conn.

ELECTRICAL REVIEW
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CONTENTS.

CAR-LIGHTING ENGINEERS.

The first annual meeting of the Association of Car Lighting Engineers was held the best part of the week at the Grand Pacific Hotel, Chicago, and several thoroughly interesting and profitable sessions were participated in. On Wednesday evening the annual banquet was held, and on Friday the engineers made a visit of inspection to Milwaukee.

Two of the papers read at the opening session were particularly interesting. The first, by Mr. Patrick Kennedy, referred briefly to the general developments of car lighting by electricity, utilizing both the straight storage-battery equipment and combinations of axle-driven generators and other forms of installation. In the course of his paper Mr. Kennedy called attention to several absurdities upon which patents had been granted, and through which it was expected that the problem would be solved.

The other paper was by Mr. W. L. Bliss, and brought out with great clearness the innumerable difficulties under which the pioneers in this development have labored. Contrary to the present-day spirit of enterprise, there were not many railroad magnates in the old days who would consent to the spending of considerable sums of money for the trying-out of the various systems of car lighting. Mr. Bliss paid tribute, however, to several of those who, through their generosity and broadmindedness, had made possible the present-day developments.

While the advantage of using electric incandescent lamps for car lighting was recognized long ago, and installations made both here and abroad in the early eighties, the general tendency, except on a few of the larger roads, has been to get along in a loose fashion with any light which might be available and easily installed, placing the light units in a more or less haphazard fashion. The car-lighting engineer of today realizes that the comfort of the passenger will be greatly increased, and the value of the services of the engineers to their employers enhanced, if proper consideration is given to selecting the best types of equipment, as regards utility, reliability and accessibility, and distributing the light sources in the most scientific fashion.

Car-lighting engineering involves considerable detail of electrical ingenuity in construction and design, high mechanical ability in the same directions, and talent in the selection and placement of the lighting units. Today we call the latter feature illuminating engineering. So there is a possibility of combining the services of highly-trained men to work out the best system of power generation, and the best system of light distribution.

The electric train-lighting system today consists essentially of a dynamo either driven from the axle of the train by some form of transmission, or operated by an auxiliary prime mover supplied with steam from the locomotive, a storage battery, a pole-changing device for taking care of the direction of running, an automatic switching contrivance for effecting the control of the battery, lamp and dynamo connections, and a regulating device for taking care of generator and lamp regulation.

The difficulties involved in axle-lighting in securing a direct and continuous drive have been almost insuperable. In most cases it is necessary to take the rough axle as it is received, equip it with a collar or hollow sleeve, and provide some form of elastic or telescopic transmission gearing between the driving axle and the pulley of the generator. The pounding and hammering to which the generator and the driving system are subjected make direct gearing almost impossible, and to secure a proper method of suspension the greatest effort has been made. The problem seems to have been best solved by the use of the rubber belt with a sufficiently large pulley ratio and wide enough pulley faces. Where the equipments are large enough to be built ruggedly and made a part of the locomotive, the problem of direct gearing is simplified. In the other case the belt forms a sort of mechanical safety fuse in the power-transmission system.

The equipment of railroad car-repair shops becomes a matter of importance in considering an axle-driven electric-lighting installation. Locomotive roundhouses are equipped with pits, which make the inspection of heavy generator cases an easy matter. Where the equipment which forms a part of the car is not placed in an easily accessible position, the labor of the repair man and the car-lighting engineer is greatly increased.

Pole-changers of every description, utilizing air, gas, gravity, mechanical movements, and others electrically operated, have been put forward for use in car lighting. The opinion seems today to favor the electrically-controlled pole-changer and brush-shifting mechanism. Some of the greatest difficulties encountered have been in effecting a proper relation between the dynamo and the discharged storage battery. To secure that regulation which will keep the battery properly charged and connect the dynamo while the train is running to either the lamp circuit or the battery circuit, as conditions may require, and which will automatically switch the battery onto the lamp circuit without prohibitive voltage fluctuations at the lamp terminals when the train is either running slow or standing still, has not been an easy task.

It is the opinion of Mr. Bliss that a great many of these problems have been, or are about to be, solved. The experience gained these many years has been profitably taken advantage of, and the men who have done the work are still available, so that it is easy to believe that they will see the consummation of their labors and enjoy the appreciation of perfected systems of train lighting in the very near future. To this end the association just organized can lend great help, and this is one of the fundamentals of the organization—to effect that uniformity of equipment and betterment of service which will put train lighting on the plane that has been reached in the best types of building illumination today.

MAINTAINING THE MAGNETITE ARC SYSTEM.

The extension of the magnetite arc lamps system in central-station street-lighting applications raises a number of special points in design and operation which are as yet not widely appreciated by power-plant attendants. The use of the constant-current transformer in conjunction with the mercury-arc rectifier presents some unusual problems in wiring, and there is here an excellent opportunity to employ the most advanced forms of iron conduit construction in planning the installation. In an ordinary 2,300-volt alternating-current plant both the constant-current transformer and the mercury-arc rectifier must come between the main station bus-bars and the arc-circuit distributing board. The first piece of apparatus obviously transforms constant potential into constant-current energy, while the mercury rectifier wipes out all the pulsations in one direction and delivers a direct current of constant amperage to the arc panels, since the latter is essential to the operation of the magnetite arc lamp under present commercial conditions. In the lay-out of such a system compactness in apparatus arrangement tends to bring the cost of wiring down, and if the equipment is not crowded, economy in first cost will be consistent with operating flexibility and ease of repairs.

In the actual operation of the system it is most important to keep the lines free from grounds, perhaps even more necessary than in the operation of an ordinary direct or alternating-current arc system. The reason for this is that the small current of four amperes used by the magnetite system at the lamps will not burn off incipient crosses as will the larger current of the older service. Hence a cross means that a circuit goes out of commission until it can be located and removed. Another point of importance is to keep the rectifier tubes from flashing. A flash amounts to an open circuit in this case, and produces a corresponding strain on the insulation of the lines and apparatus.

It is desirable to keep a careful record of the hours of service of each tube on a blank designed for the purpose. Each tube should be numbered, and in this way the life can readily be kept up to date. In some cases the tube life is now exceeding from 2,000 to 2,500 hours, which makes the cost very low at an initial investment of about $25 per tube. The ordinary magnetite arc lamp exhibits a high efficiency at the lamp, since four amperes at eighty volts are adequate for the service, but in order to check the performance of the system as a whole a recording wattmeter should be located just beyond the alternating-current bus-bars, where the initial circuits running to the tube transformers are tapped off. Instead of an average of 320 watts per arc, the total input per lamp at the 2,300-volt bus-bar is liable to be from 380 to 390 watts, representing a loss of about seventeen per cent in all the apparatus of the system. Considering the two current transformations this is not by any means a bad showing, and if the condition of the insulation and the flashing of the tubes are kept under close control, the results ought to be satisfactory in cases where this system seems to be the best for the local requirements.

MUNICIPAL LIGHTING IN CHICAGO.

At a recent meeting of the Chicago Electric Club, William Carroll, City Electrician of Chicago, made some interesting comparisons of the lighting of Chicago and other great cities in this country. Early in the year it was discovered that, as compared with New York, which contained 14,756 municipal arc lamps, Chicago had 8,822. The latter city had 3,000 less than Philadelphia, and a great many more than Cincinnati, Boston or St. Louis. The annual cost of municipal lighting in Chicago last year was $1,031,542; in New York, $2,648,546; in Philadelphia, $1,621,049, and in the other cities named considerably less. Only two of the cities—New York and Philadelphia—had a greater estimated candlepower than Chicago, and only one—New York—a greater area to be lighted.

It is interesting to note the development of the cost of municipal lighting. In 1895 it cost Chicago $1,098,000, in round numbers, for an estimated candlepower of 3,964,000. For the year 1907 the cost was $1,031,542, and the estimated candlepower 18,233,000.

Considerable improvement will be effected by changing over from the old steam stations to the new transformer substations, which will receive their primary source of current from the Drainage Canal system. The circuits which, under the old conditions, sometimes contained twenty-eight miles of wire, will also be materially shortened, the substations being established at natural centers of distribution.

It is estimated that in order to properly light the Chicago district at least 29,000 arc lamps will be needed. Assuming a cost of $115 per lamp, the total required would be nearly $2,000,000. Adding to this the cost of replacing the existing equipment, the cost would come to approximately $2,305,000.

Mr. Carroll and his predecessors have done the best possible with the facilities at hand, and the appropriations which have been available for municipal lighting. If there is to be adequate lighting in this great city, and if this result is to be accomplished quickly, the large amount of money necessary must be secured at one time, and can hardly come out of the general taxes. The adequate lighting of the city at the present day will certainly inure to the benefit of posterity, and it does not seem unreasonable that posterity should be saddled with some of the burden, and effectual means taken at once to secure, by bonds or otherwise, the wherewithal to effect this very necessary public improvement.

ELECTRIC HEATING.

The subject of electric heating has come to the fore of late years, and has attracted a good deal of discussion. Through the persistent efforts of a few hardy workers the possibilities of this method have been forced on the central stations and the manufacturers, and today we are more or less familiar with a number of contrivances for utilizing electricity as an agent for producing heat in domestic and industrial operations.

At the meeting of the American Institute of Electrical Engineers last week, Mr. W. S. Hadaway, Jr., presented a paper entitled "Electric Heating," which, in a most conservative fashion, pointed out some of the limitations and advantages of heating by electricity. It appears that for industrial operations where a high heat and localized application are desirable, there is nothing so economical as the electric heating device, leaving out of consideration the concomitant advantages of cleanliness, convenience and better hygienic conditions. In the larger applications, such as heating large rooms, it would appear that electricity is a rather poor competitor of low-pressure steam, especially where steam is readily available. On the other hand, there are those exponents of electric heating for both domestic and industrial applications who do not hesitate to say that the apparatus for converting electrical energy into heat is available, and all that is needed to make it highly popular and strictly essential is a cheapening of the cost of production. In competition with electricity the price of gas has been brought to a pretty low level, and the possibility exists that as competition continues, and as the materials of construction are more conservatively handled and the cost of production is reduced, electricity will become cheaper at a greater rate than gas. The possibility of utilizing large waterpowers, thus securing low power costs, with the probability of the raw material from which gaseous and solid fuel is converted increasing in value, heightens the likelihood of electricity taking first place as a heating agent.

THE ELECTRIFICATION OF THE ST. CLAIR TUNNEL.

On other pages of this issue there appears an illustrated description of the features of the electrification of the tunnel under the St. Clair River, operated by the Grand Trunk system between Port Huron, Mich., and Sarnia, Ontario. From portal to portal the tunnel is 6,032 feet in length, and the electrification has been carried out under the direction of the engineers of the company, with Bion J. Arnold acting in a consulting capacity.

Several interesting features in electrical and mechanical design have been worked out in order to make expedient the handling of trains through this tunnel under rather difficult conditions. As is well known, the electrical system of propulsion is supplied by alternating current at twenty-five cycles and 3,300 volts, the current being stepped down by means of ventilated transformers carried on the locomotives to 235 volts for use by the motors. The power station is built on the Port Huron bank of the St. Clair River, almost directly over the tunnel, and the feeders are led to the tunnel by means of a shaft intake extending vertically from the power house.

One of the striking features in the equipping of the generating system is the installation of an automatic system for controlling combustion, to anticipate the demands for increased power when the trains are running through the tunnels and climbing the steep ascents. By means of under-feed stokers and throttling devices the demand for power is anticipated, and a throttling device on the steam supply to the fan engine increases the boiler capacity automatically. As the pressure reestablishes itself and tends to rise above normal, the supply of steam to the fan engine is diminished, bringing about equilibrium of service.

Final Report International Conference on Electrical Units and Standards.

The sessions of the International Conference on Electrical Units and Standards were concluded on October 22. A progress report of the meetings, and including a preliminary draft of the specifications relating to mercury resistance standards, deposition of silver, and to the Weston normal cell, was given in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of November 7. The final report adopted by the Conference is as follows in full:

The Conference on Electrical Units and Standards, for which invitations were issued by the British government, was opened by the president of the Board of Trade, the Right Hon. Winston S. Churchill, M. P., on Monday, October 12, 1908, at Burlington House, London, S. W. Delegates were present from twenty-one countries, and also from the following British dependencies, namely, Australia, Canada, India and the Crown Colonies. It was decided by the conference that a vote each should be allowed to Australia, Canada and India, but a vote was not claimed or allowed to the Crown Colonies. The total number of delegates to the conference was forty-three, and their names are set out in Schedule A appended to this report.

The officers of the conference were: President, the Right Hon. Lord Rayleigh, O. M., president of the Royal Society; vice-presidents, Prof. S. A. Arrhenius, Dr. M. Egoroff, Dr. Viktor Edler von Lang, M. Lippmann, Dr. S. W. Stratton, Dr. E. Warburg; secretaries, Mr. M. J. Collins, Mr. W. Duddell, F. R. S., Mr. C. W. S. Crawley, Mr. F. Smith.

The conference elected a technical committee to draft specifications and to consider any matter which might be referred to the committee and to report to the Conference. The Conference and its technical committee each held five sittings. As a result of its deliberation the Conference adopted the resolutions and specifications attached to this report and set out in Schedule B, and requested the delegates to lay them before their respective governments with a view to obtaining uniformity in the legislation with regard to electrical units and standards.

The Conference recommends the use of the Weston normal cell as a convenient method of measuring both electromotive force and current when set up under the conditions specified in Schedule C.

In cases in which it is not desired to set up the standards provided in the resolutions, Schedule B, the Conference recommends the following as working methods for the realization of the international ohm, the ampere and the volt:

1. For the International Ohm.

The use of copies, constructed of suitable material and of suitable form and verified from time to time, of the international ohm, its multiples and submultiples.

2. For the International Ampere.

(a) The measurement of current by the aid of a current balance standardized by comparison with a silver voltameter;

(b) The use of a Weston normal cell whose electromotive force has been determined in terms of the international ohm and international ampere, and of a resistance of known value in international ohms.

3. For the International Volt.

(a) A comparison with the difference of electrical potential between the ends of a coil of resistance of known value in international ohms, when carrying a current of known value in international amperes; or

(b) The use of a Weston normal cell whose electromotive force has been determined in terms of the international ohm and the international ampere.

The duty of specifying more particularly the conditions under which these methods are to be applied has been assigned to the Permanent Commission, and pending its appointment, to the scientific committee to be nominated by the president (see Schedule D), who will issue a series of notes as appendix to this report.

The Conference has considered the methods that should be recommended to the governments for securing uniform administration in relation to electrical units and standards, and expresses the opinion that the best method of securing uniformity for the future would be by the establishment of an international electrical laboratory with the duties of keeping and maintaining international electrical standards. This laboratory to be equipped entirely independently of any national laboratory.

The Conference further recommends that action be taken in accordance with the scheme set out in Schedule D.

SCHEDULE A—LIST OF COUNTRIES AND DELEGATES.

America (United States).—Dr. S. W. Stratton, Dr. Henry S. Carhart, Dr. E. B. Rosa.

Austria.—Dr. Viktor Edler von Lang; Dr. Ludwig Kusminsky.

Belgium.—Prof. Eric Gérard, M. Clement.

Brazil.—Mr. L. Weiss.

Chile.—Don Victor Eastman.

Colombia.—Don Jorge Roa.

Denmark and Sweden—Prof. S. A. Arrhenius.

Ecuador.—Sr. Don Celso Nevares.

France.—Prof. Lippmann, M. R. Benoit, M. de Nerville.

Germany.—Prof. Warburg, Prof. Jaeger, Prof. Lindeck.

Great Britain.—The Right Hon. Lord Rayleigh (president), Prof. J. J. Thomson, Sir John Gavey, Dr. R. T. Glazebrook, Major W. A. J. O'Meara, Mr. A. P. Trotter.

Guatemala.—Dr. Francisco de Arce.

Hungary.—Joseph Váter, Dr. Desiré Harsanyi.

Italy.—Prof. Antonio Ròiti.

Japan.—Dr. Osuke Asano, Mr. Shigeru Kondo.

Mexico.—Don Alfonso Castelló, Don José Maria Perez.

Netherlands.—Dr. H. Haga.

Paraguay.—M. Maximo Croskey.

Russia.—Dr. N. Egoroff, Col. L. Swentorzetzky.

Spain.—Don José Maria Madariaga, Don A. Montenegro.

Switzerland.—Dr. Fr. Weber, Dr. Pierre Chappuis, Dr. J. Landry.

Australia.—Mr. Cecil W. Darley, Prof. Threlfall.

Canada.—Mr. Ormond Higman.

Crown Colonies.—Major P. Cardew.

India.—Mr. M. G. Simpson.

SCHEDULE B—RESOLUTIONS.

1. The Conference agrees that as heretofore the magnitudes of the fundamental electric units shall be determined on the electromagnetic system of measurement with reference to the centimetre as the unit of length, the gramme as the unit of mass and the second as the unit of time.

These fundamental units are (1) the ohm, the unit of electric resistance which has the value of 1,000,000,000 in terms of the centimetre and second; (2) the ampere, the unit of electric current which has the value of one-tenth (0.1) in terms of the centimetre, gramme and second; (3) the volt, the unit of electromotive force which has the value 100,000,000 in terms of the centimetre, the gramme and the second; (4) the watt, the unit of power which has the value of 10,000,000 in terms of the centimetre, the gramme and the second.

2. As a system of units representing the above and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, the Conference recommends the adoption of the international ohm, the international ampere and the international volt defined according to the following definitions:

3. The ohm is the first primary unit.

4. The international ohm is defined as the resistance of a specified column of mercury.

5. The international ohm is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grammes in mass, of a constant cross-sectional area and of a length of 106.300 centimetres.

To determine the resistance of a column of mercury in terms of the international ohm, the procedure to be followed shall be that set out in specification 1 attached to these resolutions.

6. The ampere is the second primary unit.

7. The international ampere is the unvarying electric current which, when passed through a solution of nitrate of silver in water, in accordance with the specification 2 attached to these resolutions, deposits silver at the rate of 0.00111800 of a gramme per second.

8. The international volt is the electrical pressure which, when steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere.

9. The international watt is the energy expended per second by an unvarying electric current of one international ampere under an electric pressure of one international volt.

SPECIFICATION 1.

SPECIFICATION RELATING TO MERCURY STANDARDS OF RESISTANCE.

The glass tubes used for mercury standards of resistance must be made of a glass such that the dimensions may remain as constant as possible. The tubes must be well annealed and straight. The bore must be as nearly as possible uniform and circular, and the area of cross-section of the bore must be approximately one square millimetre. The mercury must have a resistance of approximately one ohm.

Each of the tubes must be accurately calibrated. The correction to be applied to allow for the area of the cross-section of the bore not being exactly the same at all parts of the tube must not exceed five parts in 10,000.

The mercury filling the tube must be considered as bounded by plane surfaces placed in contact with the ends of the tube.

The length of the axis of the tube, the mass of mercury the tube contains, and the electrical resistance of the mercury are to be determined at a temperature as near to 0°C. as possible. The measurements are to be corrected to 0°C.

For the purpose of the electrical measurements, end vessels carrying connections for the current and potential terminals are to be fitted on to the tube. These end vessels are to be spherical in shape (of a diameter of approximately four centimetres), and should have cylindrical pieces attached to make connections with the tubes. The outside edge of each end of the tube is to be coincident with the inner surface of the corresponding spherical end vessel. The leads which make contact with the mercury are to be of thin platinum wire fused into glass. The point of entry of the current lead and the end of the tube are to be at opposite ends of a diameter of the bulb; the potential lead is to be midway between these two points. All the leads must be so thin that no error in the resistance is introduced through conduction of heat to the mercury. The filling of the tube with mercury for the purpose of resistance measurements must be carried out under the same conditions as the filling for the determination of the mass.

The resistance which has to be added to the resistance of the tube to allow for the effect of the end vessels is to be calculated by the formula—

$$A = \frac{0.80}{1{,}063\,\pi}\left(\frac{1}{r_1} + \frac{1}{r_2}\right)\text{ohm},$$

where r_1 and r_2 are the radii in millimetres of the end sections of the bore of the tube.

The mean of the calculated resistances of at least five tubes shall be taken to determine the value of the unit of resistance.

For the purpose of the comparison of resistances with a mercury tube the measurements shall be made with at least three separate fillings of the tube.

SPECIFICATION 2.

SPECIFICATION RELATING TO THE DEPOSITION OF SILVER.

The electrolyte shall consist of a solution of from fifteen to twenty parts by weight of silver nitrate in 100 parts of distilled water. The solution must only be used once, and only for so long that not more than thirty per cent. of the silver in the solution is deposited.

The anode shall be of silver, and the cathode of platinum. The current density at the anode shall not exceed one-fifth ampere per square centimetre and at the cathode one-fiftieth ampere per square centimetre.

Not less than 100 cubic centimetres of electrolyte shall be used in a voltameter.

Care must be taken that no particles which may become mechanically detached from the anode shall reach the cathode.

Before weighing, any traces of solution adhering to the cathode must be removed and the cathode dried.

SCHEDULE C.—WESTON NORMAL CELL.

The Weston normal cell may be conveniently employed as a standard of electric pressure for the measurement both of electromotive force and of current, and when set up in accordance with the following specification may be taken, provisionally,* as having, at a temperature of 20°C., an electromotive force of 1.0184 volts.

SPECIFICATION RELATING TO THE WESTON NORMAL CELL.

The Weston normal cell is a voltaic cell which has a saturated aqueous solution of cadmium sulphate ($CdSO_4$ 8/3 H_2O) as its electrolyte.

The electrolyte must be neutral to Congo red.

The positive electrode is mercury.

The negative electrode of the cell is cadmium amalgam consisting of 12.5 parts by weight of cadmium in 100 parts of amalgam.

The depolarizer, which is placed in contact with the positive electrode, is a paste made by mixing mercurous sulphate with powdered crystals of cadmium sulphate and a saturated aqueous solution of cadmium sulphate.

*See duties of the Scientific Committee, Schedule D.

The different methods of preparing the mercurous sulphate paste are described in the notes.¶ One of the methods there specified must be carried out.

For setting up the cell the H form is the most suitable. The leads passing through the glass to the electrodes must be of platinum wire, which must not be allowed to come into contact with the electrolyte. The amalgam is placed in one limb, the mercury in the other.

The depolarizer is placed above the mercury and a layer of cadmium sulphate crystals is introduced into each limb. The entire cell is filled with a saturated solution of cadmium sulphate and then hermetically sealed.

The following formula is recommended for the electromotive force of the cell in terms of the temperature between the limits 0° C. and 40° C.:

$$E_t = E_{20} - 0.0000406\,(t - 20°) - 0.00000095\,(t - 20°)^2 + 0.00000001\,(t - 20)^3.$$

SCHEDULE D.

1. The Conference recommends that the various Governments interested establish a permanent International Commission for Electrical Standards.

2. Pending the appointment of the Permanent International Commission, the Conference recommends (*) that the president, Lord Rayleigh, nominate for appointment by the Conference a scientific committee of fifteen to advise as to the organization of the Permanent Commission, to formulate a plan for and to direct such work as may be necessary in connection with the maintenance of standards, fixing of values (†), intercomparison of standards and to complete the work of the Conference (‡). Vacancies on the committee to be filled by co-optation.

3. That the laboratories equipped with facilities for precise electrical measurements and investigations should be asked to co-operate with this committee and to carry out, if possible, such work as it may desire.

4. The committee should take the proper steps forthwith for establishing the Permanent Commission, and is empowered to arrange for the meeting of the next Conference on Electrical Units and Standards, and the time and place of such meeting should this action appear to them to be desirable.

5. The committee or the Permanent International Commission shall consider the question of enlarging the functions of the International Conference on Weights and Measures with a view to determining if it is possible or desirable to combine future Conferences on Electrical Units and Standards with the International Conference on Weights and Measures, in place of holding in the future conferences on electrical units and standards. At the same time it is the opinion of the Conference that the Permanent Commission should be retained as a distinct body, which should meet at different places in succession.

¶Notes on methods pursued at various standardizing laboratories will be issued by the Scientific Committee or the Permanent Commission, as an appendix to this report.

*In accordance with the above, Lord Rayleigh has nominated the following committee, which has been approved by the Conference, viz.: Dr. Osuke Asano, M. R. Benoit, Dr. M. N. Egoroff, Prof. Eric Gérard, Dr. R. T. Glazebrook, Dr. H. Haga, Dr. L. Kusminsky, Prof. G. Lippmann, Prof. A. Rôiti, Dr. E. B. Rosa, Dr. S. W. Stratton, Mr. A. P. Trotter, Prof. E. Warburg, Prof. Fr. Weber, Professor Lindeck.

†This will include the reconsideration from time to time of the electromotive force of the Weston normal cell.

‡With this object the committee is authorized to issue as an appendix to the report of the Conference notes detailing the methods which have been adopted in the standardizing laboratories of the various countries to realize the international ohm and the international ampere, and to set up the Weston normal cell.

Annual Report of Cornell University.

In the annual report of Jacob Gould Schurman, president of Cornell University, which was presented to the Board of Trustees on November 7, the following figures were shown:

There were 4,465 students enrolled for the year ended September, 1908. Of these, 3,734 were regularly enrolled students during the academic year from September to June, and the others were attendants at the summer session and the winter school in agriculture. This is an increase of 240 over the enrollment for the preceding year.

The number of members of the instructing staff is given as 548, excluding the members of the staff of the Medical College, in New York. The faculty at Ithaca is made up as follows: Seventy-five professors, sixty-four assistant professors, six lecturers, 122 instructors and 144 assistants.

New courses have been added to the curriculum in the College of Engineering, notably in the field of sanitary engineering. President Schurman points out that there is little necessity for improvement in the field of hydraulics.

Excluding the Medical College in New York city, which is maintained by separate funds, the productive funds of the university amounted, on August 1, 1908, to $8,628,370.31. The inventoried value of the grounds and buildings was given as $4,263,405.07. The income statement shows a total income from all sources of $1,356,498.59, running short of the expense budget by $12,242, as a result of the purchase of campus lands.

New York Rapid Transit Investigation.

J. Edward Simmons, president of the New York Chamber of Commerce, has appointed Eugenius H. Outerbridge, Paul M. Warburg, Howard C. Smith, Clarence H. Kelsey and Marcellus Hartley Dodge as a special committee of five to investigate the conditions now surrounding the question of the construction of further rapid-transit lines in New York city.

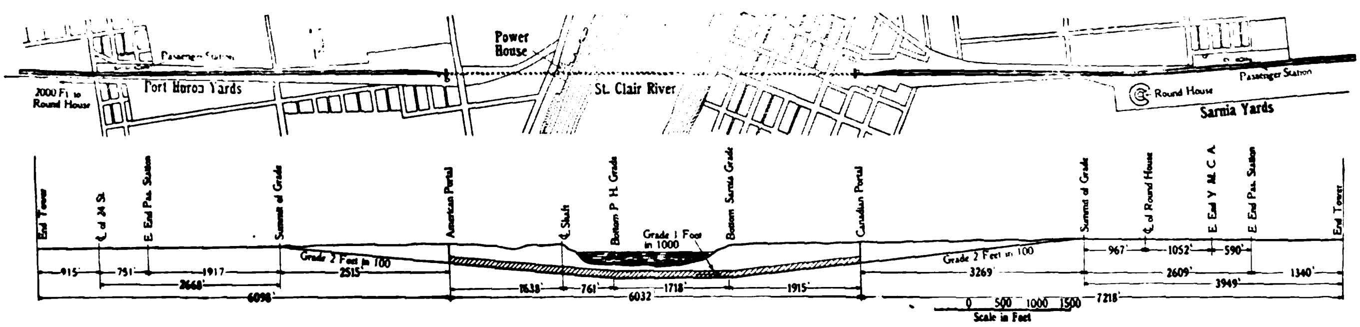
This committee was appointed under a resolution submitted at the last meeting of the Chamber by President Hepburn, of the Chase National Bank. This resolution declared that the present rapid-transit facilities of the city are insufficient and that the construction of additional lines is delayed and obstructed by causes that should be clearly established in order that they may be removed.

The Electrification of the St. Clair Tunnel.

Formal Taking Over by the Grand Trunk on November 12 of Its International Submarine Tunnel between Sarnia, Ont., and Port Huron, Mich.

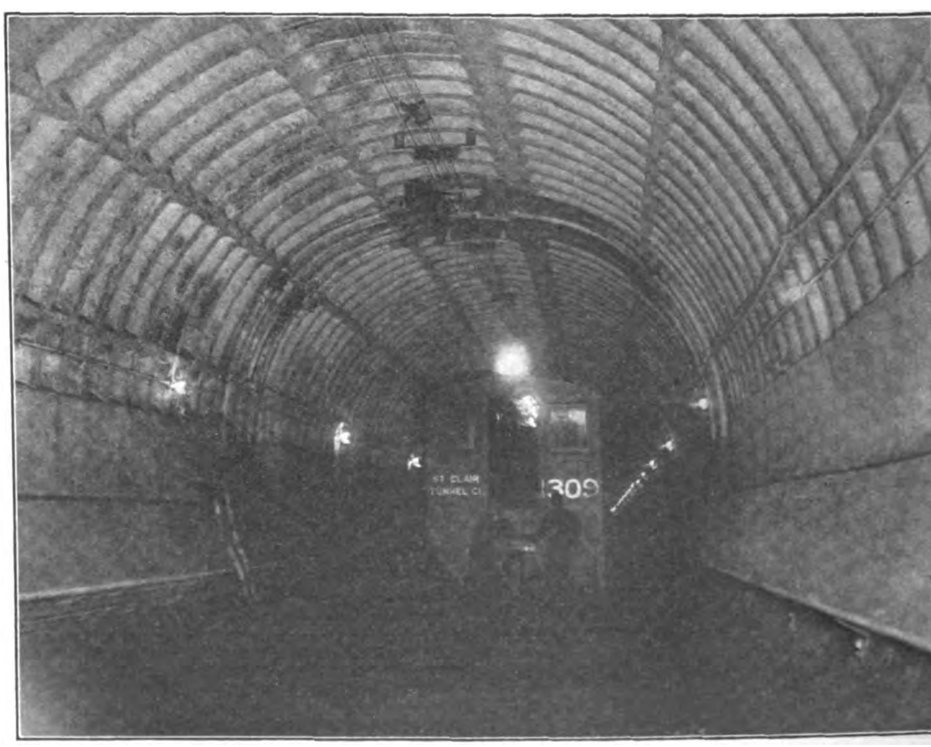
BY O. H. CALDWELL.

The electrification of the St. Clair Tunnel was formally declared complete and its operation by single-phase, alternating-current locomotives taken over by the Grand Trunk Railway on Thursday, November 12, when an inspection party of over one hundred persons, comprising officials of the Grand Trunk and other railroads, engineers, and representatives of the technical and public press, visited the tunnel, pump houses and power plant, and celebrated the electrification event with an international luncheon at Sarnia, tendered by the railroad company. The St. Clair Tunnel under the St. Clair River, near the cities of Port Huron, Mich., and Sarnia, Ontario, linking the 10,000 miles of track of the Grand Trunk system, although finished in 1890 is the longest submarine tunnel in the world. The interest of the formal occasion last week marking the change to an improved motive power was heightened by the presence of the now venerable engineer who carried through the tunnel construction almost a score of years ago, as well as the engineers who have multiplied the capacity of the tunnel and insured the safety and comfort of its passengers.



MAP AND PROFILE OF THE ST. CLAIR TUNNEL AND ADJACENT RAILROAD YARDS.

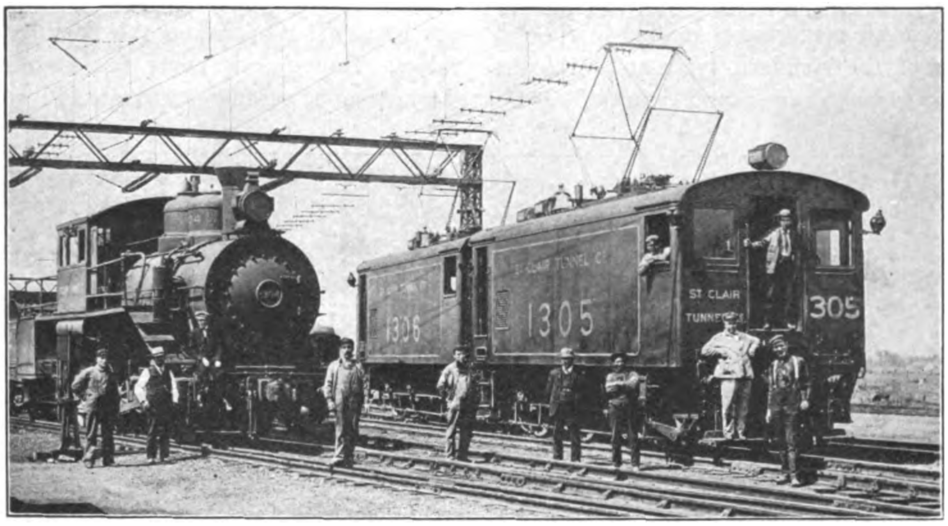
Preliminary work on the St. Clair Tunnel was begun in 1886, and after several unsuccessful efforts the present shield system was finally adopted and the tube was opened for traffic in 1890. From portal to portal the tunnel length is 6,032 feet, the bore being approached by open-cut inclines on the American and Canadian sides of respectively 2,500 and 3,300 feet in length, making the total distance between the American and Canadian summits over two miles. As shown in the accompanying plan and profile, the grade on the approaches and inclined sections of the tunnel is two per cent, while the flat middle section, 1,700 feet in length, has a slight grade toward the Canadian end sufficient to provide for collecting condensation and seepage water. A single track extends through the tunnel, connecting with a double track on both approaches. The tunnel shell proper is nineteen feet in diameter and is made up of sectional cast-iron rings. The total original cost of the tunnel, including machinery and equipment, was $2,700,000.



ELECTRIC LOCOMOTIVE IN THE ST. CLAIR TUNNEL, SHOWING THE INTERSECTION OF THE VERTICAL SHAFT THROUGH WHICH ARE BROUGHT THE FEEDERS FROM THE POWER HOUSE.

The tunnel service is operated by the St. Clair Tunnel Company, a subsidiary of the Grand Trunk Railway system, which takes the trains from the eastern division at the Sarnia yards and delivers them to the western division at the Port Huron yards, and vice versa. For this service four steam locomotives especially designed to exert a large drawbar pull and to burn anthracite coal in order to avoid smoke, were provided to operate the trains over the heavy grades in the tunnel and on the approaches. As the traffic on the road increased, these facilities were found to be inadequate to cope with the car movement, for the maximum weight of the trains handled was limited to about 760 tons, and even with this load the speed on the ascent was often very slow.

The element of danger was always present in the St. Clair Tunnel under steam operation on account of the poisonous gases given out by the locomotives, and several serious accidents occurred before the electrification was made. Under the former conditions it was considered inad-



COMPLETE ELECTRIC LOCOMOTIVE, AND SPECIAL ANTHRACITE-BURNING ENGINE FORMERLY USED TO HAUL TRAINS THROUGH ST. CLAIR TUNNEL.

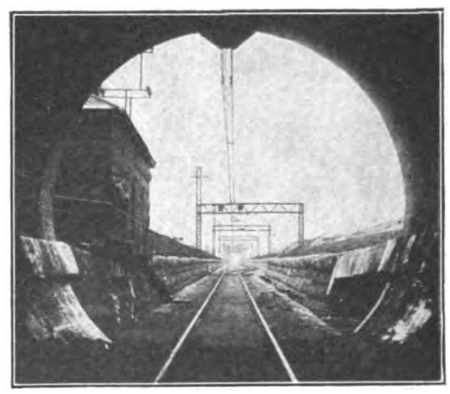
visable to use air brakes on freight trains during the run through the tunnel on account of the danger of the train breaking in two, which would result in setting the air brakes. In such a case before the engine crew could return and make the necessary hose coupling the tunnel would become dangerously filled with gases.

ELECTRICALLY-DRAWN FREIGHT TRAIN EMERGING FROM THE CANADIAN PORTAL. PUMP HOUSE AT RIGHT OF ENTRANCE.

With these serious disadvantages of the existing steam operation in view the Grand Trunk Railway officials took up the consideration of electrifying the St. Clair Tunnel, and Bion J. Arnold was called into conference as consulting electrical engineer. The advantages of the different systems of electrical operation were thoroughly considered and complete estimates were made covering the alternating-current and direct-current systems, the latter both with and without storage batteries. The final decision favored twenty-five-cycle alternating current with a 3,300-volt single-phase supply for the locomotives, using a steam boiler expedient to supply the characteristic of a storage battery in the direct-current system. It is a notable fact that this was the first single-phase installation on so large a scale planned in this country.

According to the specifications required of the contractor the installation must be capable of hauling a 1,000-ton train through the tunnel from terminal to terminal in fifteen minutes at a speed not exceeding a maximum of twenty-five miles per hour, and at not less than a minimum speed of ten miles per hour ascending the grade. The locomotives were specified to be of sufficient capacity to develop a drawbar pull of 50,000 pounds at the operating speed of ten miles per hour. This would permit of the transfer of four trains per hour between Sarnia and Port Huron, which is about three times the capacity at present required by traffic conditions.

The single-phase, twenty-five-cycle alternating-current system for the locomotives has been installed in the yards and through the tunnel. Single-catenary construction is used, the messenger cable of galvanized steel being suspended from insulators on overhead bridges 250 feet apart, and from this cable the working conductor is supported by rods of varying lengths designed to give it a uniform height above the rail of twenty-two feet. In the yards No. 0000 groved copper is used, while on the tunnel approach and in the tunnel are carried two 300,000-circu-

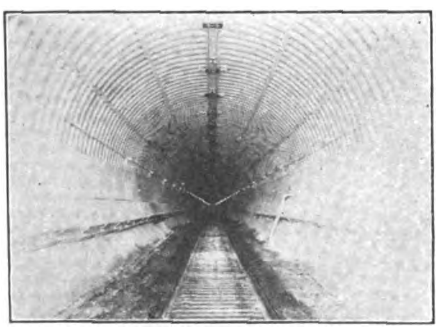


THE APPROACH TO THE AMERICAN SUMMIT AT PORT HURON.

lar-mil conductors. The messenger cables of the outside catenary construction terminates in heavy anchors in the masonry portals, and in the tunnel the working conductor is carried by special brackets, being held nine inches from the tunnel shell. The two messenger cables are supported on barrel-type insulators spaced at 12-foot intervals. The messengers carry special spiders which support the working conductors. These spider supports are not located in the center, but at a point three feet from the middle of the messenger span, as sufficient resiliency of the working conductor is obtained by this construction. The clearance between the messenger cables and the tunnel shell is three inches, and as the trolley wires are suspended six inches below the messengers, the height of the working conductor is fifteen feet five inches above the track rail.

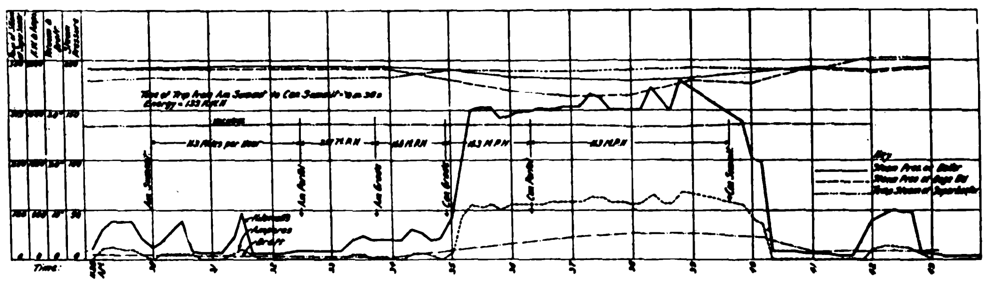
The St. Clair locomotives are of the rigid-frame type, having three pairs of drivers, each axle connected through gears to 250-horsepower, single-phase railway motors. The locomotives weigh sixty-six tons each, and being provided with multiple-unit control, are generally used in pairs. Such a combination of two locomotives was designed to draw a 1,000-ton train through the tunnel and up the two per cent grade, on the latter involving a drawbar pull of 50,000 pounds. The locomotives were further required to start from standstill such a train up the grade and accelerate it to the normal speed of eleven miles per hour. The maximum speed of the locomotives is thirty miles per hour, then exerting a tractive effort of 6,000 pounds.

The trolley-wire pressure of 3,300 volts is stepped down by means of the main transformer, carried on the locomotive, to 235 volts. Control of the motor speed during acceleration and running is effected by bringing out taps from the transformer, thus applying any desired



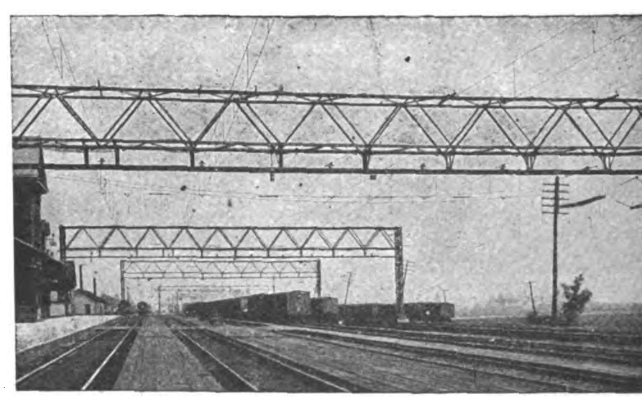
INTERIOR VIEW OF THE ELECTRIFIED ST. CLAIR TUNNEL.

graduated voltage to the motors. The master controller handled by the motorman operates pneumatic valves by means of solenoids deriving current from a twenty-four-volt storage battery. These electro-pneumatic valves in turn control the compressed-air plungers which operate the working contacts. Other operations in the locomotive cab, such as ringing the bell, sanding the tracks, and raising and depressing the pantagraph trolley, are performed pneumatically from push-buttons under the motorman's hand. The main auto-transformer is connected to the trolley through a circuit-breaker provided with a no-voltage release, so that if the car wheels should leave the track, the trolley remaining in contact with the wire, the circuit-breaker automatically opens, thus obviating any possible accident from the trolley voltage charging the ungrounded car. A single-phase motor drives the blower which delivers air to both the transformer and motors, the cooling action being so effective that when operating at full capacity the transformer and motor temperatures are comparatively little above that of the surrounding air. The heated air coming from the transformers may be passed up through the cab for heating purposes, if desired, although other standard electrical heaters are provided. The motor-driven air compressors located in the cab are of the standard type, and, like the blower motor, are supplied by a 100-volt



LOG CURVE OF POWER PLANT OPERATION DURING A TYPICAL RUN THROUGH TUNNEL.

tap from the main transformer. Air from the compressor supplies the straight and automatic air brakes, operates the electro-pneumatic switches and is used for the variety of other minor uses described. Important in operation up the grade in the tunnel and for starting a train of mixed rolling stock, is the gradual acceleration possible with these electric locomotives which are supplied with twenty-one control points, seventeen of which are running positions. A very



OVERHEAD SINGLE-CATENARY 3,300-VOLT TROLLEY CONSTRUCTION IN PORT HURON YARDS.

marked decrease in the number of train breaks-in-two has resulted with the use of these machines.

A half-unit locomotive has been tested with a dynamometer car to show a drawbar pull of 43,000 pounds before slipping the wheels on a sanded track, and on this basis, a drawbar pull of 86,000 pounds might be considered possible with a complete locomotive. The locomotives are operated equally well from either end of the cab, all controlling apparatus being duplicated. Speed indicators mounted in front of the engine-driver's seat show the speed at which the locomotive is running and provide a record for the trip. Other apparatus forming the equipment of each locomotive are the necessary ammeters, voltmeters, wattmeters, preventive resistance coils, circuit-breaker and storage battery for operating the pneumatic valves. Provision is made for charging the battery by means of a small 100-watt motor-generator set. The pantagraph trolley is of the usual standard construction. The bow presses upward on the conductor with a force of from seven to eight pounds. The following general dimensions of a single half-unit are given by the manufacturer:

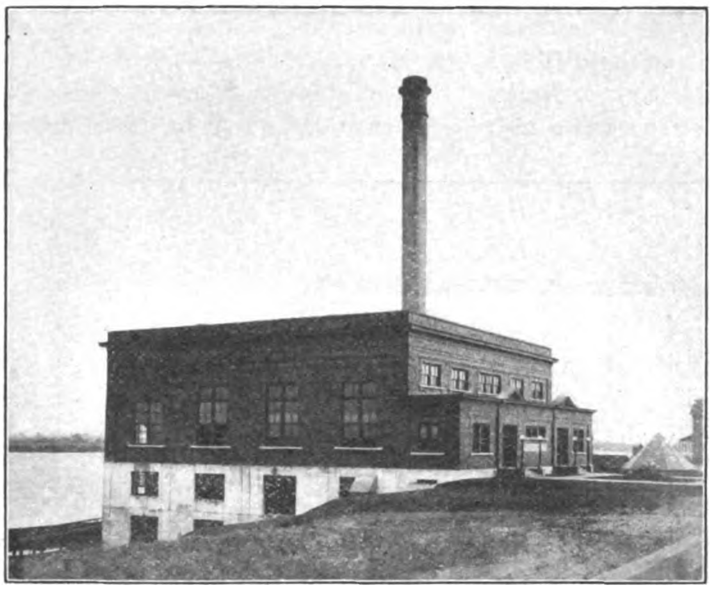
Length over all, 23 feet 6 inches; height from top of rail to top of roof, 13 feet; height from top of rail to top of pantagraph bow when lowered, 14 feet 11 inches; width of cab over all, 9 feet 8 inches; total weight of locomotive half-unit, fully equipped, 67½ tons (this weight is practically evenly divided over three drivers); weight of complete locomotive unit, 135 tons; length of rigid wheel base, 16 feet; diameter of driving wheels, 62 inches.

In service it has been found that the locomotives will readily handle a 1,000-ton train at a speed of even fourteen miles per hour up the two-per-cent grade, and since May 17 of this year the electrical equipment has been in continual service, handling the entire freight and passenger traffic of the St. Clair Tunnel Company, over whose tunnel single track is concentrated, of course, all the business of the Grand Trunk Railway at this point. A log sheet showing train-operation characteristics of a typical run is reproduced on the opposite page.

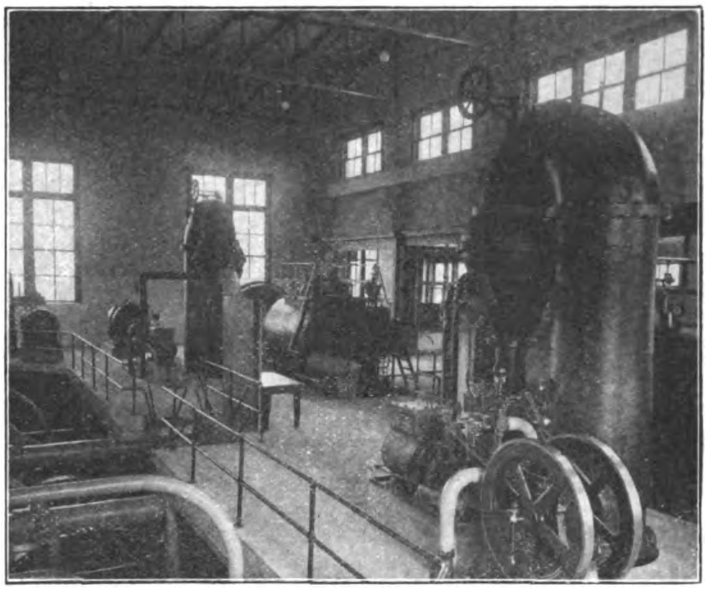
As the result of the electrification the put. The service provided by the power house involves, besides the propulsion of the trains through the tunnel, the operation of pumps when necessary for clearing the tube of drainage and seepage water, and a small lighting load in the yards, stations and adjacent buildings.

The power plant, shown herewith, is located on the Port Huron bank of the St. Clair River at a point almost directly passing down the walls and leading into the ducts.

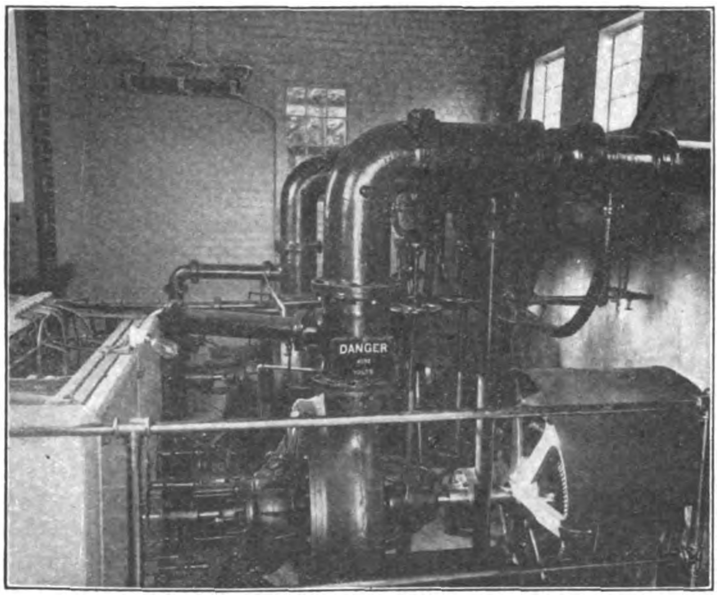
The power-house building covers a ground area of 10,000 square feet and is divided longitudinally by a heavy fire-wall which separates the boiler from the turbine rooms. The building is a dignified but ornate structure of steel and brick, and presents an attractive appearance.



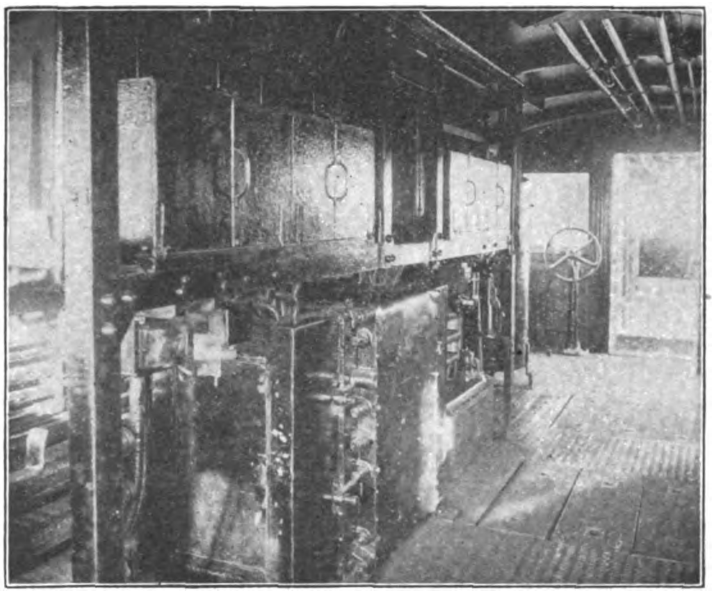
THE POWER HOUSE ON THE AMERICAN SHORE. THE CONICAL ROOF CAPPING THE VERTICAL CONDUIT SHAFT IS SEEN AT THE RIGHT.



VIEW OF THE TURBINE-ROOM FLOOR OF THE POWER HOUSE, SHOWING EXCITERS, TURBO-GENERATORS, CONDENSERS, GAUGE BOARD AND PUMPS.



A PUMP HOUSE INTERIOR, SHOWING CENTRIFUGAL PUMPS DRIVEN BY 3,300-VOLT INDUCTION MOTORS.



INTERIOR VIEW OF A LOCOMOTIVE HALF-UNIT, SHOWING TRANSFORMING EQUIPMENT.

tunnel is now a clean, white gallery, filled with pure, cool air, and the trip from portal to portal is made in a few minutes without any discomfort to passengers.

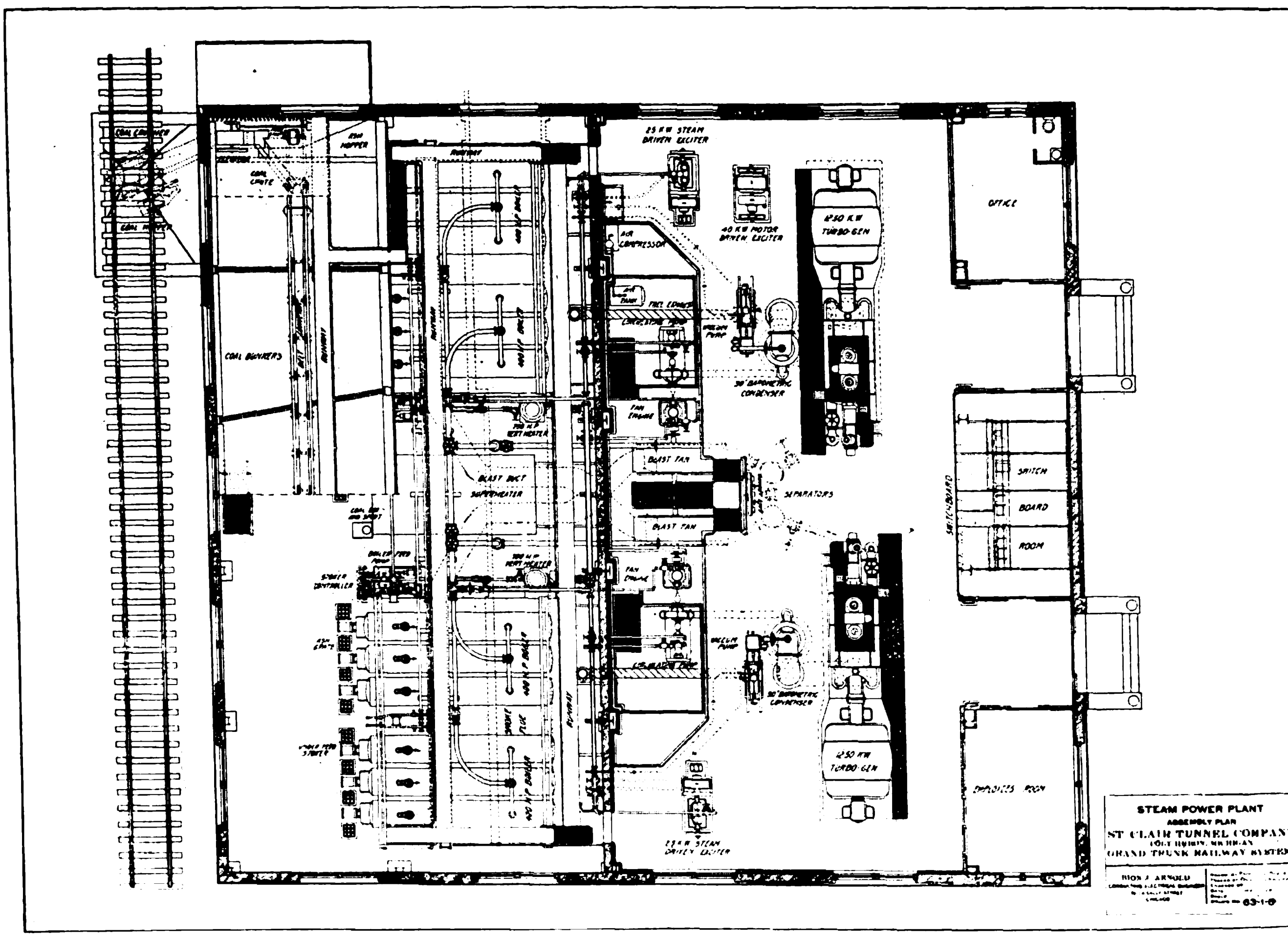
The conditions which have to be met by the power plant are unusual, entailing severe peak-loads during the passage and particularly the ascent of the tunnel trains, with long and irregular intermissions of comparatively small power out- over the tunnel. A vertical shaft extending down to the tunnel which carries the feeders for the trolley, power and lighting circuits, emerges about seventy-five feet from the wall of the building, its upper end being indicated by the pyramidal roof seen in the illustration. The lower end of this shaft is shown in another illustration, where the feeder conduits are seen entering the tunnel tube,

Coal is delivered to the plant over a wooden trestle leading above the receiver hopper which feeds directly into the crusher. The latter has a capacity of about thirty tons per hour, and also acts as a feeder, delivering the coal at a uniform rate to the vertical bucket-elevator extending to the top of the building. From the elevator the coal is dropped onto a conveyor belt, from which it is discharged into the bunkers. A twenty-horsepower, slow-speed induction motor drives the crusher, and a similar ten-horsepower motor operates the elevator and conveyor. The coal bunkers are of reinforced concrete, resting on the structural steelwork of the building, and the space occupied by the buukers, crusher pit and elevator machinery is completely enclosed by a metal partition to obviate the penetration of coal-dust into the boiler room and other parts of the building.

The expedient by which is effected an available reserve of power, amounting in effect to the automatic characteristics of a storage-battery installation, has been worked out with great nicety and ingenuity. By means of the Jones underfeed stoker equipment, the combustion under the furnaces is controlled automatically so as to be proportionate to the draft for power on the station. By means of the regulating mechanism, a part of which is shown near the center of the illustration of the boiler room, both the air supply and the rate of feeding the coal into the boiler furnaces is controlled. This regulation is accomplished by a Skitts regulating valve, which throttles the steam supply to the fan engines, at the same time controlling the rate of stoking through a Cole automatic regulator which is driven from the shaft of the fan engines. Thus when the boiler pressure has re-established itself and tends to rise above normal, the supply of steam to the fan engine is decreased, diminishing the supply of air and the rate of stoking coal to the furnaces.

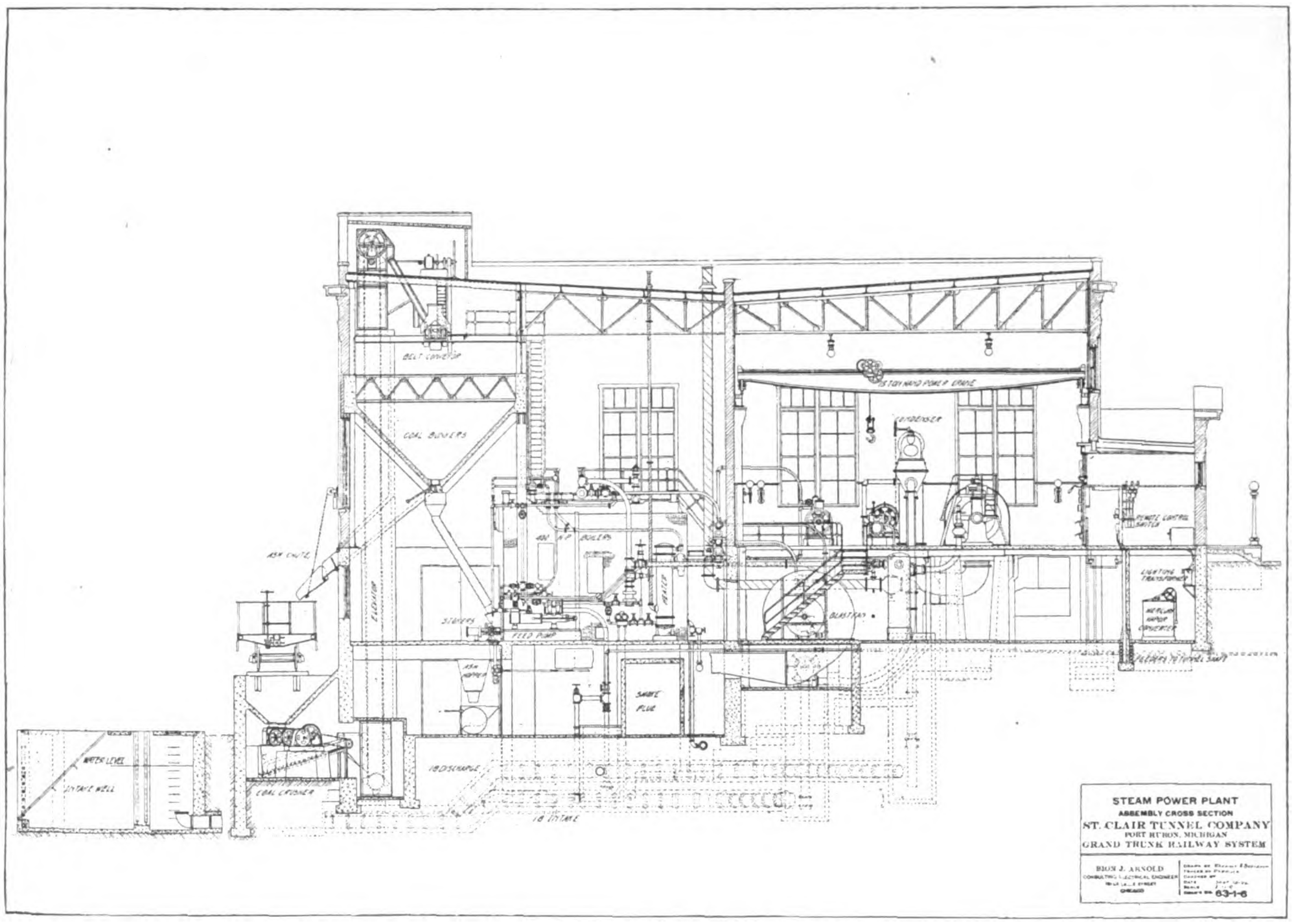
The boiler equipment consists of four 400-horsepower Babcock & Wilcox sectional water-tube boilers arranged in two batteries. These boilers are unusually wide, having the tubes arranged nine high and twenty-one wide, in order to secure quick steaming. Each boiler has three drums forty-two inches in diameter and twenty-three feet four inches in length. The drums thus provide a storage for a large quantity of heated water which becomes available as steam upon a decrease of pressure. The boilers are designed to carry 200 pounds pressure, and are equipped with tandem-connected Morris blow-off valves and the usual pressure and water gauges and check valves. Between the two batteries of boilers is seen the separately-fired Foster superheater, which was furnished by the Power Specialty Company. This superheater has a capacity to add 200 degrees superheat to 36,000 pounds of steam per hour. The superheater is hand-fired, but has an automatic temperature regulator for admitting air either above or below the fires, thus controlling the superheat within thirty degrees. A thermal coupling placed in the superheater steam outlet operates through a relay and solenoid, on the valve of a hydraulic cylinder, which controls the dampers in the air supply.

The alternating-current generating equipment consists of two Westinghouse-Parsons turbo-generators operating at 1,500 revolutions per minute. These develop a voltage of 3,300 volts with a frequency of twenty-five cycles per second. As the principal load on the station is that imposed by the single-phase locomotive demand, these three-phase machines were specified to furnish their full rated load of 1,250-kilowatt, single-phase current. The turbines are, roughly, thirty-seven feet over all, eight feet high and six feet wide. The generators are air-cooled by a self-induced draft provided by vanes on the rotor. Each turbine exhausts into a barometric jet-condenser



PLAN VIEW OF THE STEAM POWER PLANT FOR THE ST. CLAIR TUNNEL ELECTRIFICATION.

with a thirty-inch inlet, manufactured by the H. L. Worthington Company. An automatic release valve may be connected to the free exhaust piping. Condenser cooling water, obtained from the St. Clair River through a concrete and tile intake, is circulated by a ten-inch volute pump driven by seven by nine-inch vertical engines. Rotative straight-line vacuum pumps are supplied with each condensing equipment. Two twenty-five-kilowatt steam-driven exciters are provided, either one of which is sufficient to furnish excitation for a single turbine unit. A motor-driven exciter of forty kilowatts tor-driven exciter; a panel controlling current supply for light and power within the plant, two turbo-generator controlling panels; the locomotive feeder panel; one for the pumping feeders; one for the power and light feeders, and one for the control of the arc-light circuits. No high-tension current is brought to the switchboard itself, all of the high-voltage oil switches being mounted on steel framework in the switch room behind the board. Direct current at 125 volts, supplying excitation, is controlled directly from the main switchboard. The 110-volt lighting current for the power plant wattmeters. Recording wattmeters are arranged to measure the output of the plant required for the various kinds of service furnished. From the operating engineer's station in front of the switchboard, all of the electrical instruments and switches are accessible, while across the turbine-room floor is a gauge-board reporting the complete operation of the boiler plant. A fifteen-ton hand-power traveling crane, manufactured by the Northern Engineering Works, is installed on overhead tracks in the turbine room, and may be used to handle any piece of apparatus in the station.



CROSS SECTIONAL ELEVATION OF THE STEAM POWER PLANT FOR THE ST. CLAIR TUNNEL ELECTRIFICATION.

capacity is ordinarily used in the operation of the plant. A three-phase, 3,300-volt induction motor of the squirrel-cage type drives this machine. All of the excitation apparatus—engines, motors and generators—is of Westinghouse manufacture.

The switchboard, which is mounted on the turbine-room-floor level, contains ten panels, arranged in order from the left as follows: On the first panel is mounted a Tirrill regulator, voltmeters, a frequency meter and synchroscope; the second panel controls the steam-driven exciters; next, a panel controlling the motor-driven exciter; is stepped down by transformers from the 3,300-volt generator buses, or by means of a throw-over switch, can be derived from the exciter bus-bars. The entire lighting load, it should be noted, is carried on the locomotive phase. A close regulation of this voltage is secured by means of the Tirrill regulator, which operates so effectively that only an instantaneous diminution of the luminosity of the lamps is apparent during heavy acceleration of the locomotives.

The switchboard panels in general are provided with the usual apparatus, such as ammeters, voltmeters, and indicating

It is evident that of equal importance with the propulsion of the locomotives through the tunnel, is the reliable maintenance of the tube free from water, since in the case of the tunnel becoming flooded, either from seepage or drainage of rain water, the operation of trains would necessarily be suspended. The Port Huron approach to the tunnel has an area of eleven acres, while the Sarnia approach has an area of thirteen acres. Waste ditches are provided at the side, arranged with retaining levees, constructed to impound a large portion of the water falling on the approaches.

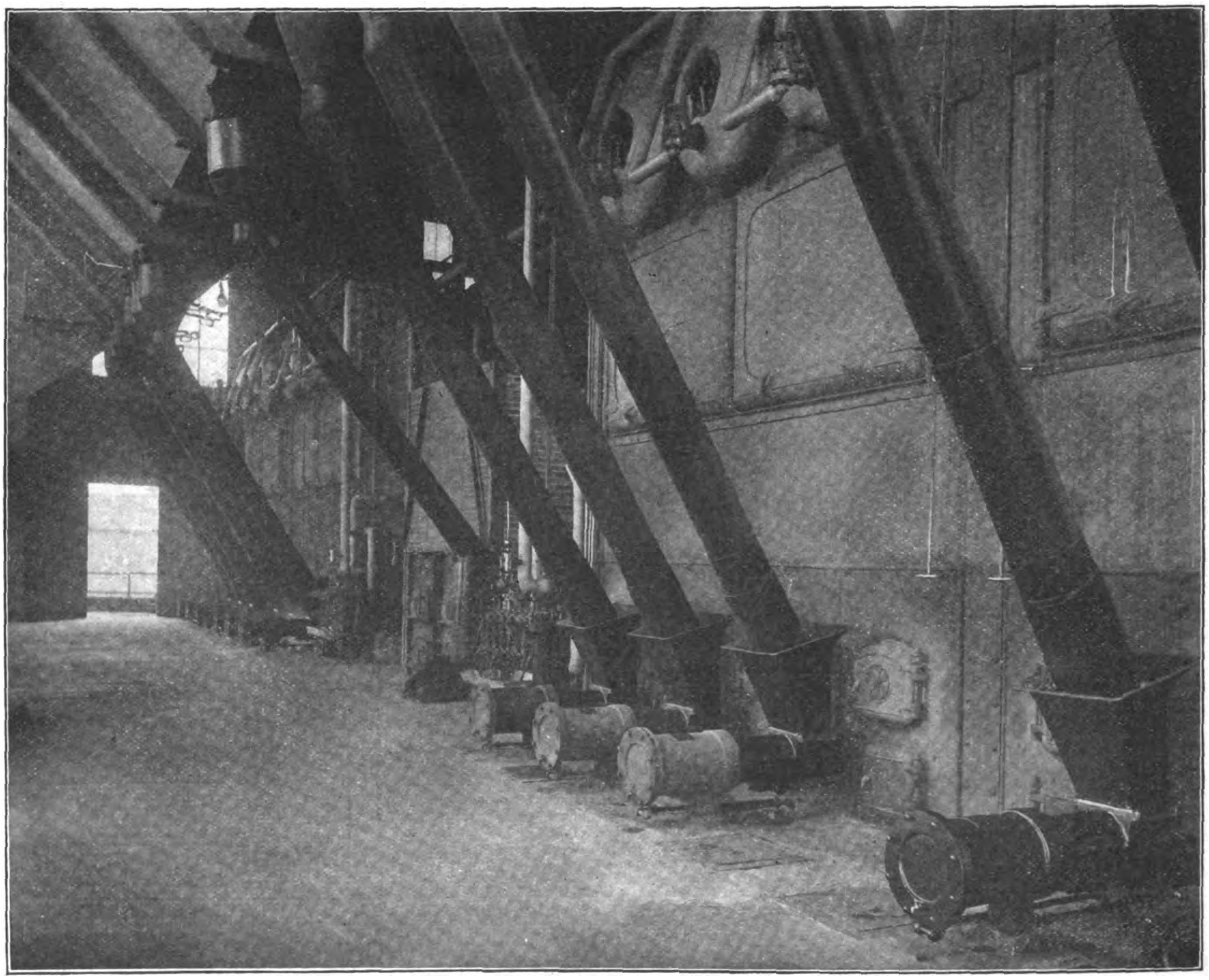
Before the electrification, boiler plants were provided at each portal for the operation of drainage pumps, and in order to take care of any rainfall which might occur it was necessary to keep fires under the boilers and maintain attendants at the pump houses at all hours for a large proportion of the year.

From the Port Huron generating plant three-phase power leads are led down the vertical shaft to the tunnel, and carried in both directions through the tunnels, in paper-insulated, lead-covered cables in ducts at either side of the tube. Emerging from the tunnel portals, the conduits enter the adjacent pump houses supplying three-phase, twenty-five-cycle, 3,300-volt induction motors driving centrifugal pumps. At the Port Huron entrance are two such pumps, each capable of delivering 4,000 gallons per minute, driven by 100-horsepower motors; while at the Sarnia entrance are two 5,500-gallon pumps driven by 200-horsepower motors.

At each pump house there is an additional 150-gallon pump driven by a small induction motor, to rid the wells of the small amount of seepage water that is continually percolating into the tunnel. These pumps need be operated for only a few hours daily. The pump-motor busbars may be supplied from two independent feeders from the power plant. The motor control is effected by means of oil switches on individual panels. As noted before, the flat portion of the tunnel has a slight grade (one-tenth per cent) in the direction of the Sarnia end. In order to dispose of the slight flow of seepage water, at the junction of the Sarnia grade and the flat section—the lowest point in the tunnel—two 150-gallon, motor-operated centrifugal pumps are located. These pumps are similar to those at the portal pump house, with the modification of being entirely enclosed and suitable for continuous operation in the tunnel, subject to conditions of moisture and condensation. These pumps discharge into the drainage well, from which the portal pumps lift the water to the outer level.

Since the electrification, the tunnel walls have been whitened and incandescent lamps placed every twelve and one-half feet throughout the tube in a staggered relation on either side, at a height of about ten feet. The tunnel lamps, of which there are 480, are operated four in series from the 440-volt secondaries of lighting transformers placed at intervals in the tunnel. A similar set of transformers furnishes current for the tunnel drainage-pump motors.

From the pump houses at either portal the lighting and power feeders emerge from conduits, and are carried as overhead conductors on the extended masts of one of the overhead-trolley structure standards. Incandescent lamps in the roundhouses, passenger stations and railroad buildings in both Port Huron and



BOILER ROOM OF THE POWER PLANT, SHOWING AUTOMATIC STOKERS AND REGULATOR WHICH MEETS PEAK LOADS AUTOMATICALLY BY ACCELERATING COMBUSTION.

Sarnia, are furnished from these lines by means of suitable transformers, reducing the 3,300-volt line potential to 110 volts. In the yards of the terminals are about thirty arc lamps, used for general illumination. Unidirectional current for these lamps is furnished by means of a mercury-arc rectifier. The total amount of lighting load is less than 100 kilowatts. At the roundhouse at Port Huron and Sarnia are 3,300-volt motors, supplied from the tunnel power plant, but the entire connected motor load does not exceed 100 kilowatts. Thus the power house is called upon to furnish slightly over 200 kilowatts for lighting and power outside the plant.

Since for the operation of the trains steam is always maintained in the boilers, the starting of the motor pumps following a rainstorm is a very simple matter, and does not require, as with the old steam-pump houses, separate fires and steam pressures for a large portion of the year.

The Tunnel division block-signal system extends from the American to the Canadian summit. In addition to telegraph orders, the conductor is handed a staff when the train enters the tunnel division. The switch and signals then remain locked until this staff is placed in the instrument at the other end of the block. It is said that not a single accident has occurred as the result of improper dispatching during the eighteen years' operation of the tunnel. Additional telephone communication is provided between the switch cabins, the power house and the officials' offices at the town stations. Telephone and telegraph cables extend the entire length of the tunnel.

On Thursday, November 12, as the result of invitations issued by the Grand Trunk Railway to more than 100 prominent railway officials and engineers, and representatives of the technical and public press, on the occasion of the official acceptance of the electrification, an inspection trip through the tunnel and power house was made, a feature of which was the congratulatory luncheon at the Hotel Vendome in Sarnia. Six large new flat-cars had been provided with upholstered coach seats and generously decorated with the national colors of Great Britain and the United States. At 1 o'clock these were boarded by the party and, drawn by a pair of electric locomotives, a slow run was made through the tunnel in order to allow the visitors to examine the features of construction. The tunnel walls had been whitened, the air was pure and cool, and the long row of tunnel lights could be seen converging to the point of change in the grade. The tunnel thus presents a marked contrast to the previous conditions, when a quick trip in closed coaches, behind a steam locomotive, was accompanied by great discomfort and indeed an element of danger, from smoke and asphyxiation.

Arriving at the Sarnia station, the party entered a special train of coaches and were taken to the Vendome Hotel, where a completely appointed luncheon was served. With E. H. Fitzhugh, third vice-president of the Grand Trunk Railway system, presiding in the stead of Charles M. Hays, general manager of the system, who was unable to be present, a series of toasts and speeches were given commemorative of the completion of the tunnel. After the assembled guests had responded to the dictates of international courtesy and good feeling with toasts to King Edward and President Roosevelt, whose names were greeted with hearty applause, Mr. Fitzhugh introduced the venerable Joseph Hobson, who was the chief engineer of the St. Clair Tunnel during its construction. Mr. Hobson is now consulting engineer for the Grand Trunk system. Bion J. Arnold of Chicago, consulting engineer for the Grand Trunk during the electrification of the St. Clair Tunnel, was next introduced and gave a short history of the men and installations that have advanced electric railroading. F. A. Sager, assistant engineer for the Arnold Company, proposed a toast to the Westinghouse Electric and Manufacturing Company, which was represented in the response by C. L. Williams. Cy Warman, who is best known as a writer of railroad stories, made a clever speech, and international amenities were further exchanged in speeches by the mayors of Port Huron and Sarnia, who were next called upon. Following the luncheon, the special train was again boarded, the tunnel trip was made, this time in coaches, and the visitors were delivered at the power house on the Port Huron shore. After an hour spent in careful inspection of this architecturally and mechanically beautiful station, during which the visitors admired the excellence of the maintenance and the ingenuity of the automatic boiler-plant devices, the party returned to the cars and was taken to the Port Huron Depot. Here, so far as the formal programme was concerned, the inspection ceremonies ended, but the majority of the engineers and visitors made a merry dinner party, with some postprandial story-telling features at the Hotel Harrington, before taking the evening trains for their destinations, east and west.

The electrification of the St. Clair Tunnel was undertaken by the Westinghouse Electric and Manufacturing Company, which contracted to be responsible for the installation and successful operation of the entire equipment, a condition which it has now satisfied in the fullest degree. Bion J. Arnold of Chicago was the consulting engineer for the railroad company, whose officials, C. M. Hays, second vice-president and general manager, and E. H. Fitzhugh, third vice-president, took a leading part in the move to electrify. The Westinghouse company's representative on the installation was H. L. Kirker.

Progress on the Detroit Tunnels.

The steel twin tubes of the Michigan Central Railroad's tunnel under the Detroit River from Detroit, Mich., to Windsor, Ont., have now been carried to a point more than half way under the river from the American side. Six of the ten great steel sections are already sunk in the channel and a seventh has been delivered at the work and now lies moored to the Detroit shore. The manner of building the tunnels is said to be unique in this kind of construction. The steel sections have their ends boarded and calked to be water-tight and are floated to position by tugs. Valves are then opened and the section is allowed to settle into place in the trench previously dredged in the river bottom. Air tanks carried on the section lighten it while it is being adjusted into position by the aid of tongues and eyes. A water-tight joint is made between the sections by immense rubber gaskets which fit into grooves in the steel end-rings. Accurate alignment of the tunnel sections is secured by sighting through an instrument from shore, the structural steel masts rigidly mounted upon the sections and extending several feet above the surface of the water when sunken. Heavy board forms of rectangular section enclose the tubes before sinking, and the space between the square and circular sections is pumped full of concrete. After placing the tunnel tubes in position the steel and concrete are covered with a layer of clay obtained from the river bottom. The steel tubes are to be given an internal concrete lining. Both of the concrete approaches on the shore ends are nearing completion and will be ready for use by the time the subaqueous tubes are finished. Work has been suspended for the winter on the placing of more sections, since the water has become too cold for the divers, but the time will be profitably spent in pumping the water out of the tunnel already laid and in finishing work on its interior. The contract date for completion is June 1, 1909, but there is little probability that this enormous undertaking can be finished within a number of months of that time.

The electrification of the Detroit tunnel will be carried out by the General Electric Company, which will install a third-rail direct-current system with a storage battery to meet the high peak loads. Power will be purchased from the Detroit Edison Company, whose 25-cycle, 4,400-volt alternating current will be converted by means of two 1,000-kilowatt synchronous motor-generator sets into 650-volt direct current. The pumping and lighting systems will be operated from alternating-current mains. The electrified zone will be 4.6 miles in length, and with the yards will comprise fifteen miles of track. Several of the locomotives for this service have already been completed by the General Electric Company.

Mineral Products of the Last Ten Years.

The United States Geological Survey, under the direction of George Otis Smith, has prepared a comprehensive table giving the amount and market value of the mineral products of the United States for the years 1898 to 1907, inclusive. Returns are given for sixty-seven products classified into metals, fuels, structural materials, abrasive materials, chemical materials, pigments and miscellaneous products. From this table the figures given below are of interest to the electrical arts. The table was prepared by Edward W. Parker, statistician in charge of mineral resources.

	PRODUCTS.		1898.		1899.		1900.		1901.	
			Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1	Copper, Value at New York City	Pounds	526,512,987	$61,865,276	568,666,921	$101,222,712	606,117,166	$98,494,039	602,072,519	$87,300,515
2	Aluminum, Value at Pittsburg	Pounds	5,200,000	1,716,000	6,500,000	1,716,000	7,150,000	1,920,000	7,150,000	2,238,000
3	Bituminous Coal	Short tons	166,593,623	132,608,713	193,323,187	167,952,104	212,316,112	220,930,313	225,828,149	236,422,049
4	Pennsylvania Anthracite	Long tons	47,663,076	75,414,537	53,944,647	88,142,130	51,221,353	85,757,851	60,242,560	112,504,020
5	Natural Gas		....	15,296,813	....	20,074,873	....	23,698,674	....	27,066,077
6	Petroleum	Barrels	55,364,230	44,193,359	57,070,850	64,603,904	63,620,529	75,989,313	69,389,194	66,417,335
7	Mica (sheet)	Pounds	129,500	103,534	108,570	70,587	456,283	92,758	360,060	98,859
8	Mica (scrap)	Short tons	3,999	27,564	1,505	50,878	5,497	55,202	2,171	19,719
9	Tungsten	Short tons	....	....	....	....	46	11,040	179	27,720

	1902.		1903.		1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	* Value.
1	$659,508,644	$ 76,568,954	698,044,517	$ 91,506,006	812,537,267	$105,629,845	901,907,843	$139,795,716	917,805,682	$177,595,888	868,996,491	$173,799,300
2	7,300,000	2,284,590	7,500,000	2,284,900	8,600,000	2,477,000	11,347,000	3,246,300	14,910,000	4,262,286	17,211,039	4,926,948
3	260,216,844	290,858,483	282,749,348	351,687,933	278,659,689	305,397,001	315,062,785	334,658,294	342,874,867	381,162,115	394,759,112	451,214,842
4	36,940,710	76,173,586	66,613,454	152,036,448	65,318,490	138,974,020	69,339,152	141,879,000	63,645,010	131,917,694	76,432,421	163,584,056
5	....	30,867,863	....	35,807,860	....	38,496,760	....	41,562,855	....	46,873,932	....	52,866,835
6	88,766,916	71,178,910	100,461,337	94,694,050	117,080,960	101,175,455	134,717,580	84,157,399	126,493,936	92,444,735	166,095,335	120,106,749
7	373,266	83,843	49,600	118,088	668,358	109,462	924,875	160,732	1,423,100	252,248	1,060,182	349,311
8	1,400	35,006	1,659	25,040	1,096	10,854	1,126	17,856	1,489	22,742	3,025	42,800
9	184	34,040	292	43,639	740	184,000	803	268,676	928	348,867	1,640	890,048

New York Public Service Commission Gives Hearing on Proposed Wilgus Freight Subway.

The Public Service Commission held a hearing in New York on November 11 on the proposed Wilgus freight subway, which the Amsterdam Corporation is seeking to build, and which is intended to facilitate the handling of goods between the railroad freight terminals and the points of wholesale distribution.

W. J. Wilgus, speaking for the project, said that less than half of the water front is open to use by foreign and coastwise trade steamship lines. The major part of the rest is used by the railroads, which are constantly asking for more space. Mr. Wilgus dwelt on the fact that of the 100,000,000 tons of freight brought into the city, 27,000,000 tons are hauled by drayage in the city, and speedier and more economical methods are needed, the average cost at present to haul one ton through the city is equal to the cost to haul by train 400 miles.

The plan includes a gravity yard in New Jersey west of the Bergen Hills, from which, after classification, the small standard-gauge cars will be brought under the river and up a line extending along the North River from the Sixtieth Street yards of the New York Central to the Battery, and up the East River to connect with the railroads in the Bronx. It is expected that ninety per cent of lower New York's freight can be handled in this way. There would be a crosstown line at some convenient point north of Twenty-third Street, and there would be facilities to carry passengers in the subway.

Mr. Wilgus went into the objections against the plan, and suggested remedies. Representatives of commercial and civic organizations argued generally for the end for which the subway is proposed, but objected to some of the locations traversed, and suggested extensions to cover outside territories in order to relieve the factory congestion of lower New York.

A proposed substitute for the Wilgus plan was a combined subway and surface road along the West Side water front similar to the arrangement in many of the European cities. General discussion followed.

Pennsylvania Electrification.

It is stated that the Westinghouse Electric and Manufacturing Company will not begin the building of electric locomotives for the Pennsylvania Railroad for several weeks. No definite decision has been reached as to whether the third-rail or single-phase system will be used, although an agreement will be reached in the near future.

The contract with the Westinghouse company calls for the electrification of the Pennsylvania terminals at Long Island, Manhattan and Jersey City. Electric trains will be operated as far as Harrison, N. J. It is probable that the Pennsylvania will eventually install electricity on its lines between New York and Philadelphia.

ELECTRIC HEATING.

231ST MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK CITY, NOVEMBER 13.

The 231st meeting of the American Institute of Electrical Engineers was held in the Engineering Societies Building, New York, N. Y., on Friday evening, November 13. The meeting was called to order by President Louis A. Ferguson, and Secretary Pope announced that at the meeting of the Board of Directors held during the afternoon there were fifty-nine associates elected. It was also announced that the new by-laws had been revised and would go into effect. These will be circulated as soon as they can be printed.

The paper of the evening was on the subject of "Electric Heating," by W. S. Hadaway, Jr. An abstract of this paper follows:

The term "electric heating" is commonly used to express the filtering down of a higher potential energy of electricity into the lower potential energy of heat. Mr. Hadaway considers that the expression, "electricity, a factor in a telethermic system," would be a better definition.

Heat energy is to be regarded as a commodity that can be generated and controlled in convenient form, and distributed and sold, and in which electricity is used either directly as the high-potential heat factor, or indirectly as an agent. The feature of the subject under consideration is the practical adaptability of commercial electricity for heating purposes and for performing useful work under the conditions imposed in general industrial and domestic life. These applications may be roughly divided into two classes, according to the degree of concentration of the heat energy used. The first class includes low-temperature heating, generally diffused and in large volumes. The second class includes high-temperature heating, generally localized and in small quantity.

The electrical unit, or kilowatt-hour, is the equivalent of 3,412 British thermal units. For practical purposes the work in hand is to determine the useful work in different lines which is obtainable from this number of heat units at a fair average cost of supply.

It has been determined that with a platinum wire held in a flame less than 0.5 per cent of the thermal energy produced in the flame was transferred to the wire, while ninety per cent of the electrical energy used appeared as heat. In another case an iron bar weighing about twenty pounds was heated by charcoal and then by electricity. In the former case about 0.75 per cent of the thermal energy was transferred to the bar, and in the latter case eighty-eight per cent.

In room-heating apparatus on continuous run we may estimate that one watt-hour (3.41 thermal units) will heat one square foot of common radiator surface through 1.26 degrees Fahrenheit; that 1,000 watt-hours, or 3,410 thermal units, will heat the surface approximately 126 degrees Fahrenheit above the room temperature. That is, for room heating from eighty-five to 100 watt-hours are practically the equivalent of steam at low pressure, condensed by one square foot of radiator surface, with the difference between the room and the radiator temperatures as above stated. We may safely assume that a fair average price of the electrical unit from large steam-electric stations is 6.7 cents. It would, therefore, cost 0.65 cent, average, to run one square foot of direct radiation surface for one hour, or the electrical unit would keep about 10.3 square feet of radiator surface at the temperature difference noted for one hour.

The steam-driven electric-light station ranks low as a heat distributor for house warming on any considerable scale, yet notwithstanding the great disparities in the cost of heat energy on a large scale, the uses to which small electric air-heaters are put are surprisingly numerous.

It is then on a comparatively small scale, and in intermittent service, that the electric air-heater is useful when power is derived from the steam-electric station, and when the heat supply is derived from electric resistance.

We must not under-rate the facility with which gas may be stored, the economy of rapid and continuous generation and available heat from combustion and discharges of by-products; whereas, in electric lighting and electric heating every unit of heat and light secured represents an appreciable loss or depreciation of the energy converter. It may be safely concluded that we cannot afford to use electricity for general diffused heating purposes on a large scale. Practical experience, however, shows that such deductions may lead to unsafe conclusions. Many practical illustrations are found, which show that no great engineering difficulties are encountered in distributing boiler energy, and also exhaust steam from the engine, for useful heating work at a distance. We are now able to formulate a multi-potential heat-supply system in which the steam, either live or exhaust, or both, is used for low-temperature work, and electricity from generators in the same station is employed for all work requiring temperatures in excess of that of the steam—that is, from about 250 degrees Fahrenheit upward. In domestic work the steam heat would be employed for house heating and water heating, for bathing, laundry and cooking purposes. Electric heat would be used for lamps, ovens, broilers, small stoves, sad-irons and all purposes requiring high-temperature localized heat. A total fuel efficiency exceeding thirty-five per cent for both low and high temperature heating is obtainable, and probably a still higher efficiency may be secured from operations on a large scale. It is in this direction that we must look for the best immediate results of electric heating in domestic life. Electrical engineers realize that the ordinary light and power station is wasteful as a heat generator and distributor, and one of the ways to improve these conditions is to introduce a basis of supply in which the load-factor is a larger percentage of the station capacity, and in which low-temperature steam distribution may also be utilized. In the modern apartment house we find it possible to effect a comparatively high distributive heat efficiency. The rooms are heated by low-pressure steam or hot-water radiation, and the hot water for laundry, bath room and cooking purposes is also supplied. Electric lighting is available, but low-heat efficiency is found in cooking except in cases where gas is available. No one can question the value of gas as a fuel in cooking. We may, however, take the ground that when a boiler plant is required for room and water heating, and an electric plant for lighting, the use of gas in cooking is unnecessary and comparatively expensive, for it is a form of heat supply not as effectively localized as electricity, and is accompanied by many disagreeable features. In these houses electricity is already in use instead of alcohol for heating convenience, also for heating sad-irons for laundry work and pressing; and it appears to be a question of time only when electric ovens and other cooking utensils will replace the range or the gas stove on a considerable scale.

There are some installations in which all or nearly all the cooking is done by electricity. These are generally successful and economical, according to the degree to which extensive water heating is eliminated. Laundry and pressing irons are found almost uniformly satisfactory. Some of the devices used in the dining room are accounted great conveniences when electrically heated. When it comes to the kitchen the same feeling of cleanliness and refinement of methods as for the dining room is expressed and hoped for, but the housewife is not so ultimately in contact with the apparatus, and ignorant manipulation is encountered, which, however, does no other harm than to add to the expense of running.

In industrial work the progress of electricity has been more rapid than in domestic applications, with the exception of the electric sad-iron. There are cases where heating by electricity is found cheaper than by fuels, setting aside all collateral advantages. In electric cars the more equitable distribution of heat on a satisfactory basis of effective warming is sufficient to employ the method and apparatus even at considerably greater cost than former methods of heating.

Following the reading of this paper, President Ferguson announced that two written discussions had been contributed by Charles E. Waddell, electrical engineer of the Biltmore Estate, Asheville, N. C., and by W. N. Ryerson, superintendent of the Ontario Power Company, Niagara Falls, Ontario. Percy H. Thomas abstracted these contributions.

Mr. Ryerson considers that Mr. Hadaway's suggestions concerning the limitations of the use of electricity for maintaining an equitable temperature in buildings during the season of cold weather are undoubtedly to the point at the present time. There are instances, however, in which comparison between the use of electricity and other heating agents on the basis of cost leads to erroneous conclusions. As an instance in point, in the office building of the Ontario Power Company, at Niagara Falls, which was equipped, under the plans of the architects, with a low-pressure steam-heating system having an auxiliary hot-water system with forced draft, it has been found that the low-pressure steam system is entirely unnecessary, a comfortable temperature being maintained in the coldest weather by an electrically-heated hot-air system designed by himself. It is true that the steam-heating system in this building is a part of a much more extensive one installed throughout the transformer building, of which the office forms an ell, but it is not necessary to maintain a high temperature throughout the remainder of the building, with the exception of the switchboard room, which is heated by direct electric radiators. During the last winter it was found that the use of the boiler was only necessary for twenty-five days, and during the remainder of the time the electric heaters in the office building and switchboard room were sufficient for all purposes. The cost of this electric heater was $388, and it consumes eighty-five kilowatts, including power necessary for a fan motor. In a plant of this size the cost of this amount of energy is negligible, whereas with natural gas and wages of boiler attendants, a large cost would be built up. The electric heater supplies 72,000 cubic feet of air space in a building exposed on three sides.

The Ontario Power Company purchased and installed a complete electric kitchen capable of cooking a meal for 300 persons, and its successful use has been demonstrated on several occasions.

Mr. Waddell considered that dividing heat applications into low-potential quantity and high-potential intensity types is a very expressive way of classifying two general conditions. In high-potential heating problems it has been demonstrated that the cost of electrical energy has little or no bearing on economy. Other factors enter that more than compensate for any discrepancy in calorific value between electricity and fuels.

It is doubtless true that the steam power plant, by reason of its low efficiency, is debarred from furnishing electric heat in competition with fuels. In the case of a thickly-settled district the use of exhaust steam for heating has been demonstrated as profitable and desirable. As Mr. Hadaway suggested, conditions may be such that it might be profitable to generate electricity for high-potential applications and use the exhaust steam for quantity work.

In house heating the efficiency of the apparatus depends almost entirely on the range of temperature in the apparatus and on the method of controlling the fires. Another point that has impressed Mr. Waddell is that not only the quantity, but the intensity of heat in domestic applications is essential to success. If electric heating is to be introduced on a large scale into house warming, it will be necessary to accord the art of heating and ventilation more scientific attention than is now usually bestowed upon this class of work. Unquestionably, of the quantity of heat annually radiated in domestic installations, the greater portion is wasted.

President Ferguson called upon W. S. Andrews to continue the discussion.

Mr. Andrews said that it had been his privilege to be associated with Mr. Edison while he was developing his low-tension, multiple-arc system of electrical distribution in the early eighties. He distinctly remembered a statement which Edison made in 1881, to the effect that he expected to utilize the general distribution of low-potential electrical energy not alone for public and private lighting purposes, but also for operating electric motors, to drive machinery in mills and factories, and for electric traction; and furthermore, he confidently expected to make electricity generally serviceable for the cooking of food, and, to a limited extent, for the warming of dwellings. Mr. Andrews agreed with Mr. Hadaway that the real difficulty in using electricity for performing ordinary cooking operations exists in the providing for a hot-water supply economically. At a price of five cents per kilowatt-hour the cost of heating a gallon of water from faucet temperature to boiling point, at an efficiency of, say, eighty per cent, is a little more than two cents, which, to many people, would be a prohibitive price, especially as the same result can be accomplished for very much less money. Apart from the question of water heating, the operations of baking, broiling, frying, toasting, etc., by electricity can be accomplished at a reasonable expense when electricity is sold at the rate of five cents per kilowatt-hour. Taking into consideration the collateral advantage of being able to raise utensils to a high temperature with localized heat, thus keeping the kitchen much cooler in hot weather than is possible when using a coal or gas range, increases the advantage of electrical service.

James I. Ayer said that the paper of the evening should be analyzed and a more optimistic view taken of the possibilities of electric heating. Mr. Ayer considers that the likelihood of the use of steam from a central station proving an important factor in developing electric heating is doubtful. Steam heating from electric central stations is not considered by those who are exploiting such systems as something they can recommend generally, and the limitation of such development has been in no manner affected by electric heating.

Concerning the competition between gas and electricity, remarkable results in development have come about. In this struggle electric heating already plays its part to a limited, though very beneficial, extent. With no important single installation of electric heaters exceeding a few kilowatts, one central station reports a total of 1,560 heating devices on its lines, having 696 kilowatts' capacity, producing an increased load of 132,000 kilowatt-hours per year, and a gross revenue for the service of $18,000, practically all at lighting rates.

Paul M. Lincoln said that electric heating must compete with other means of arriving at the same end. To win out, the electrical method must show a higher efficiency than any other method of obtaining heat. One of the big advantages with electrical apparatus is, of course, that it can be applied to the work in a much better way than by any other method.

H. P. Ball said that it was feasible, by using modern materials such as nickel-chromium wire and infusible materials, to get a very high temperature, and this was what was needed. In heating rooms, the use of a resistance conductor in the form of a thin, wide band, so as to have a maximum radiating surface, is necessary.

Max Loewenthal said that there can be no doubt that electricity converted into heat cannot be as efficient for any operation as steam generated from fuel. Again, as a general proposition, electricity converted into heat is not commercially as efficient as gas. On the other hand, figures are available which show that the electric oven, for example, compares very favorably with an oven in which solid fuel is burned. When it is considered that the fuel burned in a coal range delivers only 2.5 per cent of the thermal value of the fuel for heating the food, and in a gas stove, from three to 3.5 per cent is secured; while with the electric oven, considering the conversion of energy from steam energy into electrical energy, and assuming an efficiency of the oven of about eighty-five to ninety per cent, the percentage with electricity runs up to 4.5, the economical advantage can be seen. Making careful calculations, based upon actual figures, if the rate for electricity is reduced to 2.5 cents per kilowatt-hour, it will be identical with gas at $1 per thousand cubic feet. The final solution of the problem of using electricity for general heating will be found when the central station can reduce the cost of current to where it will be as economical to cook with electricity as with any other means.

As far as the technical development is concerned, Mr. Loewenthal believes that the resistance material will be of a refractory character more in the nature of a carbide. Samples have just been received of a European product for heating purposes—a silicate of carbon—which may be heated for a great many hours without showing any deterioration at all.

Dr. C. P. Steinmetz took up the discussion and indicated the disadvantages and handicaps under which the development of general electric heating labors. The solution of the practicable utilization of electricity for heating leads up to a method of transforming heat energy from high-pressure, low-quantity, to low-pressure, high-quantity. If you admit heat at a high temperature, a small quantity expanded down is converted into mechanical energy. By going from very high temperature to low temperature, probably fifty per cent can be converted. Carrying out the reverse process at lower temperatures, an amount of heat quantity units several times larger than the heat quantities put in at the higher temperature can be secured. Heat energy is convertible into any other form of energy or fixed equivalent of heat, but heat quantity corresponds to quantity of electricity, corresponds to current, and has no direct relation to energy, but is one of the factors of producing energy. The smaller the electromotive force, the larger may be the other factor with the same amount of energy. This mixing up is partly due to the nature of the energy transformation between chemical energy and heat energy. If we interpose the electric transformer or converter, and change from high electromotive force and small current to low electromotive force and high current, we can get a much larger output by using a much larger quantity of electric energy.

Mr. Hadaway, in closing the discussion, stated that it had been his desire to make his paper very conservative, and that, in his opinion, the thing to be considered mainly was the confining of the heat.

Before adjourning, President Ferguson stated that the next meeting of the Institute would be extremely interesting, the subject for discussion being the experiences in the electrification of the New York, New Haven & Hartford Railroad. The paper would be presented by W. S. Murray, chief electrical engineer of the system.

The meeting was then adjourned.

Reorganization of New York Metropolitan.

It was announced on November 13 that the problem of reorganizing the finances and properties of the Metropolitan Street Railway Company, in New York city, will be taken up at once by a committee representing the bondholders. The committee's work, which will require, as a preliminary, a thorough analysis of the financial and physical factors involved, will be prosecuted, it is promised, with the utmost speed, with the object of evolving a comprehensive plan of readjustment.

Both the committees representing the general and collateral five per cent bonds and the refunding four per cent bonds of the Metropolitan Street Railway Company are represented in the Reorganization Committee, which consists of four members. Donald Mackey and William P. Dixon represent on the joint committee the general and collateral mortgage five per cent bonds, and John W. Castles and Otto H. Kahn the refunding fours. In addition to these, Alexander J. Hemphill, chairman of the first-named Bondholders' Committee, and E. S. Marston, chairman of the latter, have been designated by their respective committees to act, ex-officio, in an advisory capacity to the joint committee. John W. Castles has been named chairman of the committee and Alexander Hemphill, secretary, with L. C. Krauthoff as counsel.

Civil Service Examinations for New York State and County Service

The New York State Civil Service Commission will hold examinations on December 12 to fill the position of junior draftsman, Public Service Commission, First District, $720 to $1,200 per annum. The last day for filing applications for this position is December 5. Full information and application forms may be obtained from Charles S. Fowler, Chief Examiner, Albany, N. Y.

Association of Car-Lighting Engineers.

First Annual Meeting Held at the Grand Pacific Hotel, Chicago, November 16 to 20.

The first annual meeting of the Association of Car-Lighting Engineers was called to order on Monday morning, November 16, in the German Room of the Grand Pacific Hotel, Chicago. There was a large and enthusiastic attendance, and the opening session indicated that this was a very live organization, and that there was in store for it a future of much service and value to the car-lighting engineers and the railroads with which they are connected.

The opening session was called to order by President A. J. Farrelly, of the Chicago & Northwestern Railway. Mr. Farrelly rehearsed very briefly the organization of the association. On May 20 last ten men, representing four of the large railroads, gathered together at Ogden, Utah, to discuss several points of difference which had involved the different organizations, and during the discussion it was suggested by E. M. Cutting, of the Southern Pacific, that an organization of car-lighting engineers be started. In response to some correspondence which was then carried on, a meeting was held in the Grand Pacific Hotel, in Chicago, last August, with about forty men present, and an organization effected with the following officers: President, A. J. Farrelly; first vice-president, E. M. Cutting; second vice-president, A. J. Collett, Union Pacific; secretary and treasurer, G. B. Colegrove, Illinois Central. Executive committee—H. C. Meloy, Lake Shore & Michigan Southern; A. C. Terry, "Soo;" G. W. Murray, San Pedro, Los Angeles & Salt Lake, and O. W. Ott, Oregon Short Line.

The objects of the association are to tie together the loose threads which have predominated in car-lighting engineering. While the apparatus has been standardized and perfected to a considerable degree, there is but little uniformity of installation and equipment. Except on a few of the larger roads there has been a tendency to utilize any kind of a light, in any kind of a way, and let it go at that. It is the opinion, however, of progressive railway men that one of the greatest features of attraction in railway service is adequate lighting, and to-day there is need for considerable study and interchange of ideas which would bring about that betterment of service for which all car-lighting engineers should strive in performing their full duty to their employers.

The report of Secretary-Treasurer Colegrove showed that there were 205 members; that the collections had amounted to $410, and that the expenditures outside of the cost of printing for the present convention were $108.65, leaving a balance in the treasury of $301.35.

The first paper was read by Patrick Kennedy, entitled "History of Car Lighting." This paper called attention to the valuable contributions to the literature of train lighting which had been made by Prof. George A. Shepardson, of the University of Minnesota, and by A. H. Bauer. The advantages of electrically lighting railroad cars were realized very early in the development of incandescent electric lighting, and the efforts of electrical engineers to utilize electric lamps for car illumination were contemporary with the earliest manufacture of incandescent lamps. Prior to the installation of the first Edison system in New York the London & Brighton Railway operated an electrically lighted car from a battery of Faure cells. The Pennsylvania Railroad, in the spring of 1882, equipped a number of its cars, taking current from imported Faure cells, and considerable experimentation was done with primary batteries for car lighting from 1883 to 1887 in France and America. It was recommended that a committee be appointed to prepare a complete historical treatise dealing with the subject of car lighting by electricity.

In the course of his paper, Mr. Kennedy called attention to various patents which had been granted for systems of car lighting. One of these, he said, consisted of a windmill, which was placed on the locomotive, and which was expected to generate enough current to light the train and perform some other service.

During the remarks which followed the reading of Mr. Kennedy's paper, it developed that Alexander McGary, chief electrician of the New York Central, was the expert who undertook the testing out of this installation. Notwithstanding the fact that this is now looked upon as more or less of an absurdity, it was nevertheless practicable, and it appeared at that time that a large syndicate would be organized to develop it. The installation consisted of a thirty-six-inch Sturtevant wheel equipped with a damper gate for cutting off the wind pressure as the locomotive would meet a new slant of the wind when rounding a curve or changing its direction. It was installed on a locomotive on the Grand Rapids & Indiana, running between Grand Rapids and Muskegon, Mich. The generator developed twenty-five amperes at eighty-five volts. Of course, with the controlling devices at that time available, it was not possible to regulate the voltage or maintain anything like decent illumination, and pending the construction of a better form of wheel and controller, the development of this system was allowed to lapse.

A paper entitled "The History of Axle Lighting" was presented by W. L. Bliss. This was a classical resumé of the past and present efforts made in the development of a successful axle lighting system. Mr. Bliss paid a warm tribute to those who had, along with him, done the pioneer work in bringing to the present-day perfection the system of axle lighting with which large numbers of cars are now equipped. He described the many difficulties which were overcome, and indicated the probable trend of invention and design in meeting those difficulties which it is now considered are about to be solved. The history of axle lighting is as old as any development of car lighting. From the earliest days efforts have been made to light trains electrically by means of a generator driven from the axle through some form of transmission. The first patent with which he had any acquaintance was taken out in England in 1881, by Richard Lalor, and is numbered 5,316. In America he thought that among those men who were now living, and who had been interested for the greater part of their lives in developing a system of axle lighting, in point of time of service the leader was Morris Moskowitz; that second place belonged to Patrick Kennedy, and that he himself was entitled to third place.

Mr. Bliss illuminated his paper with many amusing reminiscences and references to the early work of inventors, and made a number of excellent suggestions concerning the perfect system of train lighting which now is in fair shape to be realized.

The session then stood adjourned until 2 p. m.

The afternoon session was opened shortly after 2 o'clock, when President Farelly announced the report of the committee on the care and maintenance of storage batteries, comprised of F. R. Frost, W. F. Bauer, Dr. J. E. Widner and H. M. Beck. The paper was read by the first named, as chairman. Though the report was not lengthy, it was very comprehensive, and in a terse way set forth a great amount of valuable information concerning the storage battery and its use.

After an introductory paragraph, in which the systematic and intelligent attention to batteries at frequent intervals was strongly advised, the authors struck at once into the controversy of lead-lined tanks versus rubber jars, by summing up the following advantages for each class of container. Over the rubber jar the lead-lined tank prevailed, they declared, in its ability to withstand severe shocks, its slightly lower first cost, the value of its salvage as scrap and the greater ease of repair. On the other hand, rubber jars were stated to weigh less, to require no special care to prevent the action of wood, acids and grounds, to need no insulation to prevent short-circuiting the elements, and to show a lesser tendency for the electrolyte to creep.

The following suggestions were made for battery cell construction used in railway train-lighting work: Rubber jars were recommended to be three-sixteenths inch thick, with reinforced tops and with bridges not less than one and three-fourths inches thick. Lead linings should be made of lead weighing not less than four pounds per square foot with all laps burned, the use of solder not being permissible. Oak crates with dovetailed corners were advised, thoroughly painted inside and out with an acid-resisting paint. Jars and linings should be set in a low-melting compound, the report said, permitting of their easy removal when filled with hot water. Connectors of No. 4 or No. 6 cable, containing at least forty-nine strands and insulated with best quality rubber, were advised. For terminals brass is inferior to copper. All metal parts in the battery box must be painted with an acid-resisting compound.

For washing batteries the use of water was discouraged, as it tends to make the negative plates lose their charge. In changing plates from one electrolyte to another the elements should be kept out of the acid as little as possible. One or more cells of a series, showing up weak should be removed from circuit and treated until the normal condition is restored; meanwhile other good cells take the place of the weak cells in the working circuit. A weak cell will quickly go to pieces if continued in service, particularly if the battery is discharged to a low point as the cell may become reversed. In the use of the pilot-cell method great pains must be taken to keep the electrolyte conditions of the group uniform. Other directions for taking care of cells in and out of service were given with some detail, and a complete system of recording tests, cleanings and renewals was recommended to be observed with care.

Interesting from an historical and curious standpoint was the next paper, "Railway Train Lighting," first delivered before the American Institute of Electrical Engineers at Chicago in June, 1892, by A. H. Bauer, the father of W. F. Bauer, a member of the convention. The paper was read before the car lighting engineers by Mr. Bender. A brief abstract of the matters of historical importance contained in the paper is given below:

The first successful system of railway train lighting was that invented by Houghton and adopted by the London, Brighton & South Coast Railway of England, in 1881. Other improvements added by many inventors later made the system almost automatic. Connected by link belting to the car axle, was a Brush dynamo in the baggage car. A ball governor, rotating vertically, performed the following functions: Opened a switch when the electromotive force of the generator fell below that of the battery, adjusted a resistance to maintain the current constant, shifted the brushes to conform to the neutral point at the particular speed of the armature. The pole changer, designed to make the machine pick up in whichever direction the car should run, consisted of a freely moving rocker-arm carrying the brushes and able to be moved through a quadrant by the friction of the brushes on the commutator, at the same time operating a throw-over switch controlling the connection of the field coils. The rocker-arm was brought to position by a snap-spring arrangement: One set of accumulators, consisting of twenty-five cells, was provided for each train and placed in the baggage compartment. The maximum number of lamps in a train was seventy, of ten candlepower each, at fifty volts.

Axle-lighting seemed to have failed in America, the author observed in 1892, since the bogie truck used in this country did not allow a stable arrangement of the pulley, belt and axle, as was possible on the rigid wheel bases of Europe.

In 1887-88 the first attempt was made to use secondary or storage batteries in lighting two Pullman limited trains of six cars each. Each car was equipped with thirty cells, weighing fifty pounds per cell. Duplicate sets were kept charged at each end of the line and exchanged for the exhausted battery on the car. Twenty-six sixteen-candlepower lamps, operating at sixty volts, were used per car. This system failed because the capacity of the battery was too small and the cells were usually exhausted before 11 p. m. Another reason was the deterioration of the plates, which were of the pasted-grid type.

In 1890, four cars, each equipped with thirty-two cells of 150-ampere-hours capacity, and containing twenty-six sixteen-candlepower, sixty-volt lamps, were running between Chicago, Indianapolis and Cincinnati. The cars were charged at one end of the run while standing on a particular sidetrack near the generating station.

In January, 1888, six-car trains between Jersey City, N. J., and Jacksonville, Fla., were lighted by a vertical single-stroke engine, belt-connected to the generator in the baggage car. Steam from the locomotive boiler was used. A three-cylinder engine direct-connected to a seventy-five-volt, sixty-ampere dynamo run at 1,000 revolutions per minute was next installed. However, metallic dirt from the brakes and roadbed formed such frequent short-circuits that an extra armature was always carried and changes sometimes made while the train was in motion. Later the Eickemeyer dynamo, which was of an enclosed construction, was installed with success.

The cost of such a complete installation, with batteries, was figured at $5,808 per train, or $968 per car. "So successful has been the lighting of these trains that it is rare for other sources of illumination to be used," says the author in appreciation of the advantages of electric lighting. "There is no doubt," he concludes, "that the ideal way of running a dynamo is by connection with the axle. * * * It is, however, thought that within the next year a reliable connection will be had, after which I believe the lighting of railway trains by electricity will be universally adopted."

Following the reading of Mr. Bauer's paper, the convention took up the discussion of storage batteries and was soon engaged in a spirited dissension on the relative value of the rubber jar and the lead-lined tank. The charge made that rubber tended to crystallize and become brittle with age was denied by those who had experienced success with pure and compound rubber jars. Methods of crating and handling, all agreed, had an important part in the resultant breakage during service.

On Tuesday morning an effort was made to crystallize the results of the preceding day's discussion on the relative advantages of the rubber jar and lead-lined tank and the construction of battery trays by obtaining a vote on a resolution embodying the recommendations of the majority of the car-lighting engineers present. A resolution declaring that reinforced rubber jars set in petrolyte or some suitable material are superior to lead-lined tanks failed to pass by a single vote, the convention dividing almost equally over the merits of the respective containers. A unanimous vote was accorded the general resolution to the effect that the materials of which trays are to be made is largely governed by local conditions.

The report of the committee on "Straight Electric Lighting" was then read by C. W. Bender of the Pennsylvania Railroad. J. R. Sloan and A. McGarry were associated with him in the preparation of the paper. The report discussed the necessity for auxiliary methods of lighting trains, except the provision of emergency candles, under the varying conditions met in straight-storage, axle-generator and head-end systems. In the first case the batteries must be of ample capacity, and sufficient time for charging must be given at layover points.

In the committee's opinion the axle generator and steam turbine have been developed to such a point that with competent inspection they will give satisfactory service. The report cited the instance of one railroad operating several hundred electrically lighted cars, these cars being equipped either for straight-storage, axle-generator or head-end system, and on which, with very few exceptions, there is no auxiliary system of lighting other than emergency candles, and the failures of electric lights are gratifyingly small. The majority of those that do occur are on account of insufficient layover time and inadequate charging facilities.

In the general discussion which followed the confidence of the engineers in unreinforced electric lighting was evident and the experiences of the members showed that practice now leans toward straight electrical installations. Sole dependence on the system and a better routing of cars for electrical inspection and repair were shown to make for reliable operation of electrical equipment. The percentage of gas failures, it was concluded, is about equal to the electrical outages observed. Several engineers advised incorporating rules regarding attention to fuses and lights, in the book of train rules for the crew, and requiring examinations.

Some very interesting remarks by two outside visitors enhanced the afternoon session. Wilson E. Symons, who has been prominent in railroad development and maintenance work, attended the meeting and was called to the front of the room, where he read several extracts from a paper delivered before a technical society earlier in the year, apropos the passing of the steam locomotive. After a brief history of electric traction Mr. Symons congratulated the members of the Association of Car Lighting Engineers on the splendid work before them and predicted that as an authoritative body the association would achieve a position only second to the Master Car Builders.

A. H. Darker, of the J. Stone Company, Deptford, England, was next called upon and surprised the convention by his account of the progress of car lighting elsewhere than America. He reported that 30,000 cars equipped with an axle-lighting system were used in the civilized and comparatively unsettled countries of both hemispheres. Potentials of sixteen. twenty-four and sixty volts are common practice abroad. The severe handling in Europe, where cars penetrate half a dozen different countries during the shifting of a week, is an extreme condition which American car-lighting men are not called to meet. Instruction cards must be printed in several different languages. Electrical car-lighting with no auxiliaries has been found absolutely reliable in the extensive practice of Mr. Darker's company.

The report of the committee on train connectors, read by H. C. Milo, one of the committee with A. McGary and J. R. Sloan, involved a technical discussion of a device which, the members' remarks implied, is not yet entirely satisfactory.

E. W. Jensen, chairman of the committee on organization and systemization in connection with electric-lighted trains, followed with the report prepared by himself and his associates of the committee, W. Barnum and F. McGary. The first part of this paper was taken up with a compilation of report forms used in recording materials, renewal and inspection. Several examples were given of the force necessary to handle electrical equipment. For instance, one road has the major portion of its cars equipped for lighting from straight storage battery and its limited trains lighted with a turbine head-end system. At one terminal, ninety cars per day are handled, of which fifty-eight are straight-storage, twenty-four head-end and eight axle-lighted. There is a force of one electrician in charge, one assistant electrician, one clerk for records and correspondence, one storeroom clerk, four electrical machinists for turbine work, axle generator work and general repairs, four yard electricians for testing and charging batteries and twelve batterymen, who make all battery repairs, clean and supply the different sets of battery. At this point the majority of the cars are cleaned and repaired.

Sessions were held on Wednesday and Thursday. The annual banquet was held on Wednesday evening, and the programme called for a jaunt to Milwaukee on Friday.

A number of exhibitors occupied parlors on the convention-hall floor of the Grand Pacific Hotel, and several showed operating installations to claim the attention of the car-lighting engineers between the sessions. Exhibits of the following companies were shown: Consolidated Railway Electric Lighting and Equipment Company, the Willard Storage Battery Company, the Westinghouse Machine Company (storage batteries), Storage Battery Lighting Company, Central Electric Company, Bliss Electric Car Lighting Company, the Safety Car Heating and Lighting Company, the New York Leather Belting Company, the National Electric Lamp Association (engineering department), the Gould Car Coupler Company and the Bijur Battery Company.

Chicago Section—Illuminating Engineering Society.

The second fall meeting of the Chicago Section of the Illuminating Engineering Society was held at the Grand Pacific Hotel on the evening of November 12. After the usual dinner the meeting was devoted to a discussion of some of the papers that had been presented at the recent annual convention of the society at Philadelphia. These papers were recently abstracted in both the ELECTRICAL REVIEW and the WESTERN ELECTRICIAN.

The first paper considered was that of Leonard J. Lewinson on "The Intensity of Natural Illumination Throughout the Day." It was briefly abstracted by Albert Scheible. In the discussion J. R. Cravath gave an explanation of why the author could not read his instruments with an illumination of two foot-candles at dawn. Mr. George H. Jones spoke of the marvelous range of the eye, which can adapt itself with comfort to variations in illuminating intensity from a small fraction of a foot-candle to over 10,000 foot-candles.

A paper by J. R. Cravath and V. R. Lansingh on "The Calculation of Illumination by the Flux of Light Method" was then abstracted with great care by Mr. Cravath. He demonstrated graphically the various steps that led to the development of this method and showed how it can be used. There was no discussion of this subject.

Consideration was then given to the paper presented by V. R. Lansingh and T. W. Rolph on "Some Experiments on Reflection from Ceilings, Walls and Floors." This also was abstracted by Mr. Cravath, who showed a graphic chart prepared from the results given in the paper as to the watts per lumen required to illuminate a working plane in a room having, first, ceiling, walls and floor dark, then the ceiling light, next ceiling and walls light, and finally even the floor light. The discussion on this subject was quite general. Mr. Scheible thought that in the first case the use of a mirror type instead of a prismatic reflector would have shown even more striking a contrast in the figures with and without reflector. It was also pointed out that for the case with floor dark there was little difference between the use of a reflector and not using one. The figures for the last case were said to be now quite commonly attained by the use of tungsten lamps.

The next meeting of this section will probably consider some problems relating to illumination by gas, as its date coincides with the holding of a "Gas Show" that is scheduled for the First Regiment Armory.

New York Section—Illuminating Engineering Society.

The regular monthly meeting of the New York Section of the Illuminating Engineering Society was held on Thursday evening, November 12, at the St. Gabriel's Branch Carnegie Library on East Thirty-sixth Street.

The object of holding the meeting at the library was twofold, one being to give the members an opportunity to examine and discuss the lighting installation, and the second that the designer has the benefits of the discussion in the designs of similar buildings now under construction.

The illumination of the building was designed by the first president of the society, L. B. Marks, and the installation was described with measurements of the illumination in a paper presented at the recent convention at Philadelphia.

The meeting was called to order by Albert Wahle and the installation was described briefly by Mr. Marks. The visitors were quite as numerous as the members, including the chief of the circulation department of the New York public libraries, Mr. Bostwick, and a number of the librarians in charge of the various branches throughout the city.

A feature of the lighting of this building was that it was the first to be erected where local lighting was provided.

Prof. Morgan Brooks of the University of Illinois cited an instance where there was sufficient illumination for reading, but that upon some of the tables reading lamps were provided and the students invariably selected these tables. He thought the reason for this was that it was the attractiveness and coziness, as he expressed it, of a table lamp.

The installation was also discussed by Messrs. Doane, Lansingh, Moore, Barton, Owens, Wahle and Millar.

From the discussion it would be hardly fair to state that this particular type was altogether successful, although none of the members mentioned an installation where only general lighting was provided where results were as satisfactory as in the case under discussion. The members were the guests of the Librarians of the city, and through their hospitality refreshments were enjoyed by all.

More Westinghouse Stock.

A special meeting of the stockholders of the Westinghouse Electric and Manufacturing Company was called on November 11, to meet in Pittsburg on November 24, to provide for the carrying out of the reorganization plan. The stockholders will be asked to increase the board of directors to sixteen and to constitute a proxy committee, to remain in existence five years, according to the requirements of the modified plan of the Readjustment Committee, which is to take the company out of the hands of the receivers.

The stockholders will also be asked to make changes in the by-laws required by the plan and to increase the capital stock by $10,000,000, as well as to adopt the necessary resolutions to make the plan itself effective.

The requirements of the modified plan for the readjustment of the debt of the company will require approximately $14,200,000 of new assenting stock, to be issued to holders of the merchandise debt and bank debt and to stockholders who have subscribed for new stock in cash. Of the present authorized assenting stock of the company $12,500,000 is reserved against the convertible gold bonds and $23,940,000 is issued, leaving only $9,560,000 unissued.

Announcement is made that the Pittsburg banks have raised the $1,500,000 additional cash necessary to make the reorganization plan a success, by taking the notes of the Security Investment Company. The operation of the readjustment plan will give the Westinghouse company a total of approximately $12,000,000 cash.

The inquiries received by the Westinghouse company for electrical apparatus are larger than at any time in years past.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on November 24 for the following electrical material: Miscellaneous cable, 6,000 feet lamp cord, two generator sets, 500 lamp guards, three transformers, 1,000 molded mica sockets, 1,000 porcelain wall receptacles, 11,400 feet weatherproof wire and miscellaneous wire, for delivery at Norfolk, Va.; 20,000 duct-feet vitrified-clay conduit, for delivery at Philadelphia, Pa.; fifty arc lamps and eight knife switches for delivery at Charleston, S. C.; 4,000 incandescent lamps, for delivery at Brooklyn, N. Y.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER I. (PART VIII.)—POLYPHASE CURRENTS.

DISTINCTION FROM SINGLE-PHASE CURRENTS.

The alternating current heretofore considered is what is known as a single-

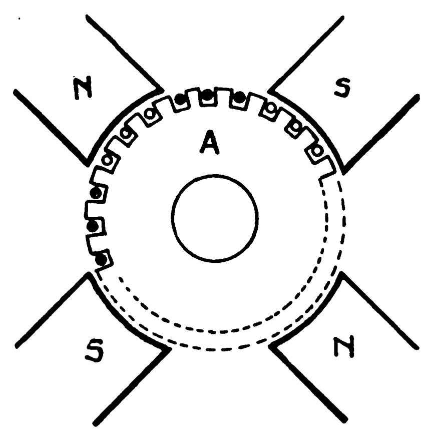


FIG. 19.—IDEAL TWO-PHASE GENERATOR.

phase current; that is, the generator delivering an alternating current to a single circuit. In the polyphase system the armature consists of two or more independent windings, each of which is connected through its own transmission lines to separate receiving circuits. Each independent circuit of a polyphase system carries a single-phase current, but these single-phase currents differ in phase, and the combination constitutes a polyphase

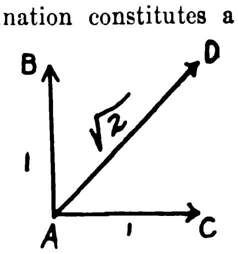


FIG. 22.—RESULTANT OF TWO QUANTITIES ACTING AT RIGHT ANGLES.

system. Two such separately generated currents differing in phase constitute a two-phase system; three separate circuits, a three-phase system, and so on.

The principal advantages of this system of generating and transmitting electrical energy are the better operation of motors and the economy secured in transmission. These two reasons for the steady increase in the use of polyphase systems will be considered in more detail under separate headings.

TWO-PHASE SYSTEMS.

In the two-phase system there are two distinct windings on the armature, each with its own collecting rings. They are so arranged that the electromotive force generated in one set of windings is ninety degrees out of phase with that generated in the other set. In other words, one is a maximum where the other is at its zero value. This is more clearly illustrated in Fig. 19. As shown by the projections marked N and S, there are two pairs of pole-pieces. A is the armature containing slots on its periphery, which carry the

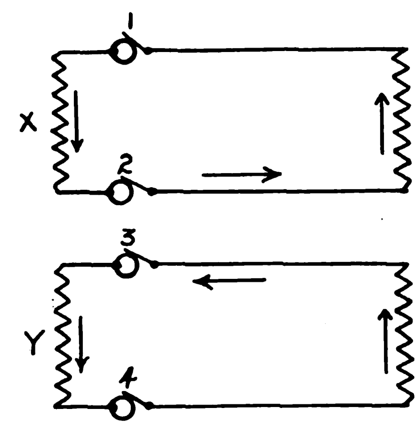


FIG. 20.—CIRCUITS OF TWO-PHASE ALTERNATOR WITH FOUR COLLECTOR RINGS.

armature windings. These are in two sets; those marked with a small circle are electrically distinct from those marked with a cross. When one set is directly underneath a pole-piece the other is midway between two poles, and accord-

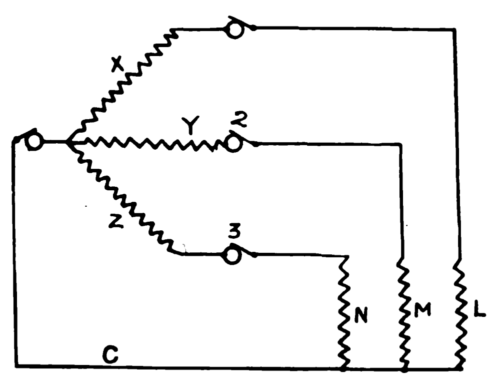


FIG. 23.—CIRCUITS OF THREE-PHASE ALTERNATOR WITH FOUR COLLECTOR RINGS.

ingly the electromotive force in one is a maximum when that in the other is zero, as already stated.

A two-phase alternator is usually provided with four collecting rings, as shown in Fig. 20, where X and Y represent the two separate windings of the alternator. Here 1 and 2 represent the collecting rings for the winding X, and 3 and 4 the collecting rings for the winding Y. The arrows show the directions of the current through the circuit while L and M represent the consuming apparatus, such as electric lamps, motors or the like. When used for motors L and M would represent separate windings in the armature of the motor.

THE THREE-WIRE TWO-PHASE SYSTEM.

It is possible to do away with one of the collecting rings by combining the two adjacent conductors of Fig. 20, as shown in Fig. 21. The two currents in the common return wire do not neutralize each other because they are ninety degrees out of phase with each other. The resultant current can be determined just

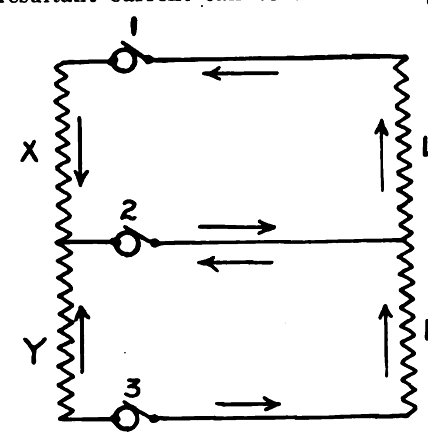


FIG. 21.—CIRCUITS OF TWO-PHASE ALTERNATOR WITH THREE COLLECTOR RINGS.

as the resultant of two forces acting at right angles is determined. Thus, as is shown in Fig. 22, AC represents the current from one winding; for example, X and AB the current from the other.

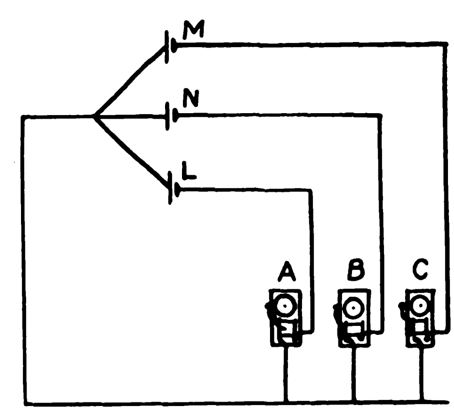


FIG. 24.—ARRANGEMENT OF CALL-BELL CIRCUITS WITH COMMON RETURN.

These two, differing ninety degrees in phase and being of equal magnitude, give the resultant AD, which is equal to $\sqrt{2}$ AC, or $\sqrt{2}$ AB. In other words, in a balanced load the current in the outside terminals of Fig. 21 being I, that in the common return is $\sqrt{2}$ I. Also, if L is the potential difference between one outside wire and the middle wire of Fig. 21, $\sqrt{2}$ E is the potential difference between the two outside wires.

THE THREE-PHASE SYSTEM.

In some cases it is preferable to use three-phase instead of two-phase current.

This can be arranged by having three separate windings in the armature of the generators connected to six collecting rings, making three distinct circuits and six transmission lines.

In practice, however, it is customary to combine these, as was done in the two-phase system illustrated in Fig. 21. One method of combination is by means of four wires and four collecting rings, as shown in Fig. 23, where the wire C acts as the common return of the others. Here X, Y and Z represent the three separate

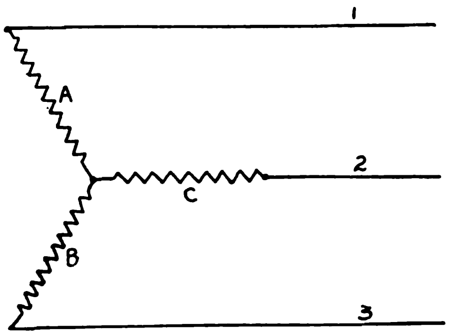


FIG. 25.—THREE-PHASE SYSTEM, STAR CONNECTED.

windings and L, M and N the receiving or consuming circuits, while C is the common return wire. This is similar to three electric-bell circuits having a common return, as shown in Fig. 24. A, B and C are three electric bells, each in a circuit with a battery, as shown at L, N and M respectively, all having a common return.

STAR OR Y CONNECTION.

It is possible to combine the four wires of Fig. 23 in such a manner as to use

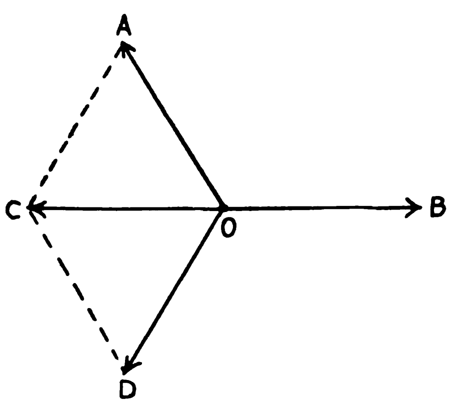


FIG. 26.—PHASE DIAGRAM SHOWING RELATION OF CURRENTS OR VOLTAGES IN A THREE-PHASE SYSTEM.

only three as shown in Fig. 25. The windings are then so arranged that the current flows toward the generator in one coil; for instance, Y, when it is flowing away from the generator in both X and Z. As will be shown by a vector addition of the current quantities, there would then be no use for the conductor C and the coils could be represented by A, B and C of Fig. 25.

The currents in a three-phase system differing 120 degrees in phase can be represented by the lines AO, DO and BO of Fig. 26. If the directions of the three currents at any one instant are as indicated by the arrows, CO, the resultant of AO and DO, is equal and opposite to BO. In other words, the currents in AO and DO exactly balance that in BO and a fourth wire is not necessary. This is called the Y or star method of connecting a three-wire three-phase system.

DELTA CONNECTION.

Another method of connecting the three wires of a three-phase system is known as the mesh or Δ (delta) system. This method is illustrated in Fig. 27. In this case the armature windings form a closed circuit, as shown by A, B and C. Each of the conductors 1, 2 and 3 carries

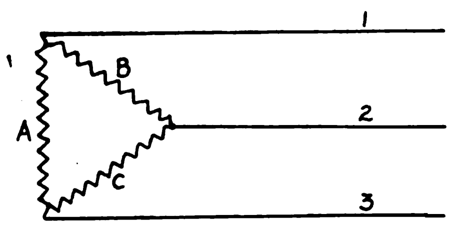


FIG. 27.—THREE-PHASE SYSTEM, DELTA CONNECTED.

currents 120 degrees out of phase with each other, and for this reason one coil does not form a short-circuit for the other two as it would if the currents generated in each coil were all in phase with each other.

Government in Favor of Lower Cable Tolls.

While the Post Office Department is watching with interest the agitation in Great Britain for lower cable tolls between the two countries, it has not yet discovered a way by which it can aid in the movement.

According to the officials, says the New York *Times*, the only way in which the Post Office Department could bring any pressure to bear on the corporations owning the cables would be through the charters granted them by this Government. These charters will be examined, and if it is found that provision is made in the documents for governmental supervision and control, some action may be taken.

Although the Government has not claimed it as a right, the transatlantic cables carry Government messages at special rates. Over the transpacific cable special rates on government business also rule, but these are the result of stipulations embodied in the government charter.

Postmaster-General Meyer is an enthusiastic believer in the establishment of the lowest possible rates on all means of communication between the United States and Europe. The two-cent Postage Convention between England and America entered into recently was framed and executed largely as a result of the Postmaster-General's belief that it would so increase the volume of mail matter that in the end the earnings would be in excess of what they were under the old rate of five cents an ounce.

No comment is made on the proposition of John Henniker Heaton, of London, that the Governments of the United States and Great Britain purchase the cables between the two countries and operate them.

Pittsburg Section of the American Institute of Electrical Engineers.

The regular November meeting of the Pittsburg section of the American Institute of Electrical Engineers was held on November 10, in the Carnegie Institute. W. Edgar Reed, chairman, presided.

Following the informal dinner held at the University Club, the attendance at the meeting was 138. The mining companies and the electrical profession in the entire surrounding district were well represented, including some engineers from the United States Geological Survey.

The subject for the evening was "Electricity in Mines," an original paper, presented by Geo. R. Wood, consulting electrical engineer, of Pittsburg, Pa., who took up the general subject and gave a very complete outline of the application of electricity to coal mining. The lecture was profusely illustrated by lantern slides.

The subject was discussed by F. L. Sessions, of Columbus, Ohio, chief engineer of the Jeffries Manufacturing Company; W. A. Thomas, T. H. Schoepf, J. N. Mahoney and F. C. Albrecht, of the Westinghouse Electric and Manufacturing Company; H. L. Brown, of the General Electric Company, and H. W. Fisher, of the Standard Underground Cable Company.

The subject for the next meeting will be "Some Experiences in the Application of Gas Power in the Operation of Sixty-Cycle Industrial Plants, with Special Reference to the Plant of the Union Switch and Signal Company," an original paper, by J. R. Bibbins, of the Westinghouse Machine Company.

Features of Municipal Lighting in Chicago—Past and Present.

At the meeting of the Chicago Electric Club, held on November 11, William Carroll, City Electrician of Chicago, delivered an interesting address on the features of municipal lighting in Chicago.

For the purpose of making comparisons, early in the year, Mr. Carroll obtained some information about the street lighting of a few American cities, and found at that time, that—

	Arc Lamps.
Chicago had	8,822
Greater New York	14,756
Philadelphia	12,018
Cincinnati	5,651
Boston	3,800
St. Louis	1,150

The annual cost of lighting was:

Chicago	$1,031,542
New York	2,648,546
Philadelphia	1,621,049
Cincinnati	411,704
Boston	805,835
St. Louis	615,960

The costs include gas and gasoline as well as electric.

The cost per square mile was the lowest in Chicago, and the highest in Boston. The cost per candlepower was the lowest in Cincinnati, with Chicago a close second, and St. Louis the highest.

Only two of these cities, New York and Philadelphia, had a greater estimated candlepower than Chicago, and only one, Greater New York, a greater area to be lighted. All maintained gas and gasoline lamps in addition to the electric arcs, New York having over 43,000 gas and 4,300 gasoline lamps. Chicago is behind Boston, Philadelphia and Cincinnati in the candlepower per square mile, but ahead of New York and St. Louis.

This is not a very good showing for Chicago, but not as bad as it might be, but such as it is the bad features exist through no fault of either Mr. Carroll's predecessors or himself. They were and are willing to improve conditions, but have never been able to get sufficient funds to make a complete job. This is an old cry, but a true one. They have been going along, a little at a time, trying to build up an electric-lighting system out of the crumbs dropped from the proceeds of general taxation, when it should have been built at once, he says, out of the proceeds of a bond issue.

The city's electric street-lighting plant was started in the year 1887. At the end of that year there were 104 lamps in service. The power equipment consisted of one 125-horsepower engine, located in the basement of a fire-engine house at the corner of Clinton and Washington streets. In the following year a 300-horsepower engine was added, it being located in a fire-engine house on Jefferson Street, near Van Buren. At the end of the year 1888, there were 279 lamps in service. In the year 1889, a power house was erected on Throop Street, near Van Buren, and the two earlier power stations were abandoned. In the year 1893, the city passed an ordinance requiring that all electric-light extensions must be made by special assessments. This put up to the property owners along each street the proposition that if they wanted electric lights, they must pay for them out of their own pockets. This action appears to have put a damper on the electric-light extensions, as in 1893 there were only ten lamps placed, in 1894 none, and in 1895, eight.

In 1896, the city placed a conduit system and erected lamps on Ogden Avenue, from Madison Street to Twelfth, by special assessment. Some of the property owners along the street refused to pay the assessment, and carried the case into court, where the ordinance was declared unconstitutional, and subsequently disappeared from the Municipal Code.

At the end of the year 1904, seventeen years after the first start was made, there were 5,107 lamps in service. During the next two years 1,909 lamps were placed in service, and in the year 1907, 1,190 lamps were added, there being at the close of that year 8,206 lamps in service.

Up to date in the present year, the city has installed approximately 1,000 additional arc lamps, and the work under way will provide for the addition of 3,000 more; 5,190 lamps in two years of the present administration, more than were added during the first seventeen years of operation.

At the present time there are 9,165 arc lamps operated from the city's circuits. The city is renting 674 lamps from the Commonwealth Edison Company. The rented lamps are located, for the most part, in the southern part of the city, where the city circuits have not been extended.

The cost to the city of Chicago for street lights during the year 1895 was, in round numbers, $1,098,000, and the estimated candlepower 3,964,000. The cost for the year 1907 was $1,031,542 and the estimated candlepower 18,233,000, there being in the last thirteen years a slight reduction in the total cost of street lighting and an increase of about 460 per cent in candlepower.

At the present time the city's streets are lighted by 9,165 municipally-operated arc lamps, 674 rented arc lamps, 10,523 open-flame gas lamps, 12,102 mantle gas lamps, and 7,000 gasoline lamps. At the end of the year we expect to have approximately 12,700 arc lamps in service, including the rented lamps and not including the lights maintained and operated by the Park systems.

The power for the operation of all the city lights is obtained from the Sanitary District of Chicago, the energy being delivered to the city at the District's terminal station on Western Avenue, near Thirty-first Street.

At three of the old stations the city is operating the old direct-current dynamos by synchronous motors, the motors being direct coupled to line shafting and the line shafting belted to the dynamos. From these stations the city is operating approximately 5,000 direct-current open-arc lamps. The steam plants are being held in reserve.

About 4,100 series enclosed, alternating-current arc lamps are being operated through constant-current transformers and automatic regulators. For future extensions to the arc-lighting system, a series of transformer substations have been planned, having a capacity of 1,350 lights each. In each substation there will be three 250-kilovolt-ampere, single-phase transformers, stepping down from 11,500 to 4,200 volts. There will be twenty-seven regulators to operate the same number of fifty-light circuits.

The buildings are to be of brick and reinforced concrete throughout, and absolutely fireproof. Two of these buildings are in process of construction at the present time. One is located on Wood Street, near Nineteenth, and the other on Wentworth Avenue, between Forty-seventh and Forty-eighth. The outside construction work, building of conduits, pulling cables, setting poles, stringing wires and hanging lamps, is nearing completion. The station at Wood and Nineteenth streets will operate all the lamps in the territory bounded by Twelfth Street on the north, the Chicago River on the south and east, and Rockwell Street on the west. From the Wentworth Avenue station there will be operated all the lamps located in the district bounded on the north by Thirty-ninth Street, on the east by Grand Boulevard, on the south by Garfield Boulevard, and on the west by Halsted Street, the stations being located nearly in the center of the districts lighted.

The circuits will be comparatively short, the longest one containing about four and one-half miles of wire. Some of the older city circuits contained twenty-eight miles of wire.

A similar station, although not so pretentious or expensive, located in the rear of a city bath house on Emerald Avenue near Thirty-fourth Street, was put in operation early in the year. From this station the city is operating 936 lamps. The circuits are all aerial, with iron poles and No. 6 weatherproof, copper wire.

The cost of the completed equipment, building, transformers, regulators, lamps, switchboards, circuits, conduits, cables, transmission lines, etc., was \$107,582—nearly \$115 per lamp. The lamps operated from the station will cost approximately \$38 per lamp per year, including investment charges. This may appear low, but there are no production charges except the \$15 per horsepower-year paid the Drainage trustees, and the distribution costs are low, on account of the new and short-circuits, iron poles, etc. The labor is practically confined to lamp trimmers, patrolmen and line repairmen. The total fixed charges for this station are estimated at \$11,508.37 per year, making the investment charges about \$12.30 per lamp.

In the report on municipal street lighting, recently submitted to the Mayor and City Council by B. J. Arnold and Arthur Young, there is given an estimate of the cost per lamp, with complete alternating-current equipment, and steam plants discarded, of \$42.17. It has been estimated that it will take altogether 29,000 arc lamps to properly light the city's streets and alleys. With 12,700 in service at the end of the year, approximately 700 of which will be rented lights, there would remain 17,000 arc lamps to be installed to complete the municipal lighting of the streets and alleys with arc lamps. Assuming that the installation will cost \$115 per lamp, there would be a total required of \$1,955,000, to which must be added the cost of replacing the existing 5,000 open-arc lamps and equipment, which may be roughly estimated at \$70 per lamp, including buildings, transformers, regulators and lamps; so that there is required for the completion of the system approximately \$2,305,000.

Assuming that the completed equipment with alternating-current lamps can be operated at \$40 per lamp, including investment charges, there is an annual cost of \$1,160,000, not much more than the present cost of the street lighting.

The problem now before the city officials is how to raise the \$2,305,000, together with money required for other permanent improvements, such as building the new City Hall, building schoolhouses, bridges, police stations, fire-engine houses and other public works, which may be considered as permanent improvements that will benefit posterity, and the cost of which posterity should help to pay.

Annual Report of the Commonwealth Edison Company.

The annual report of the Commonwealth Edison Company for the fiscal year ended September 30, 1908, was issued on November 9. The net earnings, applicable to dividends, were equal to 6.19 per cent on the \$30,000,000 of capital stock.

BUSINESS SUMMARY.

Gross income from electric current and merchandise sales...	\$ 9,500,907
Operating, repairs, and renewals, depreciation, taxes and general expense	6,374,578
Net income from all sources..	\$ 3,126,329

CHARGES AGAINST INCOME.

Interest on bonds and debentures	\$ 1,032,625
Depreciation reserve (Under the terms of the mortgages made by the Chicago Edison Company and the Commonwealth Electric Company).	236,000
Dividends paid	1,372,035
	\$ 2,640,661
Balance	\$ 485,668

ASSETS.

Plants, real estate, etc.	\$51,657,050
Unfinished plant investment	318,498
Open accounts	308,598
Material	520,199
Accounts and bills receivable	1,193,933
Cash	1,567,433
Total	\$55,565,706

LIABILITIES.

Capital stock		\$30,000,000
Bonds and debentures	\$21,243,000	
Unsold	500,000	
Sold and outstanding		20,743,000
Real estate mortgages		220,000
Depreciation reserve		1,794,500
Accounts payable		523,768
Municipal compensation		102,477
Taxes accrued		475,000
Bond interest accrued		264,139
Surplus account		1,442,820
Total		\$55,565,706

In the annual report, President Samuel Insull calls attention to the following facts:

"In opening the books of account of this company your directors thought it advisable to have made a detailed inventory and valuation of the property and business acquired through the consolidation rather than start with the book values of the constituent companies.

"The making of this inventory and valuation was intrusted to H. M. Byllesby & Co., whose exhaustive report, after an examination extending over a period of six months, has been taken as the basis for the initial-investment entries in the company's books."

The Commonwealth Edison Company came into legal existence and began business on September 17, 1907, through the consolidation of the Chicago Edison Company and the Commonwealth Electric Company, and the net earnings for the period from that date to September 30, 1907, are, for convenience, included in the surplus brought down on September 30, 1907.

The company's connected business, exclusive of electrical energy applied to other public-service corporations, amounted to the equivalent of 4,137,650 standard sixteen-candlepower lamps on September 30, 1908.

The company is also supplying electrical energy amounting to approximately 75,000 horsepower under long-time contracts, running from five to ten years, to street railways and other public-service corporations which have found it to their interest to purchase power.

Electrical Trades Association of Chicago.

The thirteenth annual meeting of the Electrical Trades Association of Chicago will be held in the new banquet hall of the Chicago Athletic Club, at 6:30 p. m., Friday, December 11. The business meeting will be in charge of William A. Browne, president, when reports of officers will be received, and other business that may properly come before the meeting enacted, followed by the election of officers.

The entertainment features will include speeches by B. E. Sunny, president of the Chicago Telephone Company, formerly Chicago manager of the General Electric Company; His Honor William H. McSurely, judge of the Superior Court; His Honor Fred Fake, judge of the Municipal Court of Chicago; the Hon. Charles E. Kremer, of the Chicago bar, and two members of the association, who will speak on association matters from the manufacturer's and jobber's standpoints. Thomas I. Stacey, of the Electric Appliance Company, will be toastmaster. Instrumental and vocal music will be rendered.

Western Society of Engineers.

On November 13 the Electrical Section of the Western Society of Engineers held a meeting in the society's rooms in the Monadnock Block, Chicago, to listen to an illustrated talk on "Recent Developments in Artificial Illuminating Engineering," by W. D'A. Ryan, of Lynn, Mass., illuminationg engineer for the General Electric Company.

In a short preliminary paper Mr. Ryan analyzed the work of the illuminating engineer, and pointed out some of the features discovered in recent illuminating problems. The designing engineer must take account of all factors bearing on his problem, both utilitarian and artistic. These factors require different consideration in different cases. In some cases high efficiency is of prime importance. In other cases the artistic effect is of chief value. Considerable attention has been given recently to the lighting of large interiors, particularly department stores, railway depots and large assembly rooms. The tendency is to do away with exposed lights, and such sources will gradually be banished as advance is made in illuminating standards. Where a perfectly white light is desired, such as in the "white" rooms of department stores, the tungsten lamp has given good results, but these are not to be classed with the success that can be attained in perfect color matching when arc lamps with diffusing globes are used. The requisites for this service are both whiteness and high intensity of illumination. The latter should approximate about two watts per square foot of floor surface. The tungsten lamp has achieved remarkable results in recent illuminating work and bids fair to take the place of even the arc lamp for many kinds of lighting.

After this Mr. Ryan showed scores of lantern slides illustrating recent advances in light sources and some good installations. He described the particular points of each type illustrated, and pointed out many interesting features in connection therewith. First, there were shown a large number of photometric curves of tungsten lamps as modified by the various forms of reflectors, shades, frosting, etc. Quite a number of views of pendent tungstoliers were shown with and without reflecting shades and varying from plain to very ornate designs comprising rich metal work and art glass. A number of chandeliers were shown ranging from simple designs to one for church lighting that was valued at $3,400.

Arc lamps with spherical enclosing globes of a large number of types were shown. Also one type having a parabolic reflector directly above the arc. This lamp is a new design and is in a class between the miniature and enclosed types. Its efficiency is said to be one watt per lower hemispherical candlepower. This lamp was particularly designed to have a perfect white light. The tungsten lamp is not nearly as white a source and, therefore, not so good for perfect color matching; however, in nine cases out of ten, Mr. Ryan said, the tungsten lamp gives more pleasing effects in the display of goods.

A variety of ceiling bowls with various types of globes and diffusers were shown. These were particularly adapted for use with tungsten lamps. An installation of this kind designed for the galleries of the Philadelphia Art Club was shown with a continuous row of these diffusers in the form of a large rectangle, which distributed the light very uniformly over the walls and left the center of the room in a subdued light.

A view of the New York Post Office was shown, in which the lighting is entirely by projecting arc diffusers. These Mr. Ryan does not regard as very pleasing in appearance, but very effective in light distribution.

The Washington Union Depot illuminating installation was shown in a number of views, particularly of the famous waiting room, which is one of the best examples of indirect lighting now in existence. Details of the lighting equipment in the coves were shown. There were also views in other waiting rooms, of the concourse and of the exterior. The Schenectady Depot was illustrated also.

The portable luximeter designed by Mr. Ryan was shown and briefly described. It is entirely self-contained, being equipped with all the instruments necessary and made up in a very compact form. It is intended for rapid and accurate determinations of illumination from zero to twelve-foot-candle intensities.

A number of views of a large machine shop showing the lighting as carried out by different systems were displayed, also a striking view of the Singer Tower in New York, which was the first building illuminated with projectors.

The lighting of Niagara Falls with several batteries of projectors was illustrated with a large number of very good views and described in considerable detail.

At the conclusion of Mr. Ryan's interesting talk the discussion was opened by James Lyman, who asked about the standard used in the luximeter. A standardized tungsten lamp is used for this purpose, said Mr. Ryan, as he gave further details about the use of the instrument.

A question by Chairman D. W. Roper elicited a reply that about 500 horsepower is used in the Niagara Falls illumination. This power is derived from the electrical plants at the falls. Prof. E. H. Freeman asked about the new white arc lamp that had been shown. Mr. Ryan described its construction further and showed how the use of small carbons increased the efficiency a great deal.

Mr. Lyman asked whether the tungsten lamp is going to reduce the use of arc lamps for interior illumination. To this Mr. Ryan replied that for interior lighting the arc lamp is now practically dead, or rather that it is fast being substituted and is passing out as steadily as the old open arc lamps. For some purposes, however, such as for instance for the lighting of white rooms, as he had already said, the arc lamp will undoubtedly hold its own. Mr. Roper remarked that since the introduction of the tungsten lamps there has been practically no new installation of arc lamps for interior lighting in the experience of his company.

P. Junkersfeld wished to know the watt consumption per square foot in the large waiting room of the Washington Depot. This, Mr. Ryan said, was arranged so that varying intensities of illumination using one, two or three watts per square foot can be used. He also showed by simple test diagrams when indirect cove lighting can be made very efficient and why, when certain features are disregarded, the lighting can be made very inefficient. With a consumption of three watts per square foot in this particular installation they claim an illumination of two foot-candles.

J. R. Cravath declared that indirect lighting has come to the front since efficient illuminants had been produced. A great advance has been made in producing light efficiently and equally great advance in utilizing the light produced. In general, he thinks, that it is highly desirable to confine the light more to the useful plane, and, therefore, to use reflectors that concentrate the light downward on the working plane without wasting much for side walls. This should hold true even for the lighting of fairly large spaces.

Mr. Ryan concluded the discussion by asserting that wide reflection is best for large interiors because it gives a much more uniform distribution. In fact, if such a thing was feasible, he would prefer to use the reflector giving as wide a distribution as possible. He showed that in lighting of department stores, for instance, where one source was installed per day a wide distribution of the light would not cause an appreciable amount of it to be wasted on side walls. Speaking of indirect lighting, he showed that an intensity of only half as much as with exposed lighting may give as good or even better results because the eye is better adapted to diffused light. Indirect lighting, however, may be carried too far since it produces a rather flat effect, such as we notice on cloudy days. Therefore, he would be in favor of having with the indirect lighting just enough direct lighting to produce a noticeable shadow in one direction so as to give tone to the general illumination effect.

National Sales Managers' Association.

About three weeks ago a half-dozen sales managers met at the Automobile Club, in Chicago, and formed a temporary organization, with C. A. S. Howlett, of the Western Electric Company, as chairman. A meeting was held on November 5, at the Great Northern Hotel, with about sixty-five present, and the National Sales Managers' Association was formed. H. H. Cushman, of L. A. Becker Company, Chicago, was elected president, and John T. Webber, of the Wabash Cabinet Company, Chicago, was elected secretary. Each of the sixty-five men present filed application for membership, and there are now four electrical men members of the organization, with about 100 others who have filed applications, representing some seventy-five different kinds of business. The plans include meeting every Thursday noon for lunch, at which time there will be an address by some prominent member of a sales organization. On November 12 the meeting was addressed by the sales manager of the Burroughs Adding Machine Company.

READY REFERENCES IN CALCULATING GENERAL ILLUMINATION.

BY W. B. BONHAM.

In designing the illumination of a room the use of the following table will be found convenient in determining the total candlepower necessary to produce a predetermined intensity:

Class of Service.	Ft. Candles.	Constant Dark.	Constant Walls.	Constant Light
Reading	2.0	0.50	....	0.40
Theaters	2.0	0.50	....	0.40
Churches	3.5	0.80	....	0.70
General store...	3.5	0.80	....	0.70
Desk illumination	3.5	0.90	....	0.70
Bookkeeping ..	4.0	0.95	....	0.80
Clothing	5.5	1.30	....	1.10
Drafting and engraving	7.0	1.70	....	1.40
Window lighting.	10.0	....	2.50	....

This table is to be used only where the light units are equipped with good reflectors.

The operation of this table gives the total candlepower, regardless of the size or type of light unit. In order to produce a uniform distribution of this light some attention must be given to the location of the units. This will be determined by the design of the rooms. As a general proposition, the lower the ceiling the greater will be the number of units necessary to produce an even distribution of light. The following formula is suggested:

$$A \times C = \text{total candlepower},$$

where A = area of floor space in square feet, and C is a constant to be found in the table opposite the class of service which is being considered, choice of the constant depending on the color of the walls in each case. The total candlepower divided by the number of units or clusters to be used gives the candlepower per unit or cluster, or the total candlepower divided by the candlepower of the unit or cluster gives the number of units or clusters necessary.

Example.—A room 70 feet by 120 feet, with light walls, is to be lighted to give good reading illumination. Referring to table (two foot-candles are required); The constant for light walls, 0.40; area equals 70 feet by 120 feet, 8,400 square feet. 8,400 $\times$ 0.40 equals 3,360 candles. Twelve units (three rows of four units each) have been decided upon; 3,360 divided by 12 equals 280 candles per unit or cluster.

If a unit containing five sixty-watt tungsten lamps had been decided upon, $5 \times 48 = 240$ candles. Then divide 3,360 by 240; equals 14 units.

Total candlepower multiplied by efficiency of lamps (watts-per-candlepower) equals total watts consumed.

If tungsten lamps are used multiply by 1.25; Gem, 2.5, etc.

The Chicago Electric Club.

At the noon-day meeting of the Chicago Electric Club on November 18, Thomas I. Stacey, secretary of the Electric Appliance Company, made an address on "Chicago, the Great Central Market." Mr. Stacey described the organization of the Chicago Association of Commerce, which was the outgrowth of the old Association of Merchants and Travelers. The present association is indebted for its organization, in large measure, to J. B. Compton, who initiated the movement in 1904. The organization has about 3,000 members. The committees include the Chicago River Improvement Committee, the Civic Improvement Committee, the Freight Traffic Committee, the Foreign Trade Committee, the Public Service Committee, the Street Traffic Committee, and the Ways and Means Committee.

To the Street Traffic Committee credit is due for the improvement in traffic conditions which is now being carried out in Chicago. The Freight Traffic Committee has secured improved service and better rates, particularly to that territory where the business interests of Chicago were not being favorably handled. One of the most important endeavors with which the association has been identified was the agitation in favor of the bond issue for building a deep waterway from the Lakes to the Gulf, giving Chicago access to the seaports of the world.

Chairman C. A. S. Howlett announced that at the next meeting of the club an address would be made by Frederic P. Vose on "Contracts."

W. P. Crockett announced that George Searing, one of the charter members of the club, was seriously ill, and it was unanimously voted to bear an expression of sympathy to Mrs. Searing.

New York Electrical Society.

The regular meeting of the New York Electrical Society will be held on November 24, at the Electrical Testing Laboratories, New York city. Dr. Clayton H. Sharp will present an address describing some of the recent developments in photometric methods and apparatus, and there will be a demonstration of the facilities available at the Testing Laboratories.

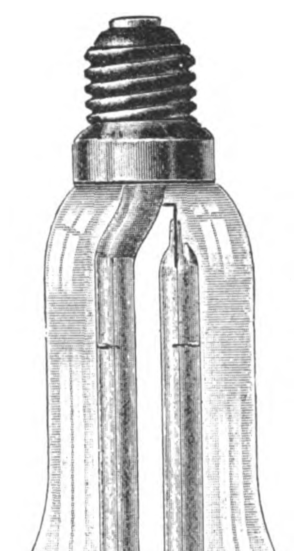
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

THE WATERPOWER PLANTS OF SWITZERLAND.

The Swiss Electrotechnical Association publishes every year statistics of the electric stations in Switzerland, which are particularly interesting, on account of the fact that over fifty per cent of all the installations are exclusively waterpower plants, while another thirty-six per cent also exploit waterpower and have installed heat motors for reserve or as an addition. According to the statistics for the year 1906, there were 539 works and undertakings engaged in the distribution of electrical energy in Switzerland. Of these, 240 produced all their current by water turbines or heat motors, fifty obtained part of the current from other works, and 249 purchased all the current they distributed from third parties. The purely hydraulic plants supply about 59.8 per cent of the total performance of all the Swiss electric generating stations. Direct current is used by 185 of the power stations, single-phase alternating current by eighty-seven, two-phase current by eleven, and polyphase current by 150. For long-distance transmission direct current with parallel connection is used in ten instances (six per cent), direct current with series connection in seven (four per cent), single-phase alternating current in fifty-three (thirty-two per cent), two-phase current in seven (four per cent), and polyphase current in 143 instances (fifty-five per cent). For lighting, direct current is used in thirty per cent of the cases, single-phase current in thirty-two per cent, two-phase current in one per cent, and polyphase current in thirty-seven per cent of the cases. The tension used in long-distance transmission varies from 1,000 to 25,000 volts for alternating current, and from 5,000 to 25,000 volts for direct current. The periodicity of the current was fifty in seventy-two instances and forty in sixteen instances, the remaining stations using various frequencies. The current-consuming devices connected to all the stations and entitled to simultaneous operation corresponded to a capacity of 161,000 kilowatts. Statistics of the capital invested in the various installations are published this year for the first time. For installations producing their own current the average investment per kilowatt of capacity was 1,080 marks, 560 marks of this sum applying to the hydraulic and caloric parts, and 520 marks to the electrical part. For installations that only purchase and distribute current the average investment per kilowatt of capacity was 460 marks.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), October 18.*

A NEW CARBON-FILAMENT MERCURY-VAPOR LAMP.

A new lamp has recently been installed by Robert Hopfelt. This lamp is claimed to combine the advantages of the carbon



NEW CARBON-FILAMENT MERCURY-VAPOR LAMP.

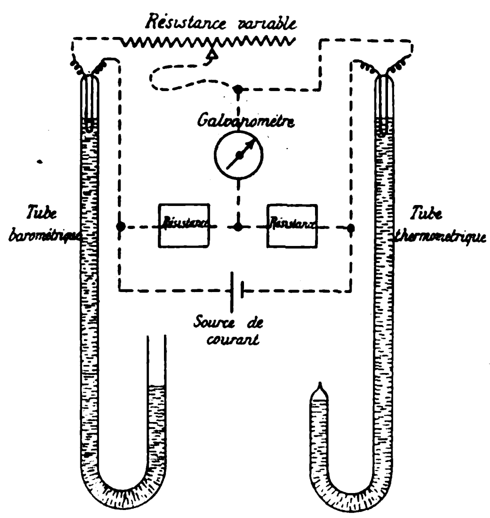
and mercury-vapor lamps, being insensitive to shock like the former and having the economy of the latter. The consumption of energy per candlepower is about sixty per cent less than that of ordinary carbon-filament lamps. The construction of the lamp is as follows: A carbon filament is fused into a U-shaped glass tube, which contains a drop of mercury and an indifferent gas in order to transmit the heat of the filament to the mercury. The U-shaped tube is then fused into a bulb, so that the completed lamp has the appearance of an ordinary incandescent lamp. When the lamp is started the filament at first glows with a consumption of about three watts per candlepower, like an ordinary lamp. As soon as sufficient mercury has been vaporized the light intensity increases more than twofold, so that the lamp consumes about 1.5 to 1.6 watts per candlepower. It requires about five minutes for the light to reach its full intensity, but as the lamps give light from the moment that current is turned on, they may be used for all purposes. The lamps are made for all the usual tensions, and their life under normal conditions is from 600 to 1,000 hours. The light is a pure white and contains no disagreeable green or blue rays.—*Translated and abstracted from Die Umschau (Frankfort a. M.), October 31.*

THE MANUFACTURE OF METALLIC LAMP-FILAMENTS.

Ing. B. Duschnitz, in this installment of a serial article on the various methods at present employed for manufacturing metallic lamp-filaments, describes the process employed by the Auer Gesellschaft, of Berlin. The firm uses an entirely new method of preparing hollow filaments of wolfram. The raw filaments, which are themselves neither hollow nor coated with a layer, consist of perfectly homogeneous material which must contain carbon; and, difficult as it may seem, they are transformed into hollow ones. The reduction methods that effect the transformation of these carbon-containing filaments into more or less pure wolfram filaments are already well known. If after one of these processes a carbon-containing wolfram filament is gradually heated and finally brought to white heat in an atmosphere which contains, besides hydrogen, or hydrogen and nitrogen, also minute traces of oxygen, then a wolfram filament is obtained which still contains a little carbon, but is not hollow. It was found that if the temperature of a raw filament through which current is flowing is rapidly raised long before the carbon has been chemically removed from it, a hollow filament is formed. This filament still contains considerable amounts of carbon which may be removed by any of the well-known methods, but the Auer Gesellschaft considers it of advantage to use the filaments directly in the lamps with rather high carbon contents. They are said to possess the advantage of requiring shorter lengths than solid filaments for equal voltages. A hollow filament is stated to be best obtained by placing a filament composed of about ninety-three per cent of wolfram and seven per cent of carbon in an atmosphere containing, besides hydrogen, or hydrogen and nitrogen, minute amounts of water vapor. The filament is then inserted in an electric circuit and the current intensity is allowed to increase rapidly by raising the tension, so that the filament is brought to white heat within a few seconds. The result is a filament which is hollow throughout its entire length. The diameter of the hollow space may be influenced by the rapidity with which the temperature is raised. If the filament is allowed to remain at a low temperature for a considerable length of time before it is brought to white heat, the hollow space will be smaller; it will be larger, if white heat is reached rapidly. The Auer Gesellschaft gives no explanation of this phenomenon, which might also be made use of for other technical purposes. With ordinary reduction methods the carbon particles contained in the raw filament come out from the filament substance only gradually with the progressive heating, and, when they arrive at the outside, are reduced to carbon oxide or carbon dioxide, and the filament substance shrinks together. On the other hand, when the carbon molecules are caused to vaporize by sudden heating, they have no time to escape to the outside, and consequently produce an interior pressure. This pressure, or expansion, of the carbon vapors forces the other filament substance radially outward, thus producing hollow interior spaces. It is possible that the resulting minute pores unite into communicating channels, the less resisting walls of the pores being expanded or broken through. As any escaping carbon is immediately absorbed by the surrounding reducing atmosphere, the filament shrinks together along its circumference; that is, the outside pores are filled by the softened metal immediately after becoming empty. The walls must then naturally become more resisting and impenetrable, and the carbon vapors circulating in the small communicating channels in the interior of the filament tend to increase these channels on account of their expansion at the high temperature of 2,000 degrees, so that after a little time a single longitudinal channel comes into existence. In support of the correctness of this explanation made by the author he cites the fact, that in such carbon-containing filaments hollow spaces may be clearly observed under the microscope, even if the process is interrupted before completion.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), October 15.*

AN ELECTRIC BAROMETER.

In this barometer, which is described by Robert Goldschmidt, the variations in the height of a mercury column resulting from the changes of atmospheric pressure are caused to modify the resistance of a filament of low specific conductivity in-



ELECTRIC BAROMETER.

serted in an electric circuit. A thin U-shaped carbon filament is fused into the closed end of a barometer tube and its terminals are connected to two binding posts on the outside of the tube. When the tube is filled with mercury, the curved part of the filament is more or less immersed in it, according to the atmospheric pressure to which the mercury column is subjected. The parallel branches of the filament traverse the vacuum of the barometer. The current passing through the two branches of the filament and the mercury meets with more or less resistance, accordingly as the mercury column is higher or lower. It is not sufficient, however, in order to obtain an indication of the changes in atmospheric pressure, to measure the variations of the total resistance of the carbon filament, as temperature changes also influence the level of the mercury column. This cause of error may be eliminated by using a second mercury column in a tube closed at both ends, in which the mercury level is influenced only by temperature changes of the surrounding medium. In this second tube, which operates as a thermometer, a carbon filament is arranged as in the first, and its resistance is modified by changes in the height of the mercury column. Thus, while the changes of resistance in the barometric tube correspond at the same time to variations of atmospheric pressure and temperature, the indications of the thermometric tube relate to temperature changes only. If the resistances composed of the two filaments are arranged in series like two branches of a Wheatstone bridge and compensated by resistances in the lower branch of the same bridge, a galvanometer connected in the usual manner across the bridge will remain at zero, when at an equal atmospheric pressure the temperature causes a change in the height of the mercury in both tubes at the same time. The relation of the compensating resistances will evidently vary according to the thickness of the filaments used in the tubes, their relative dimensions, and the changes of the mercury level produced by the same temperature variation in each tube. In order to indicate the variation of atmospheric pressure it is only necessary to insert in that branch of the bridge containing the thermometric filament, for instance, an adjustable resistance, such as a high-resistance wire mounted over a graduated scale, which, by means of a sliding contact, may be inserted more or less in the circuit. By regulating this resistance so that the galvanometer remains at zero, one adds to or takes from it exactly the same amount of resistance that has been added to or taken from the carbon filament in the barometric tube by variations of atmospheric pressure only. These variations are thus read on the graduated scale of the adjustable resistance. It is easy, by means of the arrangement described, to read variations of one-ten-thousandth of a millimeter in the height of the barometric mercury column. Curves obtained by means of this apparatus were found to correspond always with those at the Uccles Observatory.—*Translated and abstracted from Bulletin Mensual, Societe Belge d'Electriciens (Brussels), October.*

The grand total of excavation during the month of October on the Panama Canal was 3,224,638 cubic yards, the highest record for rainy-season excavation, based upon telephone reports from division engineers.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

REMOTE-CONTROL SWITCHES.

BY H. W. YOUNG.

In the construction of the modern building, the architect and engineer are often obliged to spend a great deal of time in determining the best method for the distribution and control of current for light and power service. This perplexity is occasioned by the increase in the use of electrical appliances and an attempt to control them by the usual methods, as the increase in size of conduit and conductor prohibits the location of the switch at the point most desirable for the control of the circuit.

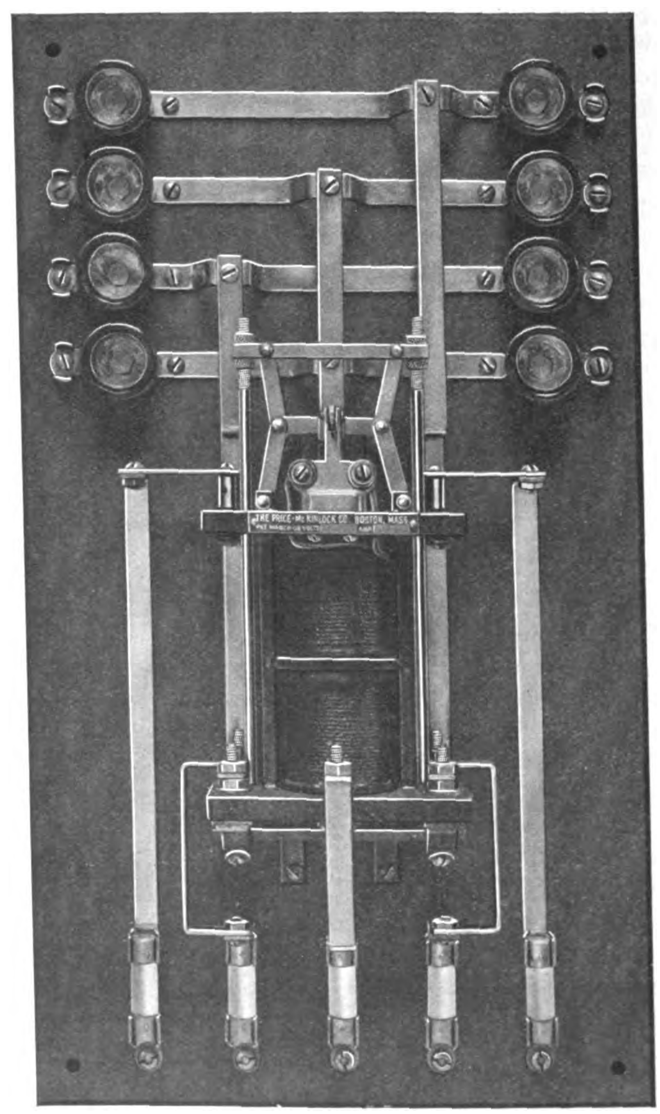
In handling circuits of greater capacity than can be controlled by standard flush switches, it has been customary to locate manual switches in the basements of buildings or in closets or corners not easy of access; and frequently the architect or contractor has been compelled to place switch panels where they marred the decorations of some room. In fact, it has seldom been possible to place these switches where they could be reached without inconvenience, though it is often necessary to use them several times a day for light or motor control.

To meet the conditions mentioned above, the remote-control switch illustrated herewith has been designed with a threefold object in view: First, to simplify the control of current; second, to enable anyone to control lights or motors from various points without making it necessary to bring the service wires to those points; third, to effect a direct saving in first cost of installation and consumption of current.

This switch is a magnetically operated device that can be furnished in practically any capacity, and controlled by momentary-contact switches, located at as many points as desired. It is built along the recognized lines of modern circuit-breaker practice, being provided with laminated contacts and steel toggle mechanism. It has a straight-line motion and cannot be left in a half-closed or half-open position.

It would be difficult to cite an instance of modern building construction in which electricity is to be used as an illuminant or a source of power where the value of remote-control switches would not be so apparent on the ground of either economy, convenience or safety as to warrant their use; and frequently the investigation would show their value to be many times their cost, in a direct saving of copper and conduit, with an indirect saving in current charges.

By the use of remote control it is possible to cut out lights or motors in any part of a building at any time, from any point where a momentary-contact flush push-button can be located. For example: If remote-control switches are located in the basement of a ten-story building which is lighted by electricity, it is possible to arrange on the desk of the superintendent, or anywhere in his office, which office could be located on any floor, a system of flush push-buttons controlling all the lights or any group of lights in the entire building. And it would only be necessary to run No. 14 wires direct to the office from the remote-control switches. Hence, with this switch there is no excuse for wasting current on account of the inconvenience of going to the ordinary switch panel-board. Other applications are obvious.



THE P-M REMOTE-CONTROL SWITCH.

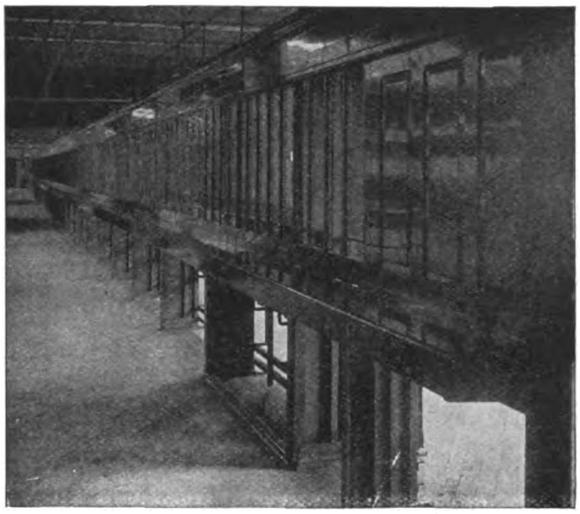
The system of remote control allows the electrical engineer to plan his wire-ways from service entrances to distributing panels without considering the switch outlets; so that the entire building may be supplied by one unbroken feed or its equivalent. This frequently makes it possible to effect a saving of fifty per cent in copper and conduit over the indirect method of wiring when a switch location is usually a long distance from the natural center of distribution.

In wiring buildings, the remote-control switches are located with reference only to their accessibility and the natural wiring centers; momentary-contact switches are located at the most convenient points from which it is desirable to control the lights, thus avoiding the necessity of either carrying the heavy mains to the switching point or installing the switch in an inconvenient location. These methods of wiring show in every case a saving of copper and conduit, and a convenience of use that reduces lighting charges and fire hazards to a minimum.

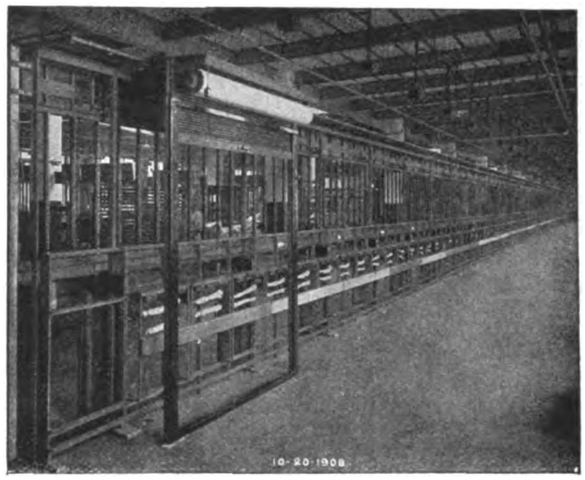
The complicated wiring systems in the modern theater may be greatly simplified by the use of remote-control switches, it being possible to so arrange a system of theater wiring as to greatly simplify the stage switchboard, giving better control of lights, and frequently making a considerable saving in the cost of wiring.

TELEPHONE SWITCHBOARD BUILDING IN RECORD-BREAKING TIME.

BY S. E. BROWN.



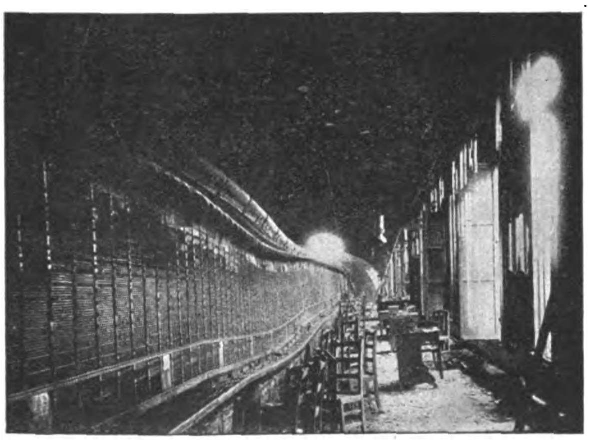
FRONT VIEW OF SECTION OF NEW WESTERN ELECTRIC PARIS TELEPHONE SWITCHBOARD.



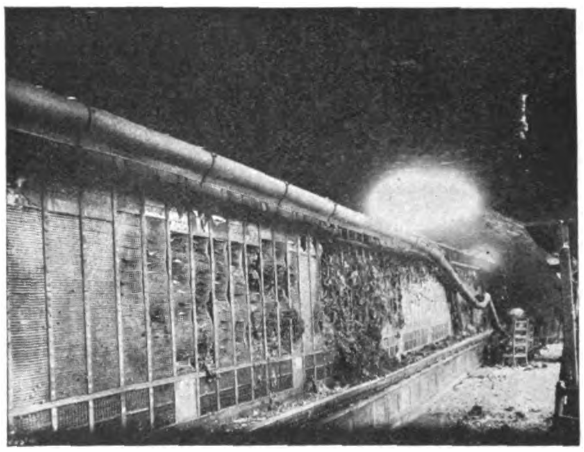
REAR VIEW OF WESTERN ELECTRIC PARIS TELEPHONE SWITCHBOARD LINED UP IN HAWTHORNE SHOPS PRIOR TO SHIPMENT.

Commercially speechless — such was practically the condition in which thousands of business men of Paris found themselves on the morning of September 21, 1908. Berlin, which the day before was at their elbows, now lay to the northward distant six hundred miles; London, only a moment's time away twelve hours before, was now across the sea; and the provinces of France which had lain within the shadow of the walls of the capitol now stretched from Alsace-Lorraine to the Pyrenees.

The burning of a single building in Paris—the great Central Telephone Exchange—was what isolated and paralyzed her commercially. The fire of a few hours' duration ate up $6,000,000 of property, took the business district out of a single structure and spread it over a wide area and pushed the city back in history more than twenty years.



PARIS MAIN OFFICE, 9,000-LINE BOARD, THIRD FLOOR, BURNED ON SEPTEMBER 20.



PARIS MAIN OFFICE, 10,000-LINE BOARD, FOURTH FLOOR, BURNED ON SEPTEMBER 20.

Rob any city of today of its telephone system and it goes back to where it stood before the telephone became a commercial necessity. But what makes the modern city helpless when its telephone equipment is destroyed is that it cannot go back. The reason for this is that the telephone made the modern city possible. Try to imagine New York's skyscraper district without the telephone! When deprived of its use, its value is appreciated.

Business for one day in Paris was carried on by means of what telegraph lines had not been ruined when the telephone building burned, by messenger service, by special conveyance, by each and every method possible that would give a greater speed than mail. The next day saw an emergency telephone equipment caring for crippled business as best it could. Meanwhile hurried conferences were being held by the Paris telephone managers with the Paris representatives of an American manufacturing company relative to an equipment to take the place of that destroyed. For emergency equipments at best are but first aids to the wounded and are to be put aside as speedily as possible.

The building of equipment for a telephone exchange the size of the one destroyed requires time, and the people of Paris were clamoring for telephone service. This explains why the managers of the Paris Telephone Company immediately after the fire took their problem up with the largest manufacturers of telephone apparatus in the world. Speed was the controlling factor; speed and quality. So they turned to a company that held the record for both.

The proposition put up to the Paris house of the Western Electric Company was a staggering one, but the Paris house had resources. They themselves had enormous facilities and back of them was the parent house in New York city which in turn was backed by the company's Hawthorne plant just outside the city of Chicago. This last-named plant is the largest telephone manufacturing plant in the world and for it rush orders hold no terrors. When fire eliminated the telephone plant in Rio de Janeiro the cable had wildly called for apparatus. Hawthorne met the demand. Then early in the year Tokyo had called on Hawthorne to build material to take the place of a large shipment for Japan which had been lost when the S. S. Holenfels was destroyed by fire. This work was done in less time than Tokyo demanded.

So when the request from Paris was telegraphed to Hawthorne the men in charge of the telephone manufacture figured coolly and swiftly. They knew what they had done before could be done again. September 22 Paris had the cabled reply that Hawthorne could furnish its part of the equipment complete in less than thirty days.

A diversion was created on September 24 by Paris asking for switchboard cable; a request which terminated a few days later in an order for 135,000 feet. The Western Electric Company, however, had the full amount of the size desired in stock at Hawthorne. Hawthorne was ordered to ship. But shipping cable by steamer differs from shipment by rail. The cable must be fully protected from salt water. Nevertheless, the twenty-five miles of cable was unwound from reels, the ends paraffined, cable rewound on reels, packed in waterproof cases and placed on cars in less than two days after receiving the order.

The most interesting fact brought out by the order, however, was not what the company did but what it could do. The Paris order for cable, as before stated, was made up from stock. The Hawthorne plant offered to turn out twice that amount weekly from raw material.

Meanwhile, the superintendent of the switchboard department at Hawthorne had been having more than a cable order to think about. On September 29 the New York house telephoned to begin work on a switchboard and cheerily informed him that the Paris house had agreed to have the entire installation completed in sixty days, and that a $600 daily penalty was attached to the contract. The information about the switchboard wasn't quite so indefinite as that, but it was pretty hazy. It was all the information New York could give, however, and all the Paris house could furnish, so the man at Hawthorne went as far as he possibly dared on his meager instructions, meanwhile wondering about the sixty days. He clearly understood about the $600 per day.

October 3 brought information which was definite. Already a large amount of material had been lined up and the moment the decisive word from Paris came, men trained to the minute in switchboard building began their tasks. In a trifle over three weeks after a definite order had been given by the managers of the telephone exchange in Paris, the finished switchboard stood at Hawthorne ready for chipment.

Meanwhile the New York agent had not been idle. The result of his efforts showed that express train speed in manufacture is only one of many ways of beating penalty time to the tape.

The same day that complete information was given Hawthorne a request was made for an estimate on the number of carloads and weight of the shipment. Reservation was made on a French Line steamer that sailed on October 29, and arrangements were made with railroads that special attention be given the shipment. It was. The six carloads of material came from Chicago to New York in about two days.

The shipment from Hawthorne together with a large amount of additional material which the New York house had manufactured was shipped to Paris on the French Line steamer La Provence, that sailed from New York on October 29. Thus, only a few days more than a month elapsed from the date the fire occurred in Paris until a completed switchboard from the United States was on the sea. A switchboard, by the way, which stands 180 feet long, requires ninety operators to operate and will accommodate more than 10,000 subscribers. While the back of this switchboard would appear as unintelligible to the layman as a page of Sanskrit, it may be of interest to know that it contains about a million soldered connections and 3,000 miles of wire. It is of some interest also to know that approximately 40,000 feet of lumber were used in packing the completed board, and that 10,000 square feet of paraffine paper was used in the cabling boxes alone.

A Big Shipment of Tungstoliers.

The accompanying illustration shows the way in which a big order for Tungstoliers was recently sent to one of the company's selling agents. This electric-lighting fixture has created a good deal of a stir throughout the entire field, and the

A BIG ORDER OF TUNGSTOLIERS.

company is booking orders which are far in excess of its expectations, although it arranged, in developing these light units, for a demand which marked a new record in supply and demand.

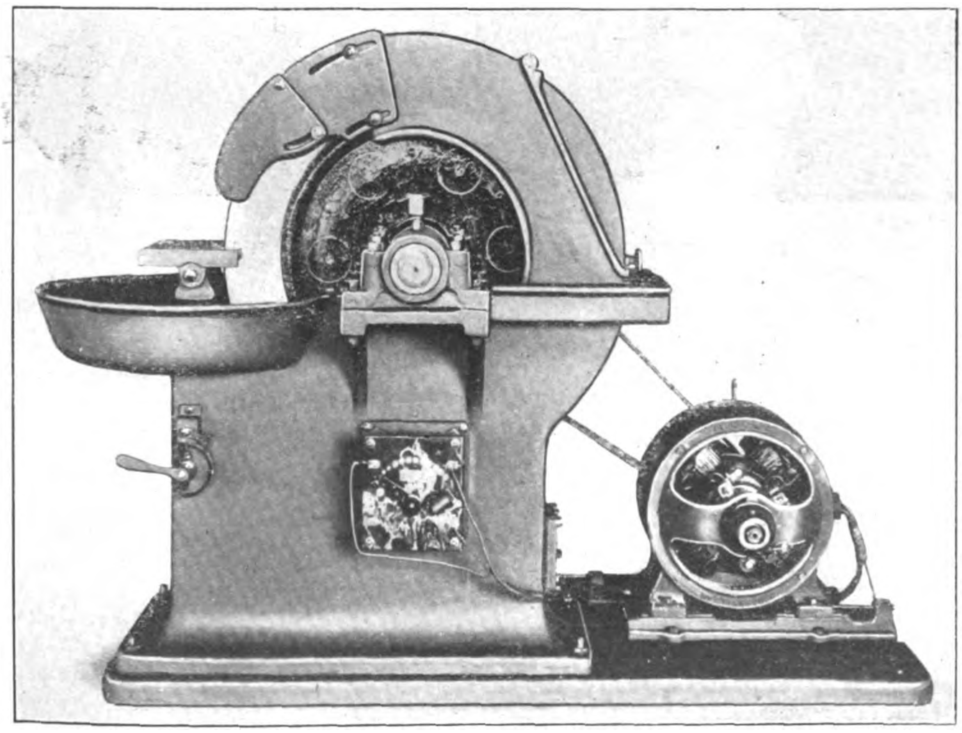
The Phelps Alloy.

Announcement is made of the discovery of the Phelps alloy by the Phelps Manufacturing Company, 54 State Street, Detroit, Mich. This metal fuses at 2,500 degrees Fahrenheit, is positively non-corrosive, and is said to be a reliable substitute for platinum for a great many purposes, such as contacts for electric bells, annunciators, telephones, spark-plugs, gasoline engines and automatic flashers. The cost of this alloy is said to be about one-third that of platinum, and from the tests which have been made it is expected that the metal will give entire satisfaction. Several large telephone companies are now using this material, and repeat orders are evidence of the satisfaction being experienced with it. The Phelps alloy is made in sheets, wires and rivets.

An Electrically Driven Tool Grinder.

Probably the first equipment in a machine shop to be driven by an individual electric motor in experimenting with electricity as a motive power is the tool grinder, because it combines so many of the various advantages of the electric drive. Tools are sharpened only at intervals and the load is fluctuating, permitting the outfit to be shut down between jobs and also taking advantage of any decrease in the demand for power. As a grinder has often to be located somewhat apart from the rest of the machinery, it becomes difficult to make the necessary belt connections where a mechanical transmission system is used. With a small motor supplying the power the grinder may be located at any point that convenience demands and the wires run to it without trouble.

The Safety Emery Wheel Company, of Springfield, Ohio, is supplying a thirty-six-inch by four-inch emery wheel, shown in the illustration, equipped with a standard Westinghouse direct-current, type S, four-horsepower motor. The motor runs at 1,175 revolutions per minute and drives the emery wheel at 450 revolutions per minute. The starting device for the motor is directly on the grinder, providing the most convenient method for bringing the wheel up to speed.



MOTOR-DRIVEN TOOL GRINDER.

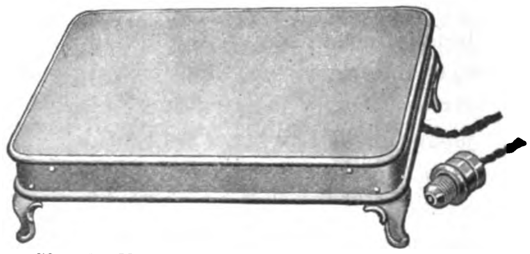
The illustration shows a constant-speed shunt motor, but the use of an adjustable-speed motor is recommended, as the speed may be increased to allow for wear of the emery wheel.

It will be noted that the motor is mounted well out of the way on the extended sub-base of the grinder, and therefore forms a very flexible outfit in that it may be moved as a unit. Two operators can work on the grinder at the same time, as a door provided in the hood in the rear allows grinding to be done there as well as in front. Water is prevented from splashing over the floor or the motor by the wide pan in front and the apron in the rear.

Electric Food Warmers.

Among articles for table service, the heated tray or platter made in plate is an old institution, and came into vogue many generations ago, its object being for keeping hot, ready for a second helping, the roasts and vegetables at dinner. These devices were made, some, with double bottoms for the reception of hot water between the two; others were made arranged with a spirit lamp for providing the heat. Because of the care in keeping these in order for service, they have never been used to anything like the extent they deserved.

The Simplex Electric Heating Company, Cambridge, Mass., has recently put on the market a line of electric food warmers, to take the place of these devices. Instead of applying the heat to a variety of platters or dishes, they provide a heated stand for use in the dining room, on which the food dishes may be set, and where they will be kept warm. They are in attractive design, in nickel or silver plate, having a top surface in dull-finish aluminum, which is not easily scratched or discolored, and the top, with the heater attached, is removable to facilitate the cleaning or polishing of the plated portions. The temperature is limited, so that there



SIMPLEX ELECTRIC FOOD WARMER.

is ample heat for the requirements, and yet not sufficient to endanger the choicest china in being injured. The current consumption is such that most of the sizes can be connected to lamp sockets, and the cost for operation is small.

These food warmers are made in a variety of sizes and designs, both oval and oblong, the top surface varying from 10 by 14 inches in the smaller sizes to 10 by 26 inches in the larger. They are furnished in moderate weights for domestic requirements, and in extra heavy weights for hotel use. The Simplex company reports an immediate demand for these goods both for hotels, restaurants and domestic use. They have supplied them in quantities to such New York hotels as the St. Regis, Hotel Astor, Cafe Martin, and others.

General Electric Orders.

The orders received by the General Electric Company for the third quarter of the year amounted to $10,397,117 and for the nine months of the year to $30,054,924. This compares with orders of $14,581,382 and of $49,677,500 received during the corresponding periods last year.

The orders received for the third quarter were smaller than in any year back to 1904, but they were larger than the orders for the third quarter of 1904 by over $2,000,000. The orders for the first nine months this year are larger by over $3,750,000 than the orders for the first nine months of 1904.

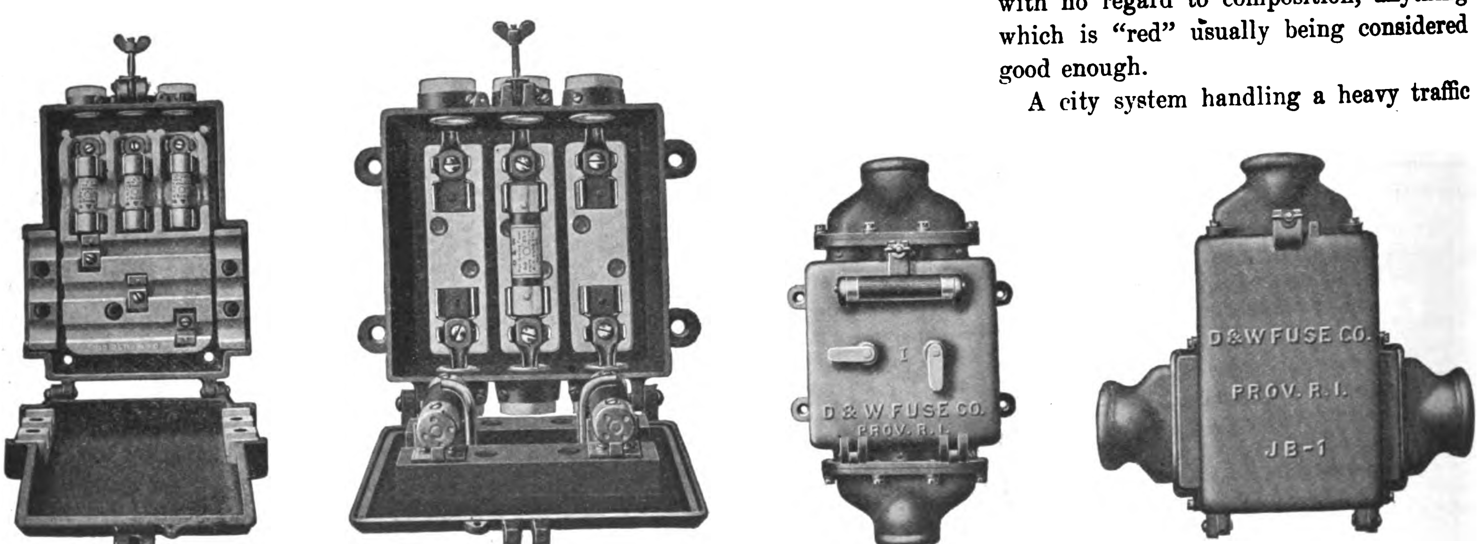
The sale of $350,000 worth of Alaska-Yukon-Pacific bonds appears to remove the last obstacle to the success of this enterprise, which is to open on June 1 next.

New Line of Service Switches and Cut-out and Branch Boxes.

The D & W Fuse Company, Providence, R. I., is placing upon the market its new service switches and boxes, which have very materially improved this line. In the casting of the iron, owing to operating its own foundry, the company is able to produce boxes of a much finer grade than it could purchase in the open market. Due to this higher-grade material, these boxes are lighter in weight than the former boxes and have a smooth surface, thereby taking a finer finish when japanned. These boxes are provided with rubber gaskets and removable porcelain bushings, through which the cable terminals may be readily passed. In the covers of the service switches are mounted fuse guides to positively align the fuses in order that the boxes may be readily closed with the fuses properly engaging in the cut-outs. There are also mounted in these covers withdrawal hooks which by one-quarter turn of the levers on the outside of the cover remove the fuses at will.

Owing to the usual practice of grounding the neutral on a three-wire direct-current system, the box is so designed that the neutral fuse remains permanently in the circuit, thus avoiding any possibility of accidents, due to the fuse being withdrawn. For polyphase circuits where all fuses should be removed, the box is provided with three hooks operated simultaneously by one lever. The fuse boxes are similar in construction to the service switches, but are intended for use only as cut-outs, and therefore no switch mechanism is provided for in the covers, the fuses being directly mounted in the boxes.

In addition to these cut-outs, the company has also brought out a line of branch boxes in which particular attention is called to the split bushings mounted in the cover, and boxes which permit of the necessary connections without any break in the wiring, thereby greatly reducing the cost of installation. For both of these types of boxes there have been designed a complete line of outlet hoods to be used in connection with the conduit system, covering every possible requirement of connection, namely, straight-away, right or left hand, and back and front. These hoods are firmly screwed to the boxes, fitted with rubber gaskets, if desired, and are interchangeable for any given type, being made to fit any size of conduit within the capacity of the box.



D & W FUSE COMPANY'S NEW LINE OF SERVICE SWITCHES AND CUT-OUT AND BRANCH BOXES.

Buying on Chemical Specifications.

Where dimensions, weight, finish and the like may be readily expressed in specifications, it is easy and natural to make them conditions upon which purchases shall be accepted. But where strength, chemical composition, durability and similar factors of ultimate efficiency are of importance, specification of these features is too often omitted.

In every industry some material is being bought on the basis of brand, reputation or even satisfactory experience in its use without the least idea that equal efficiency might be obtained at a lower price with a suitable material whose composition could be specified in advance by the chemist.

The purchasing agent of a large electric railway company was recently buying of a reputable supply house a metal for journal linings which gave good satisfaction. He was paying twenty cents a pound and, in view of the nature of the material, felt that the price was high. A sample was submitted to the Arthur D. Little Laboratory in Boston for analysis. Upon receipt of its report the purchasing agent sent out for bids upon a metal of the composition shown on analysis. A reliable concern at once offered such a metal at six cents per pound. As the amount of metal used in a year was large, the saving by having the same metal made to the formula was well worth obtaining.

Trolley ears are a class of material which the average electric road purchases with no regard to composition, anything which is "red" usually being considered good enough.

A city system handling a heavy traffic where delays cost money recently had considerable trouble by the frequent breaking of ears which they were purchasing of a reputable manufacturer. Two of the ears were sent to the laboratory named above for analysis. The report from this laboratory showed the following compositions:

	1	2
Copper	60.5	78.3
Zinc	38.5	16.5
Lead	0.4	4.4
Iron	0.1	0.2
Tin	...	0.5

The analyses show plainly the cause of the trouble: No. 1 is made of the ordinary 60-40 brass and is not strong enough for such work; No. 2 is evidently made from scrap composition and also fails to have the required strength.

This company is now buying under a strict specification. A sample from every shipment is analyzed and the number of breaks is very materially reduced.

Current Electrical News

CONTINENTAL EUROPE.

PARIS, NOVEMBER 7.—A type of petrol-electric motor car is in use upon one of the shorter railroad lines in Austro-Hungary, drawing trains made up of several trailers. The line is the Arad-Csanad local railroad, which connects a number of the large towns in the region, the most important of which is Szegedin. The present type of motor, adopted after a series of trials, consists of a long motor car of the usual form in which is placed a petrol motor and generator group, the latter furnishing current for the motors on the axles. At first the company adopted a thirty-horsepower car, which was designed especially for suburban use at slower speed. For the main lines it now uses a forty-horsepower car drawing two trailers, and more recently it ordered an eighty-horsepower car. The eighty-horsepower outfit contains a Westinghouse six-cylinder petrol motor, coupled direct to a six-pole generator. The car has two trucks, with a motor mounted upon each.

At Zürich recently I had occasion to examine the new plant which the municipality erected for the purpose of consuming household waste, which is laid out on an extensive scale. The waste is burned in a number of furnaces, using a strong air-draught to aid the combustion. The heat from the furnaces is supplied to a boiler which operates a steam turbine coupled to a generator. This furnishes all the current needed in the establishment for the lighting and for a number of motors, besides supplying several factories near by. The waste-consuming plant consists of a set of Horsfall furnaces. After the combustion there remains a certain amount of clinker and fine ash. The clinker is broken up and sifted, and may be used as gravel, while the ash serves as a fertilizer. In the dynamo room is erected a 150-kilowatt Brown-Boveri steam-turbine set, which furnishes three-phase current at 220 volts.

The ferryboat plying between Guilleboeuf and the opposite bank of the Seine, at a point near the channel coast where the river has a great width, is operated on the petrol-electric method, using a seventy-horsepower De Dion-Bouton petrol motor coupled to a 220-volt generator. This outfit is duplicated. The boat is a side-wheeler, the paddle-wheels being driven by two electric motors, which run at 540 revolutions per minute, the gear reduction enabling the wheels to revolve thirty times per minute. Ordinarily a single generator group is sufficient to supply all of the power needed, but in case the tides, which are strongly felt here, should make it necessary, the two groups can be coupled in parallel.

A hydro-electric plant of somewhat novel construction is located in the Rhone valley not far from Lake Leman. It utilizes the water of the celebrated Pissevache Fall, whose stream springs out of the side of the mountain and falls 220 feet into the valley, thus forming one of the most picturesque falls in the county. The electric plant is placed high up in the mountain side and lies above the mouth of the fall. It only uses the water in a gorge before it reaches the fall, and the water is then returned to the cascade in order that the latter will not be impaired. The turbine house is cut in the solid rock and is a chamber of elliptical section, containing the turbo-generator outfit. At present there are six principal groups installed. Two of these are used to furnish direct current at 800 volts for the Martigny-Chamonix railroad, while four of the machines supply 5,000-volt alternating current for use in a neighboring electric furnace plant. The remaining alternator also works at 5,000 volts, supplying current for lighting some of the towns in the vicinity. The water supply is taken at a point lying farther up the gorge, and in this way a head of water of 1,600 feet is obtained. The turbine plant lies at a height of at least 300 feet above the level of the valley. A. DE C.

GREAT BRITAIN.

LONDON, NOVEMBER 6.—There seems to be quite a craze at present among local authorities to go in for the trackless-trolley system, either instead of tramways, or in outlying districts, thus using this mode of traction as a feeder to the main tramway system. The Highways Committee of the London County Council, however, made a proposition this week to use the system in quite another direction. The Council is faced with the position of having its northern and southern tramway systems broken off, so to speak, by the river at Rotherhite and Blackwall by two tunnels which are incapable of holding a double line of fixed tramways. The Highways Committee, which realizes the advantages of linking up both the northern and the southern systems wherever possible, thought to overcome the difficulty by the use of trolley omnibuses in these two tunnels. How far such a policy was desirable from the point of view of the passengers, they having to make two changes in a very short distance, is another matter, but the County Council at its meeting on Tuesday vetoed the suggestion on the ground that sufficient information as to the capabilities of the system are not yet available.

Following the annual meeting of the Victoria Falls Power Company come some inquiries in Parliament as to the rights of the company to the concession for the use of the Falls water. It appears that this is given in an agreement between the British South Africa Company and the African Concessions Syndicate, which is the parent company of the Victoria Falls Power Company.

It is evident the Government intends that the London County Council shall secure control of the whole of the electric-supply arrangements of the metropolis in the future. Following the instruction to the committee which is now dealing with the bulk supply scheme to insert the name of the County Council as the purchasing authority, a similar instruction has been given with regard to the bills of the existing companies, which confer certain additional powers upon them. The question now arises what is to be done with the electrical undertakings of the London borough councils. If these are not also made purchasable by the Council, we shall have the anomalous position of the Council, when it purchases the bulk and the other companies, competing with the borough councils, the capital for whose undertakings the County Council has had to sanction and find. Presumably the committee will deal with this aspect of the case.

The Institution of Civil Engineers has just issued its list of awards for papers read during the past session, and I notice that the only paper dealing with an electrical subject which has been granted an award is that by W. Barclay Parsons on "The New York Rapid Transit Subway."

An experiment in street lighting is being carried out in Leeds, arc lamps and gas lamps being placed side by side for competitive purposes. G.

EASTERN CANADA.

OTTAWA, NOVEMBER 14.—The annual convention of the Canadian Street Railway Association, whose members include all the leading street railways of the Dominion, was in session here during the past week.

One of the most extensive industrial plants in Montreal is the Northern Electric and Manufacturing Company. It employs 1,300 persons, and its market is almost exclusively in Canada. This plant is equipped with the most modern machinery and will be operated entirely by electricity, the power being supplied by a 300-kilowatt Westinghouse-Parsons steam turbine.

It is a matter of note that Montreal consumes more electrically transmitted waterpower than any other city in the world. This power is drawn from three large generating stations located on the rivers St. Lawrence, Richelieu and St. Maurice, at distances ranging up to eighty-five miles from the central substation in the city of Montreal, while a fourth large hydroelectric plant, which derives its power from the Soulanges Canal, has just been completed. With this chain of electric plants, supported by steam stations at various points in the city, the reliability of electric supply in Montreal is assured beyond any doubt.

Canada is most fortunate in possessing as much available waterpower as any country in the world. Some idea of the supply of power that can be generated in the Dominion may be had from the fact that, it is estimated, the St. Lawrence River alone can supply over 10,000,000 horsepower. There is represented also over 1,000,000 horsepower in the falls and rapids within a radius of fifty miles from the city of Ottawa, and what is true of eastern Canada applies equally to the Lake Superior and western portions of the Dominion.

It is stated that private individuals in the town of Coaticook, Quebec, are contemplating the formation of a company and taking over the town's electric-light plant. As the town is now facing a serious problem, in the way of increased power, a proposition for purchase will probably receive favorable consideration of a majority of the rate payers.

During the week, the first unit of electric power, from the Soulanges Canal, was brought into the city of Montreal and distributed through the city over the wires of the Montreal Light, Heat and Power Company. Since purchasing the charter for the utilization of this power from M. P. Davis of Ottawa, the Montreal company has been at work on the development, which is now completed, and at a cost of $1,500,000 the company has secured a supply of 15,000 horsepower. The work included the construction of a canal connecting the Soulanges Canal, about thirty miles from Montreal, with the St. Lawrence River, a distance of about 2,800 feet. The new canal holds 75,000,000 gallons of water and is 268 feet wide from bank to bank, 232 feet at the water line, 160 feet at the bottom and eighteen feet deep. A forty-foot roadway connects the dam and the power house, and the latter is fireproof, being built of concrete, with iron and glass windows. The six gates, connecting the Soulanges Canal with the new cut, are operated either by hand or by electricity. As the Montreal Light, Heat and Power Company has, at present, contracts which call for the supply of 70,000 horsepower, and has only 65,000 horsepower available, the company has under consideration the construction of a steam plant to provide 10,000 horsepower additional. This steam plant will be completed unit by unit, but the whole will be in operation within the next two years. The disposition of the available power will then be as follows: Lachine, 15,000 horsepower; Chambly, 20,000 horsepower; Shawiniga, 20,000 horsepower, and Soulanges, 15,000 horsepower; total, 70,000 horsepower.

W.

WESTERN CANADA.

WINNIPEG, NOVEMBER 14.—The postal authorities at Edmonton, Alb., have approached the civic authorities with a view to having the new electric street railway system used for postal purposes. It is understood an agreement has been arrived at to this end and freight cars will also be operated as soon as possible.

At the meeting of the Canadian Street Railwaymen's Association held in Ottawa on November 12 it was decided to hold the next convention in Winnipeg.

The Canadian Northern Railway Telegraph Company has opened telegraph offices in the following places: Lavelle, Ont.; Lena, Myrtle, Vassar and Russell, Man., and Borden, Sask. It is understood this company will soon negotiate for connections with the States.

The incorporators of the Kootenay Telephones, Ltd., which has a capital of $200,000, and head office at Cranbrook, B. C., are announced to be: Dr. J. H. King, W. F. Gurd, James Ryan, V. Hyde Baker, A. Leitch and R. E. Beattie. The company has already secured the plant and lines of the Cranbrook Light, Heat & Telephone Company and has secured a franchise in Fernie, B. C., to construct a telephone system. The aims of the company are to construct long distance and local telephone systems throughout the Crows Nest Pass country and to connect with the system of the Alberta government, thus giving Winnipeg, connection with the Kootenays.

At Cannington Manor, Saskatchewan, a rural telephone company is being formed. Estimates show the system can be constructed for $35 per mile with one telephone to the mile. The telephone act of Saskatchewan provides for the formation of these rural companies and places the value of the shares at $25 apiece, no person being allowed to hold more than one share.

The ownership and operation of the street railway system at Port Arthur, Ont., is in a curious tangle. The system was built by Port Arthur in 1893 and extended through the sister city of Fort William. Until the present time Port Arthur has owned and operated this system, but recently some of the aldermen from both cities met in Toronto and arranged for the sale to Fort William of that portion of the system running in Fort William. No vote was put to the people and consequently when the time for handing over the portion of the line to Fort William arrived the Port Arthur commission refused to give it up to the joint commission which had been appointed to operate the system. The Ontario Railway and Municipal board was appealed to and issued instructions to the sheriff to seize the system and hand it over to the joint commission. An injunction prevented the sheriff from acting, and mass meetings, attended by virtually every ratepayer in Port Arthur, are being held to protest against the deal. The matter will come up in the courts in the near future, and petitions have been mailed to the Hon. J. M. Gibson, lieutenant-governor of Ontario, Sir James Whitney, premier of Ontario, and various other bodies of influence. At the present time two sets of officials are supposed to be drawing salaries for managing the system.

R.

IMPORTANT DEVELOPMENTS.

CLEVELAND TRACTION LINES PUT IN HANDS OF RECEIVERS—Judge Tayler of the Federal court has appointed Warren Bicknell and Frank A. Scott as joint receivers for the Municipal Traction Company and the Cleveland Railway Company. Each of the receivers will furnish a bond of $100,000. Warren Bicknell is president of the Havana Electric Company, which controls all the street railways in Havana, Cuba, and is identified with large numbers of electric traction companies in Ohio and other states. Frank A. Scott is secretary and treasurer of the Superior Savings and Trust Company of Cleveland. The receivers will take charge of the traction system at once, and will operate it under the direct supervision of the court. The rate of fare, it is said, will be as low as can be made consistent with good service.

AUTOMATIC TELEPHONE DILEMMA—Samuel McRoberts, president of the Illinois Tunnel Company, has appeared before the Chicago City Council committee on gas, oil and electric light in the interest of the petition of his company for an extension of two years in which to obtain the required 20,000 telephone subscribers. The franchise of the company provides that that number of telephones must be in operation by next February, or, according to an opinion given by Assistant Corporation Counsel Emil C. Wetten, the city can take over the telephone properties of the corporation, operating the system itself or disposing of the franchise to any other company, as it sees fit. At present the tunnel company has about 5,000 of the automatic telephones in operation. Mr. Roberts said his company could install these telephones before next February, "not in a sensible or businesslike way, but to preserve its rights if necessary." He declared that the company is not going to forfeit the franchise, as there is too much property involved.

GREAT FALLS POWER AND TOWNSITE COMPANY TO SPEND $5,000,000 ON POWER PLANT—John D. Ryan, who with associates has purchased the Great Falls Power and Townsite Company, announces that they are about to begin the expenditure of $5,000,000 in building dams and a power plant, and that the construction of a power transmission line, 165 miles long, will soon be begun. This line will run into Butte, Mont., and give power for the Butte mines. The company will also build a wire factory at Great Falls and make wire from Butte copper with which it will supply the entire copper wire market from the Missouri River to the Pacific Coast, and will operate plate-glass, carbide and cement factories in connection with the power company.

MONTREAL LIGHT, HEAT AND POWER—The Montreal Light, Heat and Power Company has made arrangements to secure 100,000 additional horsepower in the next two years. Besides securing power from the new Soulanger plant a new large steam plant will be secured.

BOSTON & NORTHERN AND OLD COLONY ROADS TO ISSUE NEW STOCK—The Massachusetts Railroad Commissioners have granted the petition of the Boston & Northern and Old Colony Street Railway Companies, Boston, Mass., for authority to issue $1,096,300 capital stock at 110. The new stock is six per cent preferred, and the distribution is $723,600 Boston & Northern, and $372,700 Old Colony. The proceeds will be used to pay off floating obligations of these companies, the amount of which, in hands of the public, is about $2,500,000.

TELEPHONE MERGER DECLARED OFF—The big telephone deal by which it was proposed to lease the property of the United States (or long-distance) Telephone Company, the Cuyahoga Telephone Company and the Columbus Citizens' Telephone Company to a holding company for 999 years, has been declared off. The negotiations to transfer the properties to the holding company had been going on for weeks and the directors of each company had recommended to the stockholders that the lease be made. Announcement that the proposed deal had failed was made by President Brailey, of the Cuyahoga Telephone Company, following a meeting of the directors.

ENGINEERING SOCIETIES.

TOLEDO SECTION, A. I. E. E.—The Toledo Section of the American Institute of Electrical Engineers held a meeting on November 6 to hear the reading of a paper on "The Westinghouse Nernst Lamp; the Value of Its High Efficiency and Improved Mechanical Construction to Modern Methods of Illumination," by A. E. Eustice. The paper was illustrated with about eighty lantern slides, showing various lamp units, their construction and characteristics, as well as commercial installations equipped with them.

STEVENS ENGINEERING SOCIETY—The Engineering Society of Stevens Institute of Technology, Hoboken, N. J., has published its programme of activities for the season of 1908-09. This includes general lectures, special lectures, inspection trips, and some information concerning the Engineering Society Employment Bureau. Lectures will be delivered by President Alexander C. Humphreys, Arthur G. Glasgow, Calvin W. Rice, W. J. Armstrong, Ferdinand Stark, G. L. Fowler, A. C. Triaca and Frederick K. Vreeland, in the general lecture course. Special lectures will be delivered by Prof. Louis A. Martin, Prof. Albert F. Ganz, Prof. Frank L. Sevenoak, Prof. John C. Ostrup, Prof. George V. Wendell, Prof. Francis J. Pond and Prof. Franklin de R. Furman.

DATES AHEAD.

National Society for the Promotion of Industrial Education. Annual meeting, Atlanta, Ga., November 19-21.

International Independent Telephone Association. Annual convention, Chicago, Ill., December 1-3.

American Society of Mechanical Engineers. Annual meeting, New York city, December 1-4.

American Roentgen Ray Society. Annual meeting, New York city, December 28-30.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

American Association for the Advancement of Science. Annual meeting, Baltimore, Md., January, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

PERSONAL MENTION.

MR. WILLIAM MARCONI, it is unofficially announced, is to receive the next Nobel prize in physics.

PROF. J. ROY ARMSTRONG, of Colorado College, has been commissioned by the City Council of Colorado Springs, Colo., to test the city street arc lamps.

MR. RICHARD O. HEINRICH, director of the European Weston Electrical Instrument Company, Berlin, Germany, is making an extended visit to this country.

MR. G. R. FOLDS has resigned as general manager of the West Penn Railways Company, Pittsburg, Pa., and will become general sales agent and assistant to the president of the H. W. Johns-Manville Company of New York, N. Y.

MR. C. H. SPOTTS, formerly manager of the paint department, and Mr. Walter F. Swearer, assistant at the general offices of the Joseph Dixon Crucible Company, Jersey City, N. J., are now associated with the Protectus Company. Mr. Spotts is secretary, and Mr. Swearer New York manager.

MR. J. R. GORDON, for many years southern district manager for the Westinghouse Electric and Manufacturing Company, has resigned from that company and accepted a position with the Western Electric Company, as power apparatus sales manager for its southern territory, with headquarters at Atlanta, Ga. He took charge of his new duties November 1.

MR HOMER E. NIESZ, manager of the Electrical Trades Exposition Company, Chicago, who has been indisposed for some little time, left Chicago November 16 for Hot Springs, Ark. Mr. Niesz will return to Chicago about the first of December, and it is hoped will then be prepared for the arduous work which the coming Chicago Electrical Show will require of him.

MR. FRANK J. SPRAGUE, of New York, passed through Chicago last week on his way to the Pacific Coast, where he is supervising the installation of a number of electric plants. While in Chicago he inspected the terminal facilities of the Illinois Central Railroad, and made a preliminary study of its traffic conditions as bearing on the electrification project.

MR. T. H. CEPERLEY has been appointed chief engineer of the Stuyvesant Falls power plant of the Albany & Hudson Railroad, to succeed W. G. Andrews. Mr. Ceperley was formerly chief engineer of the Newburgh Light, Heat and Power Company, having charge of plants at both Poughkeepsie and Newburgh.

MR. THEODORE N. VAIL, president of the American Telephone and Telegraph Company, was a passenger on the St. Louis, which sailed for Europe last Saturday. Mr. Vail said: "I shall take up no business while away. I am leaving at this time because there are no business matters in the way and no pressing problems for me to consider. The American Telephone and Telegraph Company has a clear outlook ahead, and I feel that I can go away for a two months' rest."

MR. WALTER ROBBINS, assistant general manager of the Wagner Electric Manufacturing Company, St. Louis, Mo., received, the other day, a postcard from A. W. Wyckoff, the Wagner company's genial Pittsburg representative, portraying the palatial residence of S. R. Dresser, at Bradford, Pa. A three-and-one-half-horsepower Wagner motor runs a vacuum cleaner in this residence, and the postcard bore the following legend: "This is the kind of a power house we always insist on having built around a Wagner three-and-one-half-horsepower motor; larger sizes are built in proportion."

MR. RICHARD C. McLAURIN, Professor of Physics in Columbia University, was elected on November 11 to the presidency of Massachusetts Institute of Technology made vacant by the resignation of Dr. Henry S. Pritchett, a year ago. Professor McLaurin has accepted, and will be inaugurated as soon as he can sever his connection with Columbia. The new president was born in Edinburgh thirty-eight years ago. He spent his boyhood in New Zealand, returning to England to complete a course at Cambridge, where he was graduated with high honors in law. He was afterward professor in the University of New Zealand, and later studied at McGill and Columbia, devoting himself to mathematics and physics.

ELECTRIC LIGHTING.

DALLAS, TEX.—E. A. Worden and others have applied for an electric-light and heating franchise.

ARTESIA, N. M.—Oscar A. Coates of Bisbee, Ariz., has been granted a franchise for an electric-light plant.

CUERO, TEX.—The Cuero Light and Power Company has been incorporated with a capital stock of $100,000.

SUPERIOR, WIS.—The Northwestern Lighting Company has been incorporated with a capital stock of $15,000.

DETROIT, MICH.—The Manufacturers' Light and Power Company, of Detroit, has been incorporated with a capital stock of $10,000.

WALLA WALLA, WASH.—The Washington-Oregon Traction Company has been granted a franchise for an electric light and power plant.

REEDSBURG, WIS.—A day circuit is to be established on the city electric power lines. An expenditure of $8,000 is contemplated in making the change.

CLIFTON SPRINGS, N. Y.—Richmond P. Pratt, of Clifton Springs, and E. VerPlank, of Manchester, who recently purchased the Manchester Mills, have formed the Manchester Power Company.

MISSOULA, MONT.—The Missoula Light and Water Company is planning to add to the capacity of its Missoula plant to meet the growing demand for electric service throughout the territory served.

IOWA CITY, IOWA.—The lighting committee of the city council has recommended asking for bids for 130 magnetite arcs. Bids are also asked for 250 incandescents in addition to the magnetite arcs.

KANSAS CITY, MO.—The Union Finance Company, of Kansas City, Mo., has applied for a fifty-year franchise to supply light in St. Louis County. It is proposed to supply it at twelve-and-one-half cents per killowatt-hour.

TAXCO, MEXICO—An electric power and lighting plant has been installed near Taxco, state of Guerrero, by the Compania Minera y Metalurgica. The power will be used to operate the machinery of the mines of the company.

ROGERSVILLE TENN.—The electric-light plant at Rogersville was destroyed by fire October 29, with a loss of $5,000, partially covered by insurance. The plant will be rebuilt at once, and is promised to be completed by December 15.

NEW CUMBERLAND, W. VA.—The Panhandle Electric Company, with principal office at Pittsburg, Pa., and chief works at New Cumberland, has been chartered with a capital stock of $25,000. One of the incorporators is J. L. Merrill, of Pittsburg.

ELLWOOD CITY, PA.—The City Council has decided to advertise for bids for installing an electric plant in Ellwood City. The people of the town favor a municipally-owned plant. The estimates of the cost of installing a plant have been from $11,000 to $13,500.

GUADALAJARA, MEXICO—George Mitchell and D. B. Russell, of New York, are preparing to install a hydro-electric plant near Guadalajara, to operate the machinery of a marble quarry which they own. They also expect to build an electric railway from their property to Guadalajara.

CHEYENNE, WYO.—The Citizens' Water and Power Company has been incorporated with the object of generating, distributing and selling electricity for light, power and heat in Laramie County, Wyoming, and in Colorado. The directors elected for the first year are George Bullock, G. A. Taff, F. M. McMahon, R. L. Holland and R. S. Ellison.

KEOKUK, IOWA.—The stock and franchise of the Keokuk & Hamilton Water Power Company has been transferred to financial interests which are expected to develop the waterpower of the Des Moines rapids. Fifteen million dollars will be required to develop 200,000 horsepower, and actual work must be begun by February 9, 1910.

CEDAR RAPIDS, IA.—W. G. Dows and Isaac B. Smith, of the Cedar Rapids & Iowa City Railway & Light Company, have purchased waterpower rights in the Cedar River at the Palisades, six miles below Cedar Rapids. A twenty-foot dam will be built, and it is estimated that 50,000 horsepower will be developed. Ultimately there will be an electric line to the Palisades and Mount Vernon.

CUERNAVACA, MEXICO—E. Conas, of Cuernavaca, treasurer of the state of Morelos, is erecting an electric power and lighting plant of 1,600 horsepower capacity at Cuernavaca. Mr. Conas also owns the street-railway system of that city and the power of his plant will be used to operate its cars. It will also furnish power and lights for the town. The plant will be finished about January 1.

GOSHEN, IND.—By a ruling of the Circuit Court the city of Goshen is prevented from rebuilding its commercial lighting system, at a cost of $40,000. The contract had been awarded to the Ironton Engine Company, of Ironton, Ohio. Taxpayers obtained an injunction on the grounds that the 2 per cent legal limit of indebtedness had been exceeded and that error was committed in not advertising for competitive bids.

McKINNEY, TEX.—At the regular meeting of the city council it was decided to purchase material for the extension of the city electric light system, a number of additional arc lights to be put up over the city. The material is to be purchased at once and the work of making the extension will soon be in progress. W. E. McKinnon of Dallas was elected superintendent of the city waterworks and electric light system.

NORTH ADAMS, MASS.—Plans for the building of a new electric-light plant to cost more than $100,00 have been formulated by the North Adams Gas Light Company. The accident of last summer, when a large flywheel burst, is partly responsible in determining the building of the new plant. The new station will have a complete equipment and the capacity will be practically doubled, from 2,500 horsepower to 4,000 horsepower.

ST. LOUIS, MO.—A meeting of business men and property owners in the district bounded by Fourth, Twelfth and Market streets and Washington Avenue, has been held to lay plans for the better and more uniform lighting of the down-town section of the city, especially in the district named. The meeting was under the auspices of the Lighting Committee of the Civic League, which includes J. L. Van Ornum, E. L. Andreon, Joseph D. Bascom, T. F. Chaplin, A. S. Langsdorf and John J. Lichter.

MEXICO CITY, MEXICO—The following applications have been made to the Mexican government recently for concessions to install hydro-electric plants: Mariano Alcerreca and Jose Jijar y Harro to erect a plant on the Santa Cruz and San Francisco creeks, near El Monte; Guillermo Brockman, to erect a plant on the Turbio River, state of Guanajuato; Tezuitlan Mining and Smelting Company, to erect a plant on the Sola River, state of Oaxaca; Isidro Medina, to erect a plant on the Ameca River, near Ameca, state of Jalisco; General Mariano Ruiz, to erect a plant on the Alica River, territory of Tepic; Gill S. Peyton, to erect a plant on the Lerma River, state of Jalisco; Armado I. Santa Cruz, to erect a plant on the Huitzilapam River, state of Puebla.

NOBLESVILLE, IND.—Work is progressing rapidly on the hydraulic dam which the White River Light and Power Company is building across White River, two miles north of Noblesville, and the company hopes to have the plant completed and in operation within the next sixty days. The dam is 300 feet long and develops a head of eighteen feet. The company expects to furnish Noblesville with electricity, and hopes to branch out and supply Cicero, Atlanta and Arcadia and possibly reach as far as Tipton, Lebanon, Frankfort and Elwood. Wallace Campbell, of Anderson, who is promoting an interurban line from Anderson through Noblesville to Lebanon and Crawfordsville, is negotiating with the company for power to operate the road. Mr. Campbell expects to finish the line between Anderson and Noblesville within the next year and he has asked the company for prices for sufficient power to operate the road between these two points.

PROPOSALS.

STREET LIGHTING, TAMPA, FLA.—Sealed bids will be received at the office of the city clerk until November 27 for lighting the streets of the city of Tampa with one hundred or more electric arc lights. Specifications may be had on application to the city clerk.

POST OFFICE AT COLDWATER, MICH.—The office of the Supervising Architect, Treasury Department, Washington, D. C., will receive sealed proposals until December 22 for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the post office at Coldwater, Mich., in accordance with specifications, which may be obtained from the custodian of the site at Coldwater or at the office of the supervising architect.

GOVERNMENT BUILDINGS AT ALASKA-YUKON-PACIFIC EXPOSITION, SEATTLE, WASH.—The office of the Supervising Architect, Treasury Department, Washington, D. C., will receive sealed proposals until December 21 for the construction of the United States government buildings at the Alaska-Yukon-Pacific Exposition at Seattle, Wash., in accordance with specifications, which may be obtained from the custodian of the Federal Building at Seattle, the superintendent of construction at the post office at Tacoma, Wash., or at the office of the supervising architect.

NEW PUBLICATIONS.

THE GOLDEN GATE—A very interesting brochure has been published by Adolph M. Schwarz, attorney and counselor-at-law, 299 Broadway, New York, N. Y., describing the beauties of San Francisco, Cal. Mr. Schwarz has established a chain of offices in several of the large commercial centers. It is his opinion, after traveling a great deal throughout the country, that at the Golden Gate there is the grandest opportunity for really enjoying one's work, and living.

NEW MANUFACTURING COMPANIES.

CHICAGO, ILL.—The Grand Flaming Arc Lamp Company has been capitalized at $10,000 to deal in appliances for electric lighting and heating. A. J. Lester, J. D. Ferguson and L. M. Greenlaw are the incorporators.

EDUCATIONAL.

The University of Michigan has accepted plans for an addition to the new engineering building, to be built at a cost of $75,063.75. An appropriation of $1,100 was also made for the construction of a new engineering camp at Douglas Lake.

ELECTRICAL SECURITIES.

Further breadth and activity developed in the bull campaign in last week's stock markets, with dealings more comprehensive and of a higher average than for some time. New high levels in various industrials were made for the year. Commission firms report great interest on the part of the public, and there has been large buying in this direction. The bulk of the trade is reported from western communities, which indicates the wider range of prosperity in this section than anywhere else in the country. The refusal of the United States Circuit Court of Appeals of the application for a rehearing of the Standard Oil decision was regarded favorably, and offset the unfavorable effect of the decision declaring the American Tobacco Company illegal and in restraint of trade under the Sherman Anti-Trust law. This case will be appealed by the company, and is expected to drag along for some time. There has been no lack of reports fostering increased interest, and aside entirely from speculative buying there has been a difficulty in meeting a considerable investment demand. The $20,000,000 bond issue distributed by the Illinois Central was successful beyond the expectations of the most sanguine, and the announcement of the new New York city $12,500,000 bond issue at 4 per cent is regarded as a significant indication of the better values which are now placed on these investments. Money, both call and time, ruled a little higher, and this is what has been expected and generally forecasted. It is the opinion of those best informed, however, that there will be no shortage of money, except possibly a temporary flurry near the end-of-the-year settlements. Reports continue to show the generally improved conditions of business, although there are those who do not hesitate to say that these reports are exaggerated. Railroad earnings, however, continue to show a considerable betterment, and in many well-placed lines there is no doubt whatever of a large and likely-to-be-maintained improvement.

Dividends have been declared upon the following electrical securities: Kings County Electric Light and Power Company; regular quarterly dividend of two per cent, payable December 1. American Railways Company; regular quarterly dividend of one and one-half per cent, payable December 15 to stock of record November 28, books close November 28 and reopen December 3. Grand Rapids Railway Company; regular quarterly dividend on the common stock of one per cent, payable December 1 to stock of record November 15. Chicago Railways Company, a dividend of $4 per share from accrued income to August 1, payable November 15 to stock of record November 12. Philadelphia Electric Company; semi-annual dividend of three per cent, payable December 15 to stock of record November 21. This is an increase of one per cent per annum, putting the stock on a six per cent basis.

ELECTRICAL SECURITIES FOR THE WEEK ENDED NOVEMBER 14.

New York:	*Closing.*
Allis-Chalmers common	13⅝
Allis-Chalmers preferred	47⅝
Brooklyn Rapid Transit	55⅞
Consolidated Gas	149½
General Electric	156½
Interborough-Metropolitan common	13¾
Interborough-Metropolitan preferred	35¾
Kings County Electric	128
Mackay Companies (Postal Telegraph and Cables) common	76¼
Mackay Companies (Postal Telegraph and Cables) preferred	70½
Manhattan Elevated	144
Metropolitan Street Railway	31½
New York & New Jersey Telephone	119
Western Union	64½
Westinghouse Mfg. Company	91¼

At the annual meeting of the Manhattan Railway Company Dumont Clarke was elected a director to fill the place of G. P. Morosini, deceased, and Frank J. Gould was elected a director to fill a vacancy. The old officers and the members of the executive committee were re-elected.

Boston:	*Closing.*
American Telephone and Telegraph	131¾
Edison Electric Illuminating	250
Massachusetts Electric	57¾
New England Telephone	124½
Western Telephone and Telegraph pref	70
Philadelphia:	*Closing.*
Electric Company of America	10⅝
Electric Storage Battery common	39½
Electric Storage Battery preferred	39½
Philadelphia Electric	12
Philadelphia Rapid Transit	23
United Gas Improvement	88½
Chicago:	*Closing.*
Chicago Telephone	.....
Commonwealth Edison	108¼
Metropolitan Elevated preferred	.....
National Carbon common	85
National Carbon preferred	104

Following the annual meeting of the Commonwealth-Edison Company, officers were re-elected.

It is semi-officially stated that an extra dividend on Chicago City Railway stock will be declared before the end of the present fiscal year, making a total of nine per cent for the year. The consolidation of the City Railway and Chicago Railways properties is discussed by controlling interests, but it is thought that nothing will be done until Chicago Railways has cleared its deck of various legal entanglements.

South Side Elevated advanced eight points last week. A director states that the company has a substantial cash surplus. The policy of the directors on dividends at the meeting the last of the month will be governed by future increased traffic prospects.

ELECTRIC RAILWAYS.

SAND POINT, IDA.—V. M. Smith has made application for a franchise for a street railway.

McKINNEY, TEX.—The proposed Mineral Wells & Northern Electric Railway is to be extended through Decatur and Denton to McKinney.

BELLEFONTAINE, O.—The line of the Ohio Electric Railroad, from Lakeview to Lima, has been completed and turned over by the contractors.

TOLEDO, OHIO—Construction work on the Lima-Toledo branch of the Ohio Electric Railway system is nearly completed. All of the heavy grading and filling have been finished.

MARSHALL, TEX.—The City Council has granted a franchise to M. Turney and associates to build and operate an electric car line and to furnish lights and power for a period of twenty-five years.

HUNTSVILLE, ALA.—An electric railway company is running a survey to Monte Sano, with the purpose of finding the most available route from the city to the top of the mountain. A railway to the mountain is planned for future construction.

NASHVILLE, TENN.—President H. H. Mayberry, of the Nashville Interurban Railway, makes the announcement that track laying for the road will begin at once and the work will be pushed to a rapid conclusion.

TORREON, MEXICO—A syndicate of wealthy Chinamen are building an electric railway system in Torreon and an interurban line that will connect the city with the town of Matamoros. The system will have about twenty miles of track. The syndicate are operating under the name of the Compania Bancaria y de Tranvias Wah Yick.

KANSAS CITY, MO.—A proposed interurban electric line, to pass through Bonner Springs, Turner and other small towns west of Kansas City, and to connect with the Metropolitan at Argentine, is being talked of by the farmers along the proposed route and the residents of the towns through which it will pass. The farmers say they will grant a right-of-way and are also willing to take stock in a company if formed.

RICHMOND, VA.—A charter has been granted to the Richmond, Urbanna & Peninsular Railway Company, whose president is John C. Robertson of Chesterfield. The capital stock of the company is placed at from $100,000 to $300,000. The proposed new line is to connect with the present electric line at Ashland and will run from West Point to Urbanna, a distance of sixteen miles, through a thickly populated section.

WASHINGTON, PA.—Work has begun on the construction of an interurban trolley line from Monongahela to Washington. Some time ago a franchise was granted the Monongahela and Carroll Street Railway Company to build its line in Monongahela. The company has filed extensions and is now authorized to construct its line from Monongahela to Washington, including a branch beginning near Ellsworths and to run to Marianna.

SEATTLE, WASH.—Within thirty days the Milwaukee road will be running trains between the Columbia River and the western portal of the St. Paul tunnel in St. Paul pass in the Bitter Root mountains. The tunnel through the Bitter Root mountains is 8,750 feet long. One end is in Montana, the other in Idaho. There are fifteen spans in the bridge over the Columbia, and the piers are being built and the steel framework is being pushed rapidly out over the stream.

WINSTON-SALEM, N. C.—A project of some magnitude is announced by Dr. H. P. McKnight, lessee of Vade Mecum Springs, Stokes county, about thirty-two miles from Winston-Salem, who says he will within thirty days start a force of men to work on building an electric car line from the Twin City to the springs. Later, he declares, he will continue the line to Spray and Leaksville, provided the rights-of-way can be secured. Dr. McKnight has surveyors already on the right-of-way which he has obtained.

CHICAGO, ILL.—The Chicago and Oak Park Elevated Railway will have a 155-foot viaduct erected on its main line on Lake street, between Clinton and Canal streets. This will be necessary to secure adequate headroom below its structure for the eight-track approach that the Chicago and Northwestern Railway will build into its new $20,000,000 terminal station. The approaches of the elevated structure have been raised already to an increased height of six feet at the point where the viaduct will be erected.

CHICAGO, ILL.—An innovation in traction management, consisting of an attempt to prevent overcrowding before it begins, has been introduced by the Northwestern Elevated Railroad, in connection with its new "stub" station at North Clark and North Water streets. The trains running into this station will not cross the river. Twenty-five thousand postcards, asking patrons of the road whether they intend to avail themselves of the new accommodations, are being distributed at all stations. The replies will govern the number of trains per day.

GARDEN CITY, KAN.—Work has been commenced on the electric road to be built by the Kansas & Colorado Electrical Transmission Company, which also proposes to build power plants to furnish electrical power for industrial plants in the Arkansas valley west of Garden City. The railroad line is to run from Canon City, Colo., to Dodge City, Kan., with a branch line from Garden City to Scott, Kan., in all 387 miles. The entire survey has been made and grading is completed in Colorado for a distance of about twelve miles northeast of Pueblo.

CHICAGO, ILL.—Since the directors of the Illinois Central Railroad announced that the Chicago terminal is to be electrified, commuters of the Burlington are agitating electrification of the Burlington between Downers Grove and Chicago. With the exception of the Illinois Central and the Chicago & Northwestern the Burlington has the heaviest suburban passenger business of any railroad entering Chicago, and as the company's right-of-way passes through almost the heart of the business district there have been many complaints about the smoke from the trains.

BUFFALO, N. Y.—At the annual meeting of the stockholders of the International Traction Company Nelson Robinson was elected a director, succeeding J. F. Slocum; other directors were re-elected. Subsequently the directors held their business meeting and appointed an executive committee of T. E. Mitten, Nelson Robinson and Thomas Penny. J. W. Crawford was elected secretary, to succeed J. F. Slocum. Thomas Penny, who was elected by the old board about a month ago, succeeding Henry J. Pierce, resigning president, was elected president again by the new directors.

EAST ST. LOUIS, ILL.—In order to forestall a threatened attempt of the East St. Louis and Suburban Railway Company to resume the collection of a ten-cent passenger fare between the Belleville Public Square and Edgemont, the present western terminus at Belleville, the Belleville City Council has passed an ordinance providing a penalty of not over $200 for each offense in collecting more than five cents for a single street-car ride in the city limits. An additional provision of the ordinance is that a transfer given from one line to another within the city limits shall be good for one hour after its issuance.

SAN FRANCISCO, CAL.—The new power plant of the United Railroads of San Francisco at North Beach, on which the company has been working for several months past, is now nearly complete. The new turbo-generator equipment will be capable of producing 5,000 kilowatts, supplying about 140 additional cars. The United Railroads at present get a large proportion of their current from the California Gas and Electric Company and the City Electric Company, and depend upon the latter concerns to such an extent that any interruption of their service seriously interferes with the operation of the cars. While outside power will continue to be employed almost as largely as at present, the new equipment will enable the United Railroads to give constant service regardless of any accident that is likely to occur to the machinery of either of the other companies.

TELEPHONE AND TELEGRAPH.

HOLLAND, TEX.—The Rural Telephone Company has been incorporated with a capital of $400.

BLUEFIELD, W. VA.—The Graham Telephone Company has elected the following officers: President, R. L. Gillespie; secretary and treasurer, P. J. Ritter; general manager, Dr. Carl Greever, of Tazewell.

OAKVILLE, TEX.—A. J. Moore of San Antonio, owner of the Eureka telephone system, has bought the lines and equipment of the rural telephone system, formerly belonging to E. J. Atchley, and is preparing to overhaul the property.

NORFOLK, VA.—The Common Council of Norfolk is considering the proposed merging of the two local telephone companies. The industrial commission, which has devoted considerable time to hearing all sides of the proposed merger, is expected to make a recommendation to the council.

LINCOLN, NEB.—The Nebraska-Iowa Long Distance Telephone Company has been incorporated with a capital of $1,600,000 by F. J. Day, G. O. Beno, E. H. Merriam, F. R. Davis, H. B. Jennings, F. H. Keys, T. G. Turner, W. H. Kimball and C. A. Laubach. $1,000,000 of the stock will be common, and to this stock alone will voting power be accorded.

CHESANING, MICH.—Local business men have organized a home telephone company and have now a paid-in capital of $10,000. C. O. Trask of Saginaw, organizer of the Valley Company in that city, prepared plans and gave other assistance in the organization of the Home concern. The exchange is to be equipped with the latest devices for good service, and will accommodate 250 subscribers.

SANDY HOOK, N. J.—Officers of the Signal Corps are experimenting with a long-distance wireless telephone between the Sandy Hook proving ground and New York city. Heretofore the longest distance covered by a wireless telephone has been between eight and ten miles, but it is claimed that the wireless apparatus now being experimented with will operate over a distance of forty miles.

CHICAGO, ILL.—The Illinois Tunnel Company, which operates an automatic telephone exchange in the downtown district of Chicago, in connection with its freight tunnels, has appealed to the city council for a grant of two years' extension of its telephone franchise. The company declares that, owing to the energy concentrated in pushing the freight and tunnel business, the development of the telephone exchange had been prevented, and only 5,000 of the 25,000 telephones stipulated to be installed at this time have been subscribed for so far.

SEATTLE, WASH.—The signal service wireless stations in Alaska have made another record, removing all doubt as to the feasibility of sending wireless messages overland. Fort Gibbon, several hundred miles inland, is receiving messages from Nome and St. Michael, 500 miles distant, with many ranges of hills between the two stations. A message sent by the steamer Northwestern 1,100 miles west of Cape Flattery to the United Wireless station at Cordova was copied. The message traveled about 1,200 miles in an air line over two ranges of mountains, capped with snow.

CHIHUAHUA, MEX.—The Intermountain and Mining Telephone Company of Chihuahua has adopted plans for the building of the largest long-distance telephone system in Mexico. It recently completed its first 100 miles of telephone line connecting the principal mines in the Guaronapeta mining district. In addition to this completed line the company is preparing to build a system of lines radiating out of Casas Grandes, connecting all of the principal mines within a radius of 100 miles with that town. From Casas Grandes a long-distance line will be built to El Paso, Tex., a distance of about 165 miles. Another line will be built from Guaronapeta to Madeira, where it will connect with the long-distance telephone system owned and operated by the American syndicate, which has established a large lumber business in the mountains of that part of the state. The plans call for the building of more than 500 miles of long-distance lines.

INDUSTRIAL ITEMS.

THE PACIFIC ELECTRIC HEATING COMPANY, whose main office and factory is at Ontario, Cal., has removed its Chicago factory to 63 and 65 West Washington Street.

THE BAILEY-WRIGHT COMPANY, Cleveland, Ohio, announces its incorporation as a general advertising agency, with offices in the Citizens' Building. George J. Bailey and Harland J. Wright compose the firm.

THE AMERICAN CONDUIT COMPANY, 140 Nassau Street, New York, has mailed to its friends a picture postcard showing the method of hauling its bituminized fiber conduit to the trench in Belgium by means of dog carts.

THE PETTINGELL-ANDREWS COMPANY, Boston, Mass., has published a catalogue devoted to a description of the P-M remote-control switch for direct and alternating currents. Copies of this catalogue will be furnished upon request.

THE NERNST LAMP COMPANY, Pittsburg, Pa., in its monthly house journal, *Lux*, for November illustrates some new installations of Nernst lamps under a variety of conditions, which show the useful applications of this popular illuminant.

THE BY-PRODUCTS FUEL COMPANY'S engineering department requests catalogues relating to mining machinery and equipment, power plants, coke ovens, and machine tools. The department may be addressed at Moundsville, W. Va.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a new folder describing its Type B knife switches, which conform to the National Electric Code standard. A complete list is given of the various ampere capacities, possible combinations and prices. This circular will be sent upon request.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, Ohio, has opened an office and battery depot at 1876 Broadway, corner Sixty-second Street, New York city. At this place all kinds of batteries and parts will be kept in stock. Orders for batteries and parts for New York and vicinity will be assembled at this depot, which will insure prompt service and quick deliveries.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., in bulletin No. 5532, gives a graphic description, with illustrations, of Victor flaming arc lamps. These lamps have been utilized to great advantage in a number of difficult installations, and the treatment given in the bulletin will afford considerable information to those desiring knowledge on this subject. Copies will be furnished upon request.

H. M. BYLLESBY & COMPANY, Chicago, announce the declaration of the usual quarterly dividend upon the preferred stock of the Mobile Electric Company, of Mobile, Ala., of 1½ per cent, payable November 16 to stockholders of record November 9. The preferred stock books of the company, both in New York and Chicago, are closed from November 9 to the opening of business, November 16.

THE OSWEGO MACHINE WORKS, Oswego, N. Y., extends an invitation through Niel Gray, Jr., its proprietor, to visit its new Chicago and New York salesrooms, where its most recent power and hand-driven paper-cutting machines are shown running with all the latest improvements. The New York store is located at 203 Wooster Street, and the local office, 150 Nassau Street, is in charge of W. S. Timmis, manager. The Chicago store and office is at 347 Dearborn Street, J. M. Ives, manager.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., in its bulletin No. 109, just issued, describes small generating sets consisting of Crocker-Wheeler generators and Type D engines made by the U. S. Rapid Fire Gun & Powder Company, and ranging from two to nineteen kilowatts, which are used to advantage for complete small lighting plants. The design of the generators is described in Crocker-Wheeler bulletin No. 100. Direct-current switchboard panels manufactured by the same company, and illustrated in bulletin No. 106, may be assembled to form a switchboard of any size and capacity. The bulletin contains suggestions as to the instruments and apparatus necessary on switchboards. General direct-current information and formulas for calculating the voltage drop in any feeder, the size of generator and engine required for lighting and power plants and a table of resistance and carrying capacity of wires are given in bulletin No. 107, which also describes the Crocker-Wheeler line of direct-current lighting and power generators of large sizes.

ROBERT W. HUNT & COMPANY, consulting and inspecting engineers, 1121 The Rookery, Chicago, Ill., have been awarded, by the Chicago & Northwestern Railroad Company, the inspection of the structural materials entering into its new terminal station, of which the steel will amount to about 24,000 tons. The same company has also been given the inspection of the steel to be used in the new Blackstone Hotel, now being erected at the corner of Michigan Avenue and Hubbard Court, Chicago.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has developed a compact resistance unit, having the Edison base, and suitable for mounting in a lamp socket. The head of each porcelain tube is arranged with a recess in which a small brass number-plate is inserted, on which the resistance is marked. The tube has a capacity of fifty watts and can be wound with any resistance up to 1,500 ohms. Resistance lamps have been used in many laboratories and telegraph exchanges in the past, but have the disadvantage that the resistance alters and ages and that they occupy considerable space and are costly. This tube is of the standard Ward Leonard type, and the wire has a zero temperature coefficient and is protected from electrical, chemical and mechanical depreciation. Any size Ward Leonard tube up to 200 watts capacity can be mounted in this manner.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, 184 Lake Street, Chicago, announces a new type of rheostat, giving ten to fifty times as many steps as in the ordinary rheostat, thus securing close control of the current. The instrument is compact, durable and neat, and the manufacturers believe this to be the ideal rheostat for the laboratory, and for all classes of work where fine control is an essential feature. The same company also makes speed regulators, field rheostats, battery-charging rheostats, moving-picture-machine rheostats, theater dimmers, etc.

MANNING, MAXWELL & MOORE, 85 Liberty Street, New York, N. Y., are distributing their new tool catalogue. This gives a thorough presentation of modern machine tools designed for service with high-speed steel and with the latest devices in motor drives. The tools illustrated and described are grouped carefully for convenient investigation. Great care and expense have been given to the production of this catalogue, the quality of paper, the arrangement of detail, and the execution making it a very valuable addition to literature of this subject. For the convenience of those using the book, a careful codification of all types of machine tools and appliances illustrated has been made. The catalogue contains 1,775 pages of information regarding the latest designs of machine tools now on the market.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) November 10, 1908.

903,164. ELECTROLYTIC APPARATUS. Paul Borgnet, Liege, Belgium. Filed May 11, 1907. The cathode is arranged to float unsupported in the bath and the anode is arranged in proximity to the cathode.

903,165. THERMOSTATIC CIRCUIT-CONTROLLER. George H. Bowen, Boston, Mass. Filed June 20, 1907. A glass tube encloses a movable member and sustains its fusible support.

903,177 and 903,178. SYSTEM FOR CONTROLLING ONE OR MORE ELECTRIC MOTORS. Henry H. Cutler, Milwaukee, Wis., assignor to The Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Filed August 11, 1905. In a multiple-unit train-control system there are electromagnetic switches on each car responsive to different voltages.

903,193. SYSTEM OF CONTROL. Ray P. Jackson, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed May 8, 1905. Renewed January 20, 1906. A traction motor-control system has a master controlling switch and a switch operated by the motor, both connected to the transformer winding.

903,195. TESTING-GALVANOMETER. Harry T. Johnson, New York, N. Y., and Charles E. Avery, Jersey City, N. J. Filed March 22, 1906. A flat magnet core is disposed in a horizontal central position relatively to the needle and has a greater width at its center than at its ends.

903,197. TELEPHONE-TRANSMITTER. William Kaisling, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Filed March 15, 1906. The transmitter comprises a plane diaphragm fixed at its center, a granule chamber mounted thereon, co-operating electrodes within the chamber and a body of granular carbon between the electrodes.

903,198. PRODUCING PHONOGRAPHIC RECORDS. Isidor Kitsee, Philadelphia, Pa. Filed March 6, 1908. The method consists in first recording the sound waves upon a suitable surface and electroplating upon the parts of the surface upon which no record has been made.

903,199 and 903,200. PHONOGRAPHY. Isidor Kitsee, Philadelphia, Pa. Filed March 12 and June 11, 1908. These are modifications of No. 903,198.

903,203. POUSSE-CAFE MACHINE. John Krivanek, San Francisco, Cal. Filed October 29, 1907. A series of chambers is equipped with valves and electrically controlled mechanism by which the valves are actuated to successively deliver a liquid from each of the chambers into a glass.

903,213. FLUID-GAGE. Morris Martin, Boston, Mass. Filed April 13, 1907. A removable carrier is provided with a magnetic needle and a device normally operative to lock the needle, combined with a gage head having a stud and a movable magnet.

903,221. OUTLET-BOX COVER. George B. McBean, Chicago, Ill., assignor to Mechanical and Electrical Manufacturing Company, Chicago, Ill. Filed February 23, 1907. Comprises a non-conducting socket and an annular metallic cover embracing the socket.

903,251. CIRCUIT-CLOSING DEVICE. Alfred A. White, Bangor, Me., assignor to National Trade Tapper Company, Bangor, Me. Filed May 18, 1907. Consists of a clock mechanism with a segment wheel and a contact member adapted to intermittently contact therewith.

903,257. CONTACT-OILER. Albert D. Wiswall, Utica, N. Y. Filed June 12, 1907. Renewed April 8, 1908. Combined with a controller having a rotatable shaft with contact plates thereon and fingers engaged by the plates, is a rotatable roll of lubricant-saturated material in engagement with the plates.

903,287. PROCESS OF THE MANUFACTURE OF INSULATING MATERIALS. Hermann v. d. Heide, Datteln, Germany, assignor to The Firm of Wunner'sche Bitumenwerke G. M. B. H., Datteln, Germany. Filed May 31, 1907. Consists in mixing pitch and heavy coal tar oils, emulsifying this mixture with a solution of alkaline reaction and water-glass, and oxidizing the emulsion with superoxide of barium.

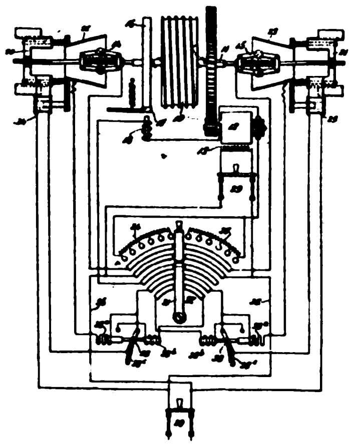
903,288. MOTOR-CONTROLLING SYSTEM. Clark T. Henderson, Milwaukee, Wis., assignor to The Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Filed March 14, 1907. There are means for maintaining the main switch closed upon the stopping of the motor until the field resistance device removes all the resistance from the field circuit.

903,316. INSULATING COVERING FOR PIPES. Alois Reimann, Zizkov-Prague, Austria-Hungary. Filed July 22, 1908. A cord coated with water-glass is coiled around the pipe, spun glass filling the spaces between the cord coils.

903,319. THERMOSTAT FOR ELECTRIC HEATERS. Earl H. Richardson, Ontario, Cal., assignor to Pacific Electric Heating Company, Ontario, Cal. Filed January 2, 1908. A heat-controlled cut-out for an electric flat iron.

903,331. TYPE-CASTING AND COMPOSING MACHINE. Oddur V. Sigurdsson, New York, N. Y., assignor to Oddur Manufacturing Company, New York, N. Y. Filed June 25, 1906. A number of type-casting units are provided with an electromagnetic starting device for each unit and a set of operating keys, any of which when manipulated is adapted to complete the circuit.

903,338. CONTROLLER CONSTRUCTION. Emmett W. Stull, Norwood, Ohio, assignor to Allis-Chalmers Company and The Bullock Electric Manufacturing Company. Filed March 31, 1906. Construction of the blow-out magnet for a drum-type controller is described.

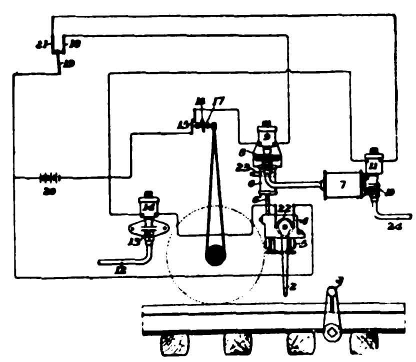


903,348.—CONTROLLER.

903,348. CONTROLLING APPARATUS. Albert G. Wessling, Norwood, Ohio, assignor to Allis-Chalmers Company and The Bullock Electric Manufacturing Company. Filed December 9, 1907. There are means for interrupting the supply of power to a hoisting motor when the latter is approaching a predetermined stopping point.

903,359. AUTOMATIC CONTROL FOR RAILWAY TRAINS. John P. Coleman, New York, N. Y., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed November 6, 1907. An electromagnet controls the air-brake valve and is itself controlled by the speed of the train.

903,366. TROLLEY POLE. Seybert D. Fenimore, Folcroft, Pa. Filed December 4, 1907. The pole has upper and lower sections connected by a knuckle joint.



903,413.—SPEED CONTROL OF TRAINS.

903,383. ELECTRODE FOR ARC LAMPS. Franz Janecek, Karlin, near Prague, Austria-Hungary. Filed May 16, 1907. Consists of a rod provided with a longitudinal dovetailed groove and a ladder-shaped metal strip located and held in the groove by its own resiliency.

903,401. ELECTRIC-LAMP SHADE HOLDER. Franklin Overbagh, Evanston, Frank E. Ayers, Hinsdale, and Irvin H. Brent, Chicago, Ill., assignors to Overbagh & Ayres Manufacturing Company, Chicago, Ill. Filed April 20, 1908. A flat annular sheet-metal body is provided with a number of projections which constitute a series of resilient prongs provided with studs spirally arranged and engaging a clamping ring.

903,404. METHOD OF SEPARATING ELECTRO-DEPOSITED METALS FROM LEAD MATRICES. Charles Reverdys, New York, N. Y., assignor to F. Wesel Manufacturing Company, Brooklyn, N. Y. Filed October 25, 1907. Consists in treating the surface of a lead matrix with a blast of carbon dioxide previous to producing the electro-deposit thereon.

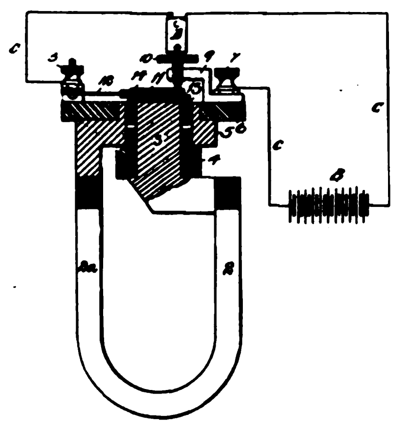
903,410 to 903,413, inclusive. APPARATUS FOR AUTOMATICALLY CONTROLLING THE SPEED OF TRAINS. Jens G. Schreuder, Edgewood Park, Pa., and Vibe K. Spicer, Chicago, Ill., assignors to the Union Switch and Signal Company, Swissvale, Pa. Filed August 3, 1907. A trip device for actuating the brake-controlled valve is normally held in operative position and shifted therefrom by a motor. Means actuated by the speed of the train control the operation of the motor.

903,414 and 903,415. COMBINED SIGNAL AND SPEED-CONTROLLING MECHANISM FOR RAILWAY TRAINS. Jens G. Schreuder, Edgewood Park, Pa., and Vibe K. Spicer, Chicago, Ill., assignors to the Union Switch and Signal Company, Swissvale, Pa. Filed August 3, 1907. A stop signal and caution signal have each a separate track stop and actuators shift the stops into and out of operative positions.

903,416 and 903,417. APPARATUS FOR AUTOMATICALLY CONTROLLING THE SPEED OF TRAINS. Jens G. Schreuder, Edgewood Park, Pa., and Vibe K. Spicer, Chicago, Ill., assignors to the Union Switch and Signal Company, Swissvale, Pa. Filed August 8, 1907. These are modifications of Nos. 903,410 to 903,413.

903,499. ELECTRIC-LIGHT STAND. Jefferson F. Pierce, Tampa, Fla. Filed May 11, 1908. The stand has a normally concealed coiled spring, the lower portion of which constitutes a clamping member.

903,508. ELECTRIC PICK MINING MACHINE. Alfred Sandstrom, Chicago, Ill., assignor to John F. Bush, Chicago, Ill. Filed April 1, 1904. Renewed April 7, 1908. An electromagnet holds a reciprocatory tool in retracted position and a motor produces sufficient air pressure to release the tool from control of the magnet and to thrust it forward.



903,745.—INTERRUPTER.

903,547. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed June 29, 1903. Relates to signaling means for a common-battery system.

903,552. LIFTING MAGNET. Arthur C. Eastwood and Frederick R. Fishback, Cleveland, Ohio, assignors to the Electric Controller and Supply Company, Cleveland, Ohio. Filed April 4, 1908. The magnet has a winding of low resistance adapted for operation in series with an electric hoisting motor.

903,561. TELEPHONE SYSTEM. Joseph A. Geller and Stephen H. Geller, Chicago, Ill. Filed November 4, 1907. This patent covers a selective controlling mechanism for the signaling and receiving circuits.

903,568. ELECTRICAL CONTACT-MAKER. John H. Hart, Memphis, Tenn. Filed January 20, 1908. A lever is yieldingly suspended across the path of a wire.

903,577. ELECTRIC FLOOR PUSH-BUTTON. Henry F. Keil, Bronxville, N. Y. Filed March 3, 1908. Consists of a face plate, a plunger, two spring fingers and an insulating body to support the same.

903,580. ELECTRIC-CURRENT REGULATOR. David R. Knapp, Philadelphia, and Howard E. Cade, Pencoyd, Pa. Filed May 29, 1907. A regulator for a storage battery charging system.

903,592. POWER GENERATOR. Charles J. Low, Chelan, Wash. Filed January 3, 1907. A wheel is mounted on the shaft in front of the boat and drives an electric generator that supplies current to the propelling motor.

903,640. ELECTROMEDICAL APPARATUS. Reinhold H. Wappler, New York, N. Y., assignor to Wappler Electric Controller Company, New York, N. Y. Filed December 30, 1907. Comprises a coil, an interrupter disc, and means for simultaneously rotating the disc-actuating means for taking a sinusoidal shunt current from the coil.

903,653. GEARING. Arthur V. Allen, Chicago, Ill. Filed April 6, 1907. On top of the field frame of a motor is mounted a bracket for an adjustable friction gearing.

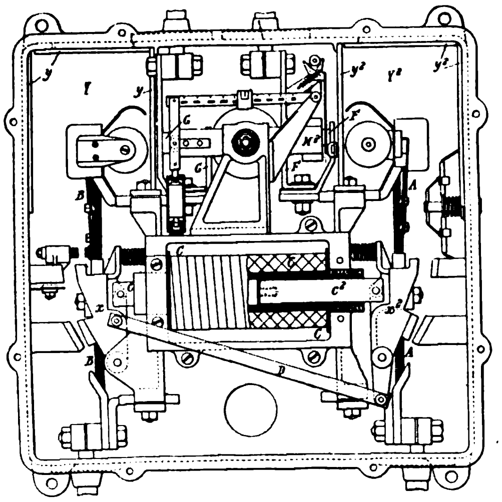
903,689. AIR AND GAS ENGINE. Hugh T. Dunn, New York, N. Y., assignor of one-half to Benjamin A. Jackson, New York, N. Y. Original application filed January 22, 1902. Divided and this application filed April 28, 1903. A pin mounted in a reciprocating arm makes contact between two stationary electrodes in the cylinder.

903,692. FEEDER-WIRE INSULATOR. George M. Finckel, Columbus, Ohio, assignor to the Sackett Mine Supply Company, Columbus, Ohio. Filed May 20, 1908. The insulator body has a through opening provided with a keyway.

903,968. TROLLEY WHEEL. Edmund J. Fredericks and Dilla R. Fredericks, Ohio, Ill., assignors to Lucien F. Hutchens, Minnie Remsburg and Dora Chase, Conneaut, Ohio. Filed September 27, 1907. A harp with oil chambers formed therein carries a hollow axle having apertures so that the oil chambers communicate with the axle and conduct the oil to the wheel.

903,705. ROTARY SNAP-SWITCH. Gilbert W. Goodridge and George B. Thomas, Bridgeport, Conn., assignors to the Perkins Electric Switch Manufacturing Company, Bridgeport, Conn. Filed January 3, 1908. The switch piece consists of a central blade with contact ends, top and bottom plates, and intermediate insulating sheets, the top plate having arms and an indicating dial clamped thereon.

903,733. TELEPHONE BRACKET. Benjamin M. Lampert, Cedar Bluffs, Neb. Filed June 10, 1908. Depression of a pedal opens the lazy-tong suspension for a desk telephone.



903,791.—DOUBLE-POLE CIRCUIT BREAKER.

903,745. INTERRUPTER. Carl E. Pearson, Lansing, Mich., assignor to Charles H. Bates and James H. Wellings, Lansing, Mich. Filed July 10, 1907. A make-and-break apparatus is provided with a tongue adapted to make connections with a contact point, a conductor being secured to the tongue and located in a permanent magnetic field.

903,752. PROCESS OF FORMING PLATES FOR STORAGE BATTERIES. William Morrison, Chicago, Ill., assignor to George Rumrill Coryell, Chicago, Ill. Filed December 26, 1902. Consists in subjecting the lead plates to electrochemical action in a solution formed by a mixture of sulphuric and nitric acids and permanganate of potash.

903,768. SIGN RECEPTACLE. Clarence D. Platt, Bridgeport, Conn., assignor to the Bryant Electric Company, Bridgeport, Conn. Filed December 12, 1907. A lamp receptacle has a body and a ring to attach it to the sign plate in combination with means to lock the receptacles to the sign plate in a number of positions.

903,785. SIGNAL SYSTEM. John J. Ruddick, Newton, Mass., assignor to United States Electric Signal Company, Portland, Me. Filed May 23, 1908. A block system consists of a normally closed circuit throughout the block and means for sending a signaling current by opening this circuit and connecting one point thereof to the source of current and another point to ground.

903,791. DOUBLE-POLE ELECTRIC CIRCUIT-BREAKER. William H. Scott, Norwich, England. Filed July 24, 1908. The sparking points of the switches are arranged in separate compartments so that flashing over from one to another is prevented.

903,796. ELECTRIC BLOCK-SIGNAL SYSTEM. Paul J. Simmen, Oakland, Cal. Filed January 28, 1907. Sections of one rail of the track are connected only by inductive resistances to permit the passage of direct current and prevent the passage of alternating current.

903,799. STORAGE BATTERY. John L. Smith and Malcon O. Smith, Cleveland, Ohio. Filed July 20, 1908. The edges of the plates are carried by elastic non-conducting frames and a mud guard frame of non-elastic material is clämped between the plate-holding frames.

903,807. ADJUSTABLE SUPPORT FOR ELECTRIC WIRES. Albert W. Bensley, Pawtucket, R. I. Filed September 15, 1908. A support carries two insulators that can be adjusted to different angular positions.

903,811. RELAY FOR REINFORCING SOUND. Jens H. Christensen, Sövejen, Sölleröd, Denmark. Filed March 30, 1905. A telephone relay comprises a diaphragm, a pendulum adjacent thereto and having a contact bearing against it, the pendulum being supported by jewel bearings consisting of a mercury contact for conducting current through the pendulum.

903,812. ELECTRICAL PROTECTIVE APPARATUS. Frank B. Cook, Chicago, Ill. Filed March 8, 1906. A thermal protector for a telephone circuit has a number of conducting rods associated therewith.

903,813. CONTACTLESS THERMAL PROTECTOR. Frank B. Cook, Chicago, Ill. Original application filed July 28, 1905. Divided and this application filed April 12, 1907. This is a modification of the above.

REISSUE.

12,878. SUPPORT FOR POLE CROSS-ARMS. Edward C. Short, St. Paul, Minn., assignor to Steel Gain Manufacturing Company, Chicago, Ill. Filed June 13, 1906. Original No. 804,630, dated November 1, 1905. A curved post plate and a cross-arm plate with flanges are connected by tongues, and a bolt clamps the plates between the cross-arm and the post.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired November 17, 1908:

463,154. ELECTRIC ARC LAMP. William Jandus, Cleveland, Ohio.

463,174. ARMATURE FOR DYNAMOS OR ELECTRIC MOTORS. B. D. Southard, Chicago, Ill.

463,188. TELEPHONY. J. W. Gibboney, Lynn, Mass.

463,192. ELECTROMAGNETIC SWITCH. C. H. Herrick, Winchester, and W. M. Rand, Boston, Mass.

463,198. ELECTRIC STOP MECHANISM. L. Mellett, Somerville, Mass.

463,207. TELEPHONIC RELAY. E. E. Weaver, Philadelphia, Pa.

463,242. DYNAMO-ELECTRIC MACHINE. M. C. Burt, Chicago, Ill.

463,247 and 463,248. GALVANIC BATTERIES. W. A. Crowdus, Memphis, Tenn.

463,257. ICE-BREAKER AND ELECTRIC-CURRENT TRANSMITTER. C. Smith, Wilkesbarre, Pa.

463,297. ELECTRIC LOCK. F. H. Starrett, Clinton, Mich.

463,298. THERMO CIRCUIT CLOSER FOR ELECTRIC FIRE-ALARMS. J. Wrigley and G. Chambers, Paterson, N. J.

463,311. ELECTRIC SWITCH. E. J. Bagnall, St. Louis, Mo.

463,314. ALTERNATING OR PULSATING CURRENT MOTOR. L. Gutmann, Pittsburg, Pa.

463,315. POWER-STORING MECHANISM FOR ELECTRIC LOCOMOTIVES. J. A. Hochett, Stirling, Kan.

463,340. FIRE-ALARM TELEGRAPH REPEATER. G. M. Stevens, Cambridge, Mass.

463,356. ELECTRIC LOCOMOTIVE. S. H. Short, Cleveland, Ohio.

463,384. ELECTRIC CIGAR-LIGHTING APPARATUS. W. W. Foster, Boston, Mass.

463,395. ELECTRIC TRAIN SIGNAL. J. B. Strauss, Cincinnati, Ohio.

463,396. ELECTRIC SWITCH. A. Swan, Orange, N. J.

463,420. COUPLING FOR ELECTRIC WIRES. F. X. Gartland, Philadelphia, Pa.

463,428. TELEGRAPH SOUNDER. J. Maret, Mount Vernon, Ky.

463,486. PROCESS OF WELDING METALS ELECTRICALLY. C. L. Coffin, Detroit, Mich.

463,487. ELECTRIC WELDING OR WORKING OF METALS. C. L. Coffin, Detroit, Mich.

463,512. ELECTRICAL CONDUCTOR. P. H. Holmes, Gardiner, Me.

463,545. MULTIPLE SWITCHBOARD. F. A. Pickernell, Newark, N. J.

463,558. APPARATUS FOR MEASURING AND RECORDING ELECTRIC CURRENTS. William Thompson, Glasgow, Scotland.

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CONTENTS.

RAILWAY ACCIDENTS.

For some time there has been a conscientious effort upon the part of railways to eliminate the possibility of fatal accidents both to employes and others liable to injury in the ordinary conduct of railway systems. For the perfection of safety devices railway corporations have expended large amounts of money, and the efforts of inventors have been encouraged in order to procure the greatest measure of safety to those coming in contact with the vicissitudes of railway operation. The heavy penalties exacted in case of injury, and the readiness with which the ordinary jury has sought to mulct the transportation company, have been sternly contributory to the attitude of mind which has prompted the safeguarding of human life. Even when the railroad corporation has done all that seems reasonable to protect others from injury there has come about recently a new idea as to what constitutes contributory negligence on the part of one injured. Notwithstanding ordinary safeguards, such as block signals, train annunciators and gated crossings, it has been held in several important suits at issue that the loss of one's life is too great a penalty to pay for ordinary negligence, and that the railroad must see to it that the trespasser be not allowed to suffer by reason of his well-proven negligence.

The compilation of statistics by commissions in several states and by the Interstate Commerce Commission has thrown some actual light on the decreased number of accidents in recent years, and it is a cause for satisfaction to realize that in spite of increased traffic and more rigorous demands upon the railway systems in general, the number of accidents is decreasing. Bulletins of the Interstate Commerce Commission for the year ending June 30 show that during this period there was a total of 3,764 killed and 68,989 injured, a decrease in the total number of 1,236 killed and 3,297 injured, compared with the number reported for the same period a year ago. For the three months ending June 30 the total number of casualties was also lower.

Not only in this country does this condition obtain, but the same is true of the United Kingdom, for which statistics are at present available. According to the Board of Trade report on railway accidents in Great Britain last year, 120 passengers lost their lives on the railways, as against 166 in the preceding year. During 1907, 454 servants of railway companies or contractors lost their lives, and 5,813 were injured, as against 438 killed and 4,365 injured in 1906. While this shows an increase, it is only an apparent increase, owing to the new Board of Trade regulations, which list minor accidents involving only a day's absence from work, which were not reported in previous years.

ELECTRICAL DRIVING IN COTTON MILLS—TWO BRITISH VIEWS.

In a recent issue of the *Electrical Review,* of London, Mr. W. H. Booth takes issue with those engineers who have put forward what he considers extravagant claims as to the desirability of installing motor-drive in cotton mills, and speaks strongly against the adoption of direct-connected motors, and particularly individual driving. Comparing belt-drive with direct connection, Mr. Booth says that while it may be possible to start a frame more quickly than is done with a belt, it will perhaps be sufficient to say that the frame may be brought to full speed by belt quicker than it now is started, because the women "tenters" are paid on the piece system, and are aware that they may lose more by starting too quickly than by starting at a gentle acceleration. This seems to be a point which can hardly be considered a disadvantage in electrical driving. With properly constructed starters and with motors of the interpolar type, not only a gentle, but a very even, acceleration can be secured; and although it must be admitted that the cotton-spinning machines generally run continuously and at a constant speed, it is an advantage to have a driving device that will allow the speed to be changed, and will also permit the machine to run efficiently if more than one speed is desirable.

Mr. Booth claims that usually, when driving a ring frame by its own electric motor, it is necessary to make room for the motor by decreasing the length of the frame by several spindles. It is said that the greater output of yarn per spindle in a recent case investigated was more than counterbalanced by the reduced number of spindles. The better appearance, the advantage of the absence of belts, and the improved lighting facilities, are admitted. Even though the spindle output be increased, say, five per cent, he believes it is not worth while doing so if this entails an expenditure of seven per cent of the spindles cut away to make room for the separate motor.

In the same issue of our London contemporary there is an illustrated description of the electrical equipment in an English cotton mill. The identity of this installation is not revealed, but the following paragraph is of interest, remembering the criticisms made by Mr. Booth, and referred to above: "Fortunately, circumstances do arise occasionally when a really modern electrical drive appeals to the mill-owner, a case in point being a recently-built doubling shed erected by a well-known firm of fine cotton spinners and doublers. In this case electrical driving was only decided on after exhaustive tests had been carried out."

The illustrations show the spinners and doublers equipped with enclosed motors, with the switch gear attached to the ends of the frames. The absence of belting allows a fine wiring scheme to be carried out, and makes possible very good daylight and artificial illumination.

The shed contains fifty doubling frames and the necessary auxiliary machinery, each frame being driven by a twelve-horsepower motor. The textile operations dealt with necessitate a wide range of speed, and variable-speed, ball-bearing motors of the interpolar type have been installed. Speed variation is of special importance in this class of work, and the speed of any frame may be carried to the highest limit, according to the particular work being dealt with at the time.

It may be well to mention, in passing, that experience has already shown that the cost of running is so low that the proprietors are installing some thousands of additional spindles, to be driven from another 150-kilowatt generating set.

WIRELESS TELEPHONES FOR THE GOVERNMENT.

It is understood that the United States Navy Department is about to ask for bids for powerful wireless telephone apparatus, the specifications calling for devices capable of establishing reliable communication for distances of not less than 100 miles. It is intended to supersede, as far as practicable, the wireless telegraph, and make communication by wireless telephone as complete as possible between certain to-be-established points of rendezvous.

The great amount of attention which has been paid by the Government to the development of wireless telegraph and wireless telephone apparatus is in marked contrast to its attitude when Morse was looking for governmental help to run his Washington-Baltimore line fifty years ago. At that time meager appropriations were squeezed out by painful efforts and great persistence on the part of this hardy inventor. Today not only is the Government making goodly appropriations for the development of wireless telephone and telegraph apparatus by private individuals, but the engineering corps is bending its best efforts to the improvement of the material turned over by private investigators. Some of the best work in wireless development has been done by the Government engineers, and to them is due the credit for establishing all of our most recent records for both distance and quality of service.

The success of the initial equipment of de Forest wireless telephone instruments on board United States men-of-war has helped materially to establish the advantages of the wireless telephone as a means of ready communication between ships at sea and between ships and nearby shore stations. There seems to be no reason why greater ranges of distance cannot be covered by improved apparatus, and a number of investigators have apparently pointed out the way in which this can be readily accomplished. Indeed, it seems that with the remodeling of present-day apparatus, particularly in reconstructing the telephone transmitter to work reliably at higher potentials, and to withstand the heating effects introduced by the high-frequency oscillations superimposed upon the natural vibrations of the transmitter diaphragm, a great step in advance will be taken, and we are promised that this consummation is near at hand. It is unfortunate that at present the field of wireless telephony is more or less clouded by litigation and the rival claims of several bona-fide and conscientious investigators. This, however, will hardly retard the progress of development, and the attitude of the Government, whether it work to the benefit of the individual investigator or not, will hasten the day when at least near-perfection shall be attained.

DEPRECIATION AND REPAIRS.

Depreciation amounted to 4.09 per cent, and repairs to 6.06 per cent annually, during sixteen and one-half years, on an average, according to the statement of one electric-lighting company.

This statement was made several years ago, at a public hearing on the question of further stock issues, as bearing on the value of the electric plant, and was not controverted.

It is not the purpose here to either indorse or criticize the accounts of this company, and no investigation has been made that would warrant either course, but the figures are given for what they are worth. While they may be entirely correct for the electric plant in question, it is of course very uncertain how far they would apply in any other case.

At the time that the statement of its repair and depreciation accounts was made, the electric company had a steam-driven generating plant of about 1,100 kilowatts capacity, made up of both direct and alternating-current apparatus. During the period of sixteen and one-half years to which the repair and depreciation accounts apply, the electric plant had gradually grown from a capacity of about 200 kilowatts.

Taking the entire series of years, the average investment of the company was put at $168,895, in each year, while the total depreciation was given as $114,011, and the entire amount expended for repairs was $138,741. With these amounts as a basis, the average annual depreciation of the plant was put at $6,909, and the average amount annually expended for repairs was $8,408. From these figures came the above conclusion of 4.09 per cent on investment for annual depreciation, and 6.06 per cent for repairs.

Perhaps the most interesting part of the accounts, as stated, was the separate items of repairs, which were as follows: Repairs, steam plant, $42,408.11; repairs, electric plant, $18,152.81; repairs, lines and transformers, $70,413.09; repairs, station building, $7,767.17; total repairs, sixteen and one-half years, $138,741.18.

As was to be expected, the items for steam-plant repairs and for line and transformer repairs are large, and the size of the steam-plant item brings out in a striking way the great change that has taken place in motive-power equipment since electric stations were started some twenty years ago with simple non-condensing engines, often in sizes as small as 100 horsepower.

Stated in percentages, the steam plant absorbed 30.5, the electric plant thirteen, lines and transformers 50.7, and the station buildings 5.6 per cent of the repair charges.

At the middle of the period of sixteen and one-half years covered by the depreciation and repair accounts, the generating capacity of the electric station amounted to very nearly 800 kilowatts, and if this be taken to be the average capacity for the period, the average annnual depreciation appears to have been $8.63 per kilowatt of generators, for the entire plant.

On a like basis, the total average repairs amount to $9.26 yearly, per kilowatt of generator capacity, for the entire electric system.

THE WESTINGHOUSE PLAN.

The modified reorganization plan of the Readjustment Committee of the Westinghouse Electric and Manufacturing Company, which has been under consideration for several months, has been declared operative, and apparently all that remains before the discharge of the receivers is the carrying out of the formalities connected with the issuing of the new stock provided for, and, of course, other details which, now that the fundamentals are ready for promulgation and inauguration, will be incidental to the course of reconstruction. By the end of this week the stockholders will have met in Pittsburg to elect new directors and ratify the various measures necessary to the completion of the reorganization plan. Undoubtedly, the merchandise creditors and the bankers who have been co-operating for the purpose of reorganization will have a powerful voice in the affairs of the company, and with this end in view the directorate will be increased from twelve to sixteen, divided into four classes, serving from one to four years each.

Four factors have combined to win success for the reorganization plan, and this success has been won against great odds. These factors have been the loyalty of stockholders in subscribing for $6,000,000 worth of stock at par when it was selling at hardly half that price in the open market; the liberal co-operation of merchandise creditors in agreeing to take $4,000,000 of stock at par in settlement of that amount of claims held against the company; the participation of bankers holding $7,900,000 short-time notes of the company in coming to the front with eighty-five per cent of the total amount and taking securities in payment of their obligations. To these factors must be added that which has been most important and inspiring: the personal enthusiasm and optimism of George Westinghouse, president of the company.

THE CHICAGO ELECTRICAL SHOW.

The fourth annual Chicago Electrical Show will be held under the auspices of the Electrical Trades Exposition Company at the Coliseum, Chicago, from January 16 to January 30. Present indications point to even greater success than has attended the efforts of those responsible for the show on the three former occasions, when expositions of record-breaking proportions, both in number of attendants and general interest, were conducted. Last year, although in the midst of a financial disturbance of considerable magnitude, stockholders and exhibitors alike were well satisfied with the money put into this enterprise. This year eighty per cent of the exhibit space has now been spoken for, and it is expected that by the middle of December all the available allotments will have been taken up.

The same excellent decorative features, with a possible enhancement of lighting effects, will obtain at the coming show, and it is purposed to increase the number of working demonstrations and render the exposition, if possible, more attractive than ever to the general public, at the same time making it particularly and significantly an electrical exhibition for the benefit of the electrical industry.

PUBLIC SERVICE CASES.

BY ALTON D. ADAMS, LL.B.

LEGAL RATES—DEPRECIATION AS EXPENSE.

A California statute authorizes county supervisors to fix the maximum rates at which water is sold for irrigation and other purposes, so that the net income upon the value of the property used in furnishing water will be not less than six nor more than eighteen per cent annually. Before fixing the rates the supervisors are required to estimate the value of the property used in furnishing water and the reasonable expenses of operation, including repairs of the water system.

The system of an irrigation company supplies water in the counties of Fresno, Merced and Stanislaus, California, and the supervisors of these counties have fixed the maximum rates for irrigation at eighty-five cents per acre per annum in Fresno County, $1.65 per acre per annum in Merced County, and $1.50 per acre per annum in Stanislaus County. Head works of the irrigation canal are in Fresno County, and after passing through Fresno County the canal runs through Merced County and thence into Stanislaus County. This location of the irrigation system is supposed to be the reason for the higher rate fixed for Merced County than for Fresno County, because of the greater expense of delivering water in Merced County, and the same reasoning would lead to a still higher rate in Stanislaus County instead of the lower rate of $1.50.

The irrigation company asks the court for an injunction to prevent the enforcement of the rates fixed in the three counties, on the ground that these rates will not provide net earnings of at least six per cent on the value of the irrigation system, as provided by statute, and also on the ground that the enforcement of these rates will take its property without due process of law.

According to the estimates of the supervisors of the three counties named the total value of the irrigation system in these counties is $1,201,706.32, and the reasonable annual expense of operating the system is $93,750. On the basis of the number of acres actually irrigated in the three counties, and at the rates fixed by the supervisors, the gross earnings of the irrigation system would amount to $137,873.65 per annum, so that the net earnings would be $44,123.65, or 3.67 per cent on the value of the property as estimated by the supervisors. According to the estimate of an engineer, the value of the physical property in the irrigation system is $1,166,904.53, and the books of the company show an operating expense of $86,437.50 during 1906, giving net earnings of $51,436.15, or 4.4 per cent on this physical valuation, with gross earnings at $137,873.65.

This net earning of 4.4 per cent on the value of the physical property is obviously less than the six per cent provided by statute, and the court said:

"Disregarding the provision of the statute, there is no evidence before the court that an income of 4.4 per cent per annum for this kind of property is reasonable and just."

Besides the physical value of the irrigation system there was the right to divert 760 cubic feet of water per second from the San Joaquin River, which was estimated by the company to have a value of $760,000, but the value of this right was not considered by the court in reaching its decision, but was reserved for future consideration. This right to divert water is in the nature of a franchise, and as to it the court said:

"While this right is undoubtedly of value, it may not be a value upon which ultimately complainant may be given a return under the law."

The estimate of the supervisors as to the value of the irrigation system was based on the present prices of materials, less physical depreciation, and as to this the court said:

"If a deduction is to be made from the value of the plant on this account, then an allowance should be made for such deduction and added to the annual income to enable the complainant to renew and reconstruct, so as to preserve the integrity of the plant."

A temporary injunction was granted pending the final hearing against enforcement of the rates fixed by the supervisors.

San Joaquin and Kings River Canal and Irrigation Company versus Stanislaus County, 163 Federal Reporter 567, United States Circuit Court.

The Waterpowers of Sweden, Norway and Switzerland.

An address was delivered recently by Eduard Engelmann, Austrian state railway superintendent. In view of the intended erection of electric power stations by the Government for the operation of railways in the Austrian Alps, the modern waterpower installations and electric traction systems in Scandinavia and Switzerland were examined by the author. The Brennan mono-rail system was also investigated. The extraordinary advances in turbine construction have been accompanied by the exploitation of waterpowers in Sweden and Norway on a large scale, and a mighty movement is afoot there to adapt the antiquated water laws to the new conditions. The Government is aiding the development in every possible manner and has for itself secured sufficient waterpower to operate the most important railways. According to recent investigations the total waterpowers of Sweden are estimated at ten million horsepower, those of Norway at twenty-eight million horsepower, and those of Finland at four million horsepower. About ten million horsepower could be utilized in the near future. It may be stated that the waterpowers of France and Italy are estimated at three to four million horsepower in each country, and those of Switzerland at one million horsepower, and in none of these countries are the conditions for regulating the water courses so favorable as in Scandinavia, where over four million horsepower are available without regulation. At present there are in operation or under construction plants of a capacity of 500,000 horsepower in the three countries named. It is estimated that by the exploitation of some further million horsepower the imports of coal, iron, fertilizers and other commodities will be so greatly reduced that the present condition will be reversed and the exports will exceed the imports by some twenty million kroner. The cost of the electric generating stations without transmission lines is estimated to be from 250 to 300 kroner per electric horsepower in the south of Sweden and 150 to 300 in the North and 140 to 200 kroner in Norway.

Independent Telephone Convention.

The annual convention of the International Independent Telephone Association will be held at the Auditorium Hotel, Chicago, on December 1, 2 and 3. Sessions will be held in the morning and afternoon of each day for reading and discussion of practical papers. The banquet will be held on Wednesday evening. The manufacturers of telephone supplies and kindred apparatus are co-operating with the association, and a number of comprehensive exhibits will be placed in various rooms, adjacent to convention headquarters.

CONDENSERS.

BY S. K. PATTERSON.

The general use of condensing engines has led to the development of a branch of engineering connected with the construction and operation of condensers, and the knowledge in this field is nowhere near as general and complete as it should be, considering the importance of the subject. Thus condensers consist of a number of different types with different theoretical and mechanical efficiencies and different costs of installations. Some types are only used in special service and others are especially fitted for special types of engines. The various difficulties that are encountered in the operation of a condenser and the maintenance of the vacuum have been more or less satisfactorily met in a number of ways, but each of these possesses disadvantages, and in the selection of an average condensing installation the various advantages and disadvantages of each type must be considered and a selection made with this knowledge.

Thus condensers at the present time can be divided into two general classes, jet and surface condensers. Again they can be divided, with equal propriety, according to the maintenance of the vacuum by natural or mechanical means. A number of other divisions exist, but these are of minor importance, as will become apparent in the further development of the subject.

The general theory of condensers is well known. By the maintenance of a vacuum at the exhaust port of the steam-engine cylinder and the condensation of the steam at this point with a rapidity equal or superior to that of its entrance, the advantage of an additional pressure equal to the normal air pressure is obtainable on the piston of the steam engine. The great variability of efficiency of the modern turbine with that of the connected condenser is a fact well-known, and the importance of high vacuum and satisfactory condensation in this field cannot be overestimated. The increase in efficiency due to diminution in steam consumption, for the production of a given amount of power or due, on the other hand, to increased power from a given installation, ranges from fifteen to, in some cases, nearly forty per cent, depending upon the nature of the unit and the efficiency of the condensing device. That condensing machinery has reached its maximum efficiency is a conclusion that can scarcely be made but undoubtedly great steps in advance have been made, as is at once apparent from a study of their relative efficiencies, increased simplicity of construction and of their operative features, many of which only become apparent as the result of continuous operation of the condenser itself under all conditions of load and water variability.

Now, in order to get a clear realization of some of the difficulties actually met with in operation and design of condensers a few details not ordinarily considered may be casually mentioned. In order to produce condensation cold water must be circulated through the vacuum into which the steam comes, and the air carried in by this and by the steam must be removed for the maintenance of the vacuum. The circulating water system must be accomplished through a closed water seal against the atmospheric pressure and this water undergoes, during circuit, comparatively wide variations in regard to pressure and temperature. Heated by the steam in the presence of the high vacuum, where the boiling point of the water is extremely low, the temperature of the water may rise to a sufficient extent to produce spontaneous boiling. Under these circumstances the operation of the condenser for condensing purposes and the increased development of power practically ceases. Again, the air must be removed for the maintenance of the vacuum, which must be held comparatively high, and this can be accomplished most efficiently by the use of vacuum pumps. If boiling occurs the rubber gaskets or packing in the vacuum pump are apt to be burnt out, and flooding with steam or water is an occurrence under many conditions, with resulting deterioration to many of the parts and inconvenience and delay in restarting the condensing feature. Again, many large steam units are so installed today that they do not possess sufficient power if they do not maintain the condensing feature in conjunction with their operation. Thus the temporary withdrawal of the condenser from active service, due to any of these causes, often results in actual shutdown of the plant itself. This feature was formerly more or less present in such installations as rolling mills, etc., where the load was excessive and the duty on the condenser variable and often excessive.

Now, a few words in regard to the constructive details of the various types. The vacuum chamber in connection with the exhaust port of the steam engine is maintained in contact with atmospheric pressure by the use of two columns of water approximately thirty feet high, in actual operation. These columns are identical in theory and operation to the ordinary mercury barometer, and a water circulation is produced merely by pumping the water in one column over the intervening height, whereupon its withdrawal in the other column by gravity is effected automatically. The position of the pump in this device is a very variable factor. It may be used directly to lift the water into the condenser and the outflow accomplished by means of gravity as mentioned. It may be used, on the other hand, to force the water down and out in one of the columns, thus balancing the air pressure directly by mechanical means. The height of the water column under these circumstances is much reduced, and its necessity in others often completely eliminated. Again, this thirty-foot vertical height condenser column may occupy various positions with respect to the surface of the earth and the available water supply. If sunken the pump may be used to remove the water from the hot well, with the maintenance of a fixed level at this point and the consequent automatic flow of water through the condenser to supply the deficit. By the use of a pump injecting water into the vacuum the velocity of this water can be used to assist the force of gravity in its removal, and in many of the jet-condenser types this velocity of the water entering into the vacuum, and produced by mechanical or natural means, is often used to assist in the evacuation of both the water and air from the condenser chamber.

This variability of design and mechanism to produce identical conditions has resulted in a considerable variation in size and design of the average condenser. The jet condenser in which water is injected through a fine spray, and then carried off by means of a positive pressure or rotary pump, is the simplest in design and comparatively small in construction. It can be readily attached to the steam engine in any position, but possesses various limitations on efficiency due to the low vacuum maintained with the small ejection of the air by this means. It can exist in very small units in this type, and even in the large ones its size appears very small in comparison to the types using thirty-foot vertical water columns for the maintenance of the vacuum and the operation of an air pump for the removal of the air. The types using the air pump and the water column, while probably not so common in small installations, possess undoubtedly an increased efficiency over the other type and exist in some cases in comparatively enormous units, single condensers for the condensation of the steam from units as high as 24,000 horsepower being not uncommon.

These various types of condensers are used in various situations and under various conditions of special advantage for each type. Thus, the barometric condenser or condenser using a large water column for a seal against the atmospheric pressure is practically impossible of utilization on shipboard. Some type of the jet condenser utilizing either a simple spray with the velocity of the water itself for the removal of the air or possessing, further, an injector addition for the further removal and entanglement of the air in the outgoing stream is common here. In large stationary plants, where the space is available, the other type is undoubtedly more efficient and satisfactory.

When the water supply is limited, various types of condensers, run in conjunction with cooling towers, which may or may not be an actual part of the mechanism, aften possess special advantages. In these the water after being heated by the steam is in turn cooled by evaporation into the air in the cooling tower. The loss by evaporation is less than the supply due to steam condensation, since the latent heats of evaporation and condensation in the two cases are about identical and the water is cooled in addition by conduction to the air. Hence, in this type a slight addition of water is continually made from the steam, which more than counterbalances the loss to the condenser water in the cooling tower, so that no water supply is necessary here. With impure or saline water the surface condenser is necessary. The boiler water must be maintained pure and the water resulting from steam condensation kept separate from the condenser water. This is accomplished by the use of a device equivalent to the ordinary tubular boiler or shell cooler such as is used in refrigeration. The vacuum is maintained on one side of the tubes and the cold water circulated on the other. If this water of condensation is pumped directly through the reheater to the boiler, no necessity for a water seal against atmospheric pressure is necessary in this part of the mechanism. The circulation of the cold water in the other half of the condenser is not limited in operation by the maintenance of a vacuum and much higher temperatures can be acquired by this water without affecting seriously the operation of the condenser. Thus the closed or surface type of condenser possesses many advantages in regard to economy of water consumption, since a given quantity of the water may be made much hotter. However, the rapidity of heat transfer in this type is nowhere near as great as in the jet or barometric condenser, and much larger surfaces must be used to perform the same duty in steam condensation. A given condenser, if of the surface type, possesses less ability to take care of a steam overload but is practically the only type available when limitations are in force on account of water impurity.

A number of additional features of interest to engineers, and not commonly considered, enter in the operation or maintenance of a condenser. A centrifugal pump is often extremely unsatisfactory in the production of water circulation in a condenser of the barometric type. The output of such a pump varies greatly with the air pressure and its action in this regard proves a great disadvantage. When additional steam enters the condenser chamber the water supply falls off instead of increasing with this type. Extreme heating of the water may result, with consequent boiling and a breaking of the vacuum. A positive pressure pump of either a rotary or reciprocal type is much superior. A periodic steam overload, again, may often result in a periodic surging of the water column up and down with ultimate breaking of this and the destruction of the vacuum, and suitable valves must be installed for the prevention of this. In the Weiss type of barometric condenser boiling of the water is prevented by an ingenious device. When the vacuum falls, due to an overload of steam which may cause excessive heating, or when boiling of the circulating water occurs, an automatic valve allows a small quantity of air to enter the vacuum chamber. This lowers the vacuum, raises the boiling point, and stops the boiling of the condenser water. The vacuum is gradually strengthened by the operation of the vacuum pump, and the condenser goes on without stoppage and only a slight diminution in efficiency with this occurrence. With many of the other types boiling of the water results in absolute shut-down. The Alberger condenser possesses two distinct advantages, in turn, over its competitor. The spray valve is maintained in position by a spring which automatically accommodates itself to the quantity of water entering the condenser head. No attention need be paid to the regulation of this valve, as exists in other types, and the water supply is regulated only by the speed of the pump. Its other advantage consists in the very complete and satisfactory device for the separation of the air and moisture in the chamber immediately above the spray cone. Much drier air is furnished the vacuum pump by this device than can be obtained by the other types. Consequently the efficiency in the operation of the vacuum pump is much increased in this development. The steam and water entering in the same direction, assist each other's flow in the downspout. When a counter-current action is attempted with these two ingredients a more complete transfer of heat for a given quantity of water is apt to occur, but steam overloads tend to diminish the water supply on account of the variation in velocity and pressure. Water enters a vacuum under normal air pressure with a velocity of forty-seven feet per second, and steam enters the same vacuum, under normal conditions of operation, at a speed of about 1,900 feet a second. This high velocity, and its utilization in the maintenance of water flow through the condenser, is undoubtedly partially responsible for the great efficiency of this type of condensing apparatus. Practically all makers of the barometric type of condensers make jet condensers, using a pump directly as well. The field is so divided that all types of condensers serve a distinct and separate purpose in special fields in which other types cannot compete with any degree of satisfaction. The necessity of having large pipes with rapid flow and a high capacity in turbine condensers is well known, and the result is that specialization in this field is going on with considerable rapidity, and new developments are of almost daily occurrence.

Madame Curie for Paris Chair of Physics.

Mme. Curie, who jointly with her husband, the late Professor Curie, discovered radium, has been appointed Chief Professor of Physics in the Faculty of Science at Paris University. This is a recognition, well earned, which will be appreciated and commended by all interested in this remarkable woman's work in pure and applied science.

An Inductor Alternator as a Telephone Relay.

It has sometimes been proposed to employ as telephone relays direct-current dynamos having the field winding in the primary circuit and the armature winding in the secondary circuit, so as to produce in the latter currents of the same frequency and wave form as the currents in the primary circuit. The operation of such devices is interfered with by the disturbing effect of the collecting devices, and no relay of this type is in commercial use.

An invention of Ernst F. W. Alexanderson of Schenectady, N. Y., has been recently patented and assigned to the General Electric Company, and consists in using a high-frequency inductor alternator as a telephone relay. In such a machine both the field winding and the armature winding are stationary; the only moving part is the inductor, which is magnetized by the field winding. The inductor is designed so that its natural frequency, which is determined by the number of its poles and its speed, is very high compared with the frequency of the currents in a telephone circuit, so that each wave or pulsation of the telephone current corresponds to a large number of the alternations due to the movement of the inductor. The variation of the current in the primary circuit in which the field winding is connected does not change the frequency of the armature currents, but does change the amplitude of these currents; and if their frequency is above that of an audible note, the effect on a telephone receiver is simply that of the variation in amplitude, which corresponds to the variation of current in the primary circuit.

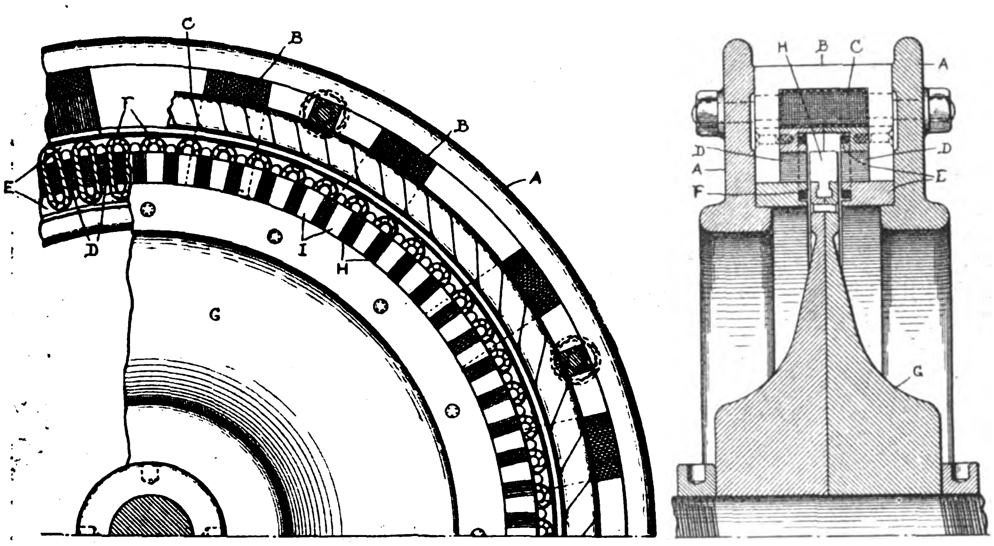
In Fig. 1 is shown a partial end view, partly in cross-section, of an inductor alternator designed in accordance with the invention for use in a telephone relay; Fig. 2 shows a side elevation of the same. A A represent end frames, between which the magnetic circuit of the stator is secured. This comprises bundles of laminations B B, arranged radially and surrounding the field coil C, which extends circumferentially around the machine, and the laminations D, which extend in a circumferential direction, and form with the laminations B a nearly closed magnetic circuit for the field winding C. The laminations are supported and spaced apart by non-magnetic spacing blocks E. The air-gap in the magnetic circuit of the stator has its opposite faces lying in adjacent radial planes; and in slots on these faces are placed the coils F of the armature winding.

The inductor G is shaped for maximum strength with respect to centrifugal strains, in order that it may be operated at very high speeds. It carries at its rim magnetic poles H formed of small bundles of laminations, which revolve between the opposite faces of the magnetic circuit of the stator. Non-magnetic blocks I are placed between the magnetic poles H, in order to strengthen the poles mechanically, and to decrease winding losses.

The field winding C is connected in circuit with a source of current and a telephone transmitter, either directly or through a transformer, according to common telephone practice. The armature winding F is connected in circuit with a suitable receiving device, which may comprise a liquid receiver of a type well known in wireless telegraphy, and a telephone receiver and a source of current connected in shunt to the liquid receiver; the principle of this arrangement being that the high-frequency alternations impressed on the liquid receiver vary its resistance, and the resistance variations result in current variations in the telephone receiver, which are audible therein.

The principle of operation of this telephone relay is as follows: The currents in the armature or transmitter circuit vary in amount when a message is being transmitted, and this variation is both in amplitude and frequency corresponding to the sound waves. The currents induced in the armature winding are of a high frequency, compared with the currents in the primary circuit. The frequency of these currents is not affected by currents in the primary circuit, but their amplitude is affected and varies in proportion to the primary current. The frequency of the armature currents is so high as to be inaudible in a telephone receiver, but the variation in amplitude produces audible sounds in the receiver of similar quality to, but of greater amount than, those that would be heard if a telephone receiver were substituted for the field winding of the alternator in the primary circuit.

It has already been stated that the stator laminations D extend circumferentially, while the laminations B, forming the greater part of the magnetic circuit, extend radially. The purpose of the circumferential arrangement of the laminations D is to localize the flux variations due to the high-frequency armature currents. Since the laminations in which the armature coils are placed extend circumferentially, the flux due to the currents in these coils can close itself directly around the coils, without producing any variations in the main part of the magnetic circuit.



FIGS. 1 AND 2.—PARTIAL END VIEW AND CROSS-SECTION OF INDUCTOR ALTERNATOR.

Projected Bank for Electrical Undertakings.

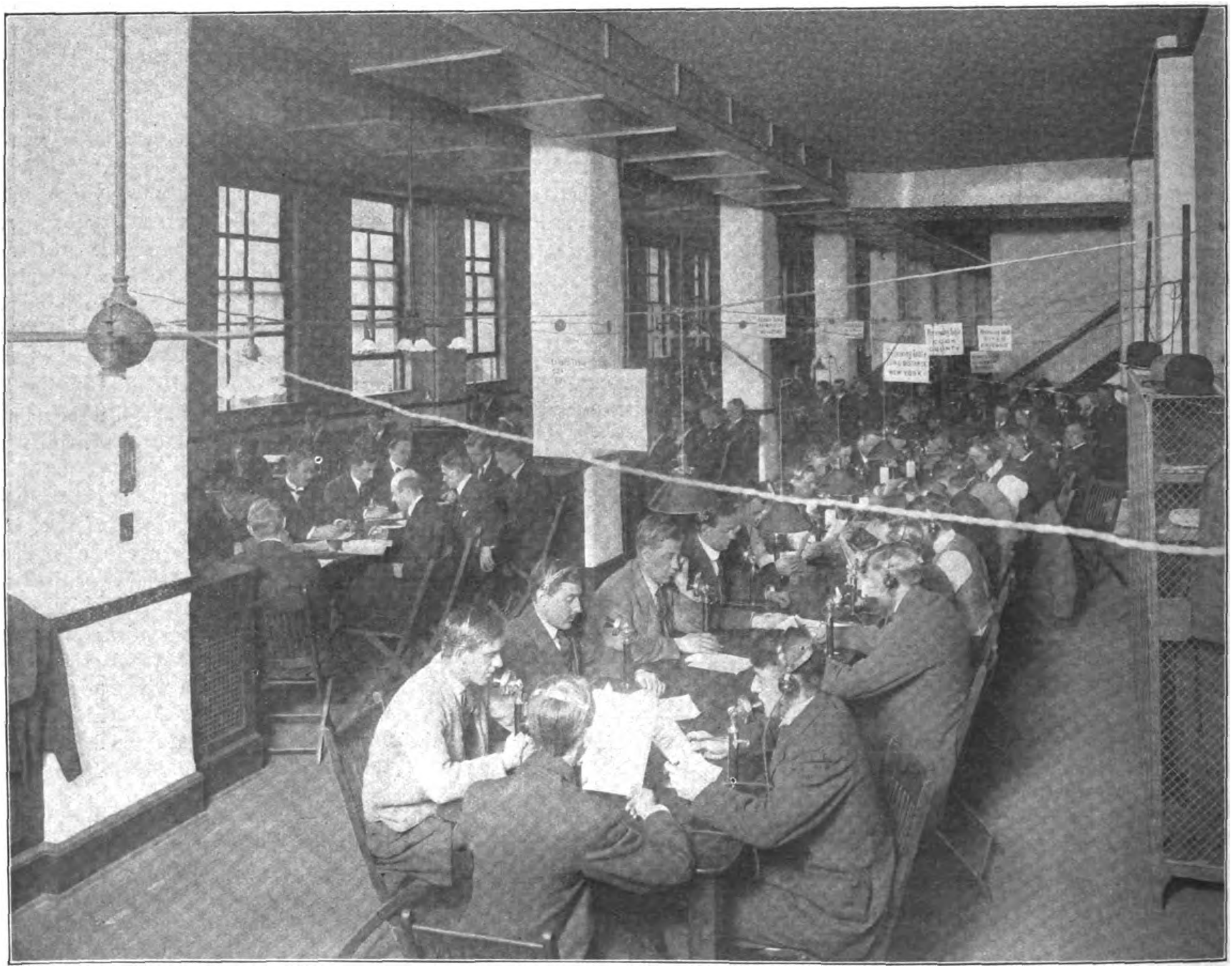
It is announced in the *Frankfurt Gazette* that some of the great German electrical firms propose to form a special banking institution to finance electrical undertakings. It is spoken of as the "Electro-bank." The capital is to be $7,500,000, with a large note issue in the form of bonds carrying interest at the rate of four and one-half per cent. The two companies mainly concerned in the new bank are the Allgemeine Elektrizitäts-Gesellschaft and the Siemens-Schuckert Works. It is understood that only large contracts for government and municipal bodies will be dealt with by the new financial institution, and it is doubtful if proposals of an industrial character will be entertained.

Election Returns by Telephone in Chicago.

Preparations throughout the country for transmitting election returns by telephone were more elaborate this year than ever before. The American Telephone and Telegraph Company, operating its extensive long-distance service, established headquarters in each of the states reached by its lines, comprising essentially all of the country east of the Rocky Mountains. At these headquarters the state returns were gathered and transmitted directly to New York. The returns were there compiled and sent out again all over the country by the long-distance wires, in the form of brief bulletins, telling the principal features of the results on an up-to-the-minute basis. As the information was in general confined to a few of the principal candidates, the results were quickly compiled and reached the entire country in a shorter time, doubtless, than any similar bulletins ever sent out in this or any other way.

In the large cities special arrangements had been made to gather the returns quickly and transmit them by telephone. In Chicago, by arrangement with the City Press Association, returns from the city precincts were telephoned to the Main Exchange compiling office immediately they were received at the City Hall. Similar means were provided for gathering news in the various counties around Chicago, and these returns were made up into brief bulletins for local distribution and also transmitted to New York.

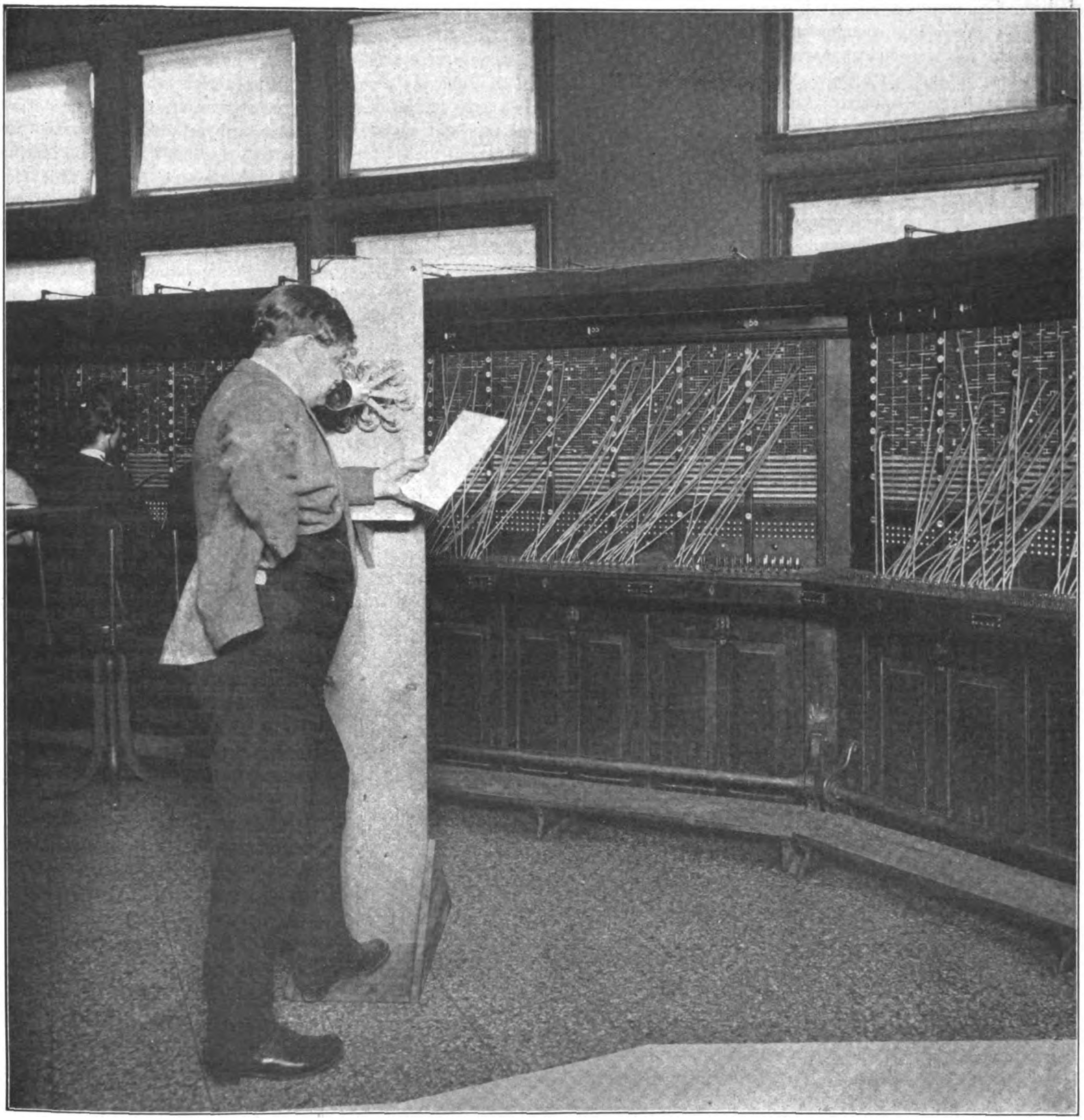
The Chicago Telephone Company has for many years distributed election news to telephone subscribers generally, as well as to newspapers, clubs and public gatherings. This year the demand for the service was greater than ever before, and preparations for the bulletin transmission were necessarily more elaborate. An entire floor of the company's new toll building at 87 Franklin Street was devoted to this work. Here were gathered about 175 men, engaged in receiving, compiling, editing and transmitting election news and bulletins throughout the night, and from about 5 o'clock p. m. until after midnight this was the center of election-news activity in the city. A photograph, reproduced herewith, shows the election-news force at work. Three sets of bulletins were prepared; the continuous bulletins, which averaged one a minute, the ten-minute bulletins for Chicago subscribers, and the thirty-minute bulletins for the suburban area. Special readers transmitted the continuous bulletins to newspapers, clubs and various public gatherings. These readers, by a combination of instruments, shown in the accompanying illustration, were able to talk into ten transmitters at the same time, and in some cases four or five lines were



CHICAGO TELEPHONE COMPANY ELECTION SERVICE—TRANSMITTING RETURNS TO 225,000 TELEPHONES IN CHICAGO AND VICINITY.

grouped on to each transmitter circuit. The ten-minute bulletins were transmitted by readers directly to each of the company's twenty-three principal exchanges and ten or more neighborhood exchanges in Chicago. Subscribers of these exchanges desiring to receive the news had simply to ask the operator for telephone bulletins. The operator then announced the number of the current bulletin, and ordered the subscribers' lines connected with a group being formed at that moment; the bulletin reader meanwhile was announcing the bulletin to a group previously made up. At the end of each bulletin the reader switched from one group to the other and proceeded with his work. At the close of each bulletin the subscribers' lines in the group were disconnected, and they were able to call again for the next bulletin. The total number of calls for election news received in this way during the evening was 53,298. The greatest number came from exchanges in the residence districts, where thousands of subscribers heard the latest election news without leaving their own homes.

Many commendations of the press and subscribers have attested to the remarkable telephone-bulletin service throughout the country on election night, and the success of the bulletin transmission has demonstrated once more that the telephone is one of the greatest and quickest news distributors.



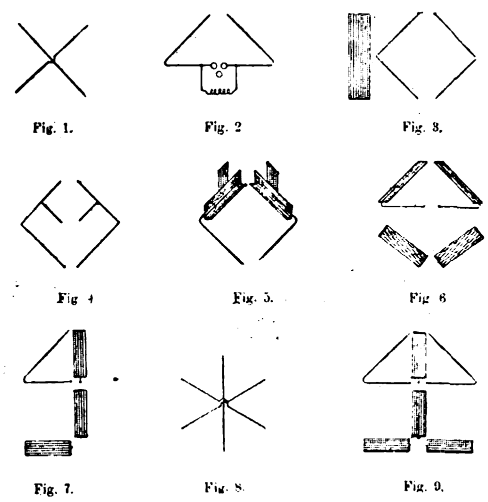
CHICAGO TELEPHONE COMPANY ELECTION SERVICE—READING BULLETINS OF THE ELECTION RETURNS TO MORE THAN 200 TELEPHONES AT THE SAME TIME BY AID OF MULTIPLE TRANSMITTER.

The Artom System of Radiotelegraphy.

Whoever has followed in the slightest the marvelous development of wireless telegraphy must certainly be aware of the serious difficulties that were in the way of the practical application of this wonderful method of communication, says Professor Alessandro Artom in a communication to the Italian Electrotechnical Association, and printed in the "Atti Della Associazione Elettrotecnica Italiana," Vol XII, No. 4, July-August, 1908. It happened continuously that wireless messages sent by a certain transmitting station were caught by all the receiving stations within the circle comprising the average transmitting distance of the station. Atmospheric electricity also caused serious disturbances, so that at times the service had to be suspended for hours. It was necessary to give to the phenomenon of the propagation and reception of the electric waves a much more definite character and, in order to meet the exigencies of practice, it was necessary to develop systems of radiotelegraphy which would make it possible (1) to send the effects of the transmitting apparatus mostly in one definite direction—that is, to find means of directing the electric waves; (2) to render the receiving apparatus most sensitive to waves coming from a certain direction; (3) to prevent the serious disturbances due to atmospheric electricity; (4) to make the receiving apparatus insensitive to waves emanating from extraneous transmitters. Artom says:

"When the work of Marconi was first announced it occurred to me that for a practical solution of the problems mentioned he might have turned to the use of phase difference between two or more electrical oscillations. To produce practically a difference of phase between two Hertzian vibrations of the order employed in wireless telegraphy appeared at that time impossible, but later the idea spread and it is now applied in numerous wireless systems. In my own work I have found it most useful to employ rotating electric and magnetic fields generated by two electrical oscillations differing in phase for proving the existence of phase differences, as will be clearly seen from the experiments here described.

"The rotating magnetic field is generated by two windings, through one of which flows the principal oscillating current, and through the other a current induced by means of a small transformer of a few turns. The existence of the rotating magnetic field can be easily demonstrated by introducing an armature into the field. The existence of very high-frequency rotating electrostatic fields may be demonstrated in various ways, for example, by the use of a Braun tube, which obviously is also eminently suitable for showing the magnetic field. In order to influence the cathode beam of the Braun tube by the vibrations of the high-frequency electric field it is only necessary to fasten to the neck of the tube, a little below the diaphragm, two pairs of tinfoil strips, properly insulated, at right angles to each other on the periphery of the tube, and connect the strips with four points of the oscillating circuit, between which there exist differences of potential out of phase. The effects of a rotating electric field may thus be easily observed; the cathodic spot describes open elliptical forms manifesting themselves in the shape of



SHOWING THE DISPOSITION OF THE CONDUCTING AERIALS USED IN THE ARTOM SYSTEM OF WIRELESS TELEGRAPHY.

spirals, since the oscillations are damped. These elliptical forms, according to which the electric lines of force resulting from the composition of two electrical oscillations of different phase arrange themselves, may conveniently represent a transverse section of a beam of rays of electric force analogous to a beam of light polarized elliptically. Having thus demonstrated experimentally the composition and interference of two electrical vibrations, I endeavored to apply the effect to wireless transmitting and receiving apparatus with a view of producing unsymmetrical electromagnetic fields and devised for this purpose a number of arrangements of aerial conductors which constitute one of the characteristics of my system of radiotelegraphy. They are represented in Figs. 1 to 9, and consist of two or three aerial conductors inclined toward each other at angles which may vary from zero to 180 degrees, but which may generally be most conveniently chosen between forty-five and ninety degrees. When oscillatory currents of displaced phase are sent into aerial conductors arranged in this manner they possess remarkable properties regarding transmission as well as receiving, as experiments made under the auspices of the Italian Royal Navy have shown. As regards the transmitting aerials, the following facts will be observed at once: (1) in the aerials inclined toward each other the mutual induction is very small, when oscillating currents flow through them. This fact permits of establishing absolutely in advance the period of oscillation to be used in the transmission.

"(2) The inclination of the aerials toward each other serves to produce the phenomena of composition and interference between electromagnetic waves emitted by two conductors, because it compels a superposition of the respective beams of electric and magnetic lines of force.

"(3) When connected to an oscillator or to a receiver, these two aerial conductors constitute an arrangement that is in electrical equilibrium, in the sense that the electrical capacities of the two branches, with regard to the earth, are of remarkably equal value, so that the ground connection of the transmitting as well as receiving apparata may be eliminated, as has been demonstrated in practice. This is of practical advantage.

"The various types of aerials shown are approximately equal in their effects, but the triangular arrangement presents some practical advantages in that it requires only one mast. Experience has shown, furthermore, that with this arrangement it is possible to obtain quite well conditions of syntony between transmitter and receiver.

"The characteristic property of the transmitting apparatus is the production of a profoundly unsymmetrical magnetic field, that is, directed electric waves, as the experiments made by the Royal Italian Navy have demonstrated. The use of inclined aerials alone evidently constitutes a reason for the unsymmetrical character of the effects. But an experience of years has demonstrated a property, which is also possessed by some other systems using two aerials, namely, that the axis of propagation according to which the electromagnetic effect reaches the greatest distances, may be perpendicular to the plane of the aerials, or it may lie in the plane of the aerials themselves. When the oscillating currents in the aerials are made to differ in intensity as well as in phase, that is, if they are of different amplitude, this axis of greatest propagation may be inclined in any direction with respect to the plane of the aerials. This fact is useful in practice, as a wireless telegraph station should evidently be able to meet any special conditions imposed by its topographical position.

"In fact, it is possible to vary the constructive elements or form of these aerials as well as their electrical elements, that is, the amplitude and phases of the oscillating currents by which they are excited. Furthermore, supplementary aerials may be added which, if arranged, as shown in Fig. 4, will greatly reduce the radiation in the direction of the plane of the aerials. Their effect is evidently to generate interfering fields, or fields opposite in sign to the principal electromagnetic field. In experiments made in 1904, in which these aerials were lengthened and arranged almost horizontally in the direction of the receiving station, an increase of radiation in that direction was observed.

"As has been stated, the electrical elements of the apparatus may also be varied; it may be operated with or without ground connection, the difference of phase between the currents may be varied from zero to 180 degrees, and the relation of the amplitude between the two currents may be made to differ. Thus it will be seen that with the arrangement described it is possible to obtain curves of distribution of energy corresponding to the most widely differing azimuth angles, these curves being the natural consequence of the arrangement devised by me.

"In order to apply the idea of phase difference to the reception of signals I devised various types of receiving apparatus, but the one that proved most successful was an arrangement resembling the differential galvanometer, and is illustrated in Fig. 10. Three coils are arranged on a core which may be of insulating material or of iron wires. The central coil is connected to any kind of electric wave detector. Alongside of the central coil are two other coils, each of which has one of its terminals connected to one of the two antennæ, the other ends are joined together and may be connected to the ground or not. These two coils may be made to act by induction on the central coil in such a way that their effects are either in opposition or in accord. When they act in accord on the central coil and the apparatus is connected to the ground, it will receive signals like an ordinary aerial from whatever direction they may come. But when the two receiving antennæ are arranged in the plane of the waves arriving from the transmitter, the waves strike first one aerial and, after a certain time, the other one that is farther removed from the transmitter. The magnetic flux generated in the two coils induces currents in the central coil, which is connected to the detector and behaves

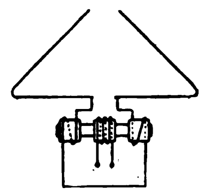


FIG. 10.—ARTOM SYSTEM OF WIRELESS TELEGRAPHY.

according to known laws. Assuming, on the other hand, that the two aerials are affected at the same instant, then the flux generated in the two coils is equal, of the same phase and opposite in direction, and the effect on the induced circuit connected to the detector is practically nil. The result is that from all transmitting stations outside of the plane of the receiving aerials, and more particularly from those stations in a perpendicular direction, the electromagnetic effects arrive at the two receiving aerials at the same instant and the receiving apparatus is not sensitive to them. The same is true in the case of electric waves due to atmospheric electricity. When the ground connection is eliminated the two coils may be dispensed

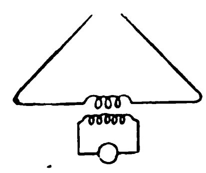


FIG. 11.—ARTOM SYSTEM OF WIRELESS TELEGRAPHY.

with and the apparatus assumes the simple form shown in Fig. 11, and its operation is then principally due to the electromotive force resulting from the magnetic flux traversing the space included by the aerials. The effect is maximum when transmitting and receiving aerials lie in the same plane. This physical fact was made use of by me in the fall of 1905 with very good results for determining the position of transmitting stations on vessels and on land.

"The selective properties of my receiver with triangular aerials have been made still more distinct by the use of electromagnetic syntony, and special apparatus were invented in which, in addition, local syntony was employed, that is, the apparatus has a slow natural period of vibration at which alone it will operate. This local syntony is determined, as regards the transmitter, by the low-frequency current feeding the coils or transformers and, as regards the receiver, by a very weak alternating current under the influence of which only the receiver can act. This apparatus was devised about two years ago, and in experiments made proved to be very sensitive and well suited as a receiver in wireless telephony."

Annual Meeting of the American Society of Mechanical Engineers.

The twenty-ninth annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies' Building, New York, on December 1 to 4, inclusive. The opening session will be held on Tuesday evening, when President M. L. Holman will make an address on "The Conservation Idea as Applied to the Associated Societies of Mechanical Engineers," which will be followed by an informal reception and reunion.

On Wednesday morning, following the annual business meeting, a paper on "Aeronautics" will be presented by Major G. O. Squier, U. S. A. The afternoon will be devoted to four papers relating to steam and power plants, among these being one by C. R. Weymouth on "Fuel-economy Tests at a Large Oil-burning Electric Plant." In the evening Lieut. F. P. Lahm, U. S. A., will deliver a lecture on "Aeronautics," illustrated by stereopticon views and moving pictures.

On Thursday morning five papers on machine-shop practice will be presented and discussed. In the afternoon while the main body will consider five miscellaneous papers, the Gas Power Section will take up two papers by Prof. F. C. Wagner and L. H. Nash.

On Thursday evening the annual reception will be held, followed by dancing and a collation.

The professional sessions will be concluded on Friday morning with the consideration of four papers giving various experimental methods and results. Among these will be one on "An Averaging Instrument for Polar Diagrams," by Prof. W. F. Durand.

At the annual meeting last year 1,232 members and guests were present. This number, it is believed, will be greatly exceeded this year.

SOME PRELIMINARY STEPS IN HYDRO-ELECTRIC ENGINEERING.

BY FRANK KOESTER.[1]

In developing waterpowers much preliminary study has to be made to ascertain whether or not the proposition will be a paying one. A lot of facts have to be collected before capitalists can be interested in the project, showing them where and how they can receive the best returns from their investment.

Usually the first steps toward a waterpower development are made by some progressive individual in the neighborhood of an undeveloped waterpower and not by the manufacturer or power user with an already established steam-generating station, who in some respects even tries to handicap the development for fear of the partial loss of the money invested in his old plant. He overlooks the fact, however, that current may be purchased much cheaper from a main central station than his own plant can generate it. Besides this, he is relieved of the work of generating current and has additional ground area for increased manufacturing purposes.

Another reason why a promoter can best, and possibly with greater success, further the scheme of development is because he has the interest of the community at large under consideration, while the individual manufacturer looks after his own interests alone. Again, the endeavor of the promoter is to utilize as much energy as possible, while the manufacturer utilizes only a portion, which is sufficient for his own needs.

In some localities, particularly when he comes from the "outside," the promoter is looked upon as a persona non grata, while in reality he is a benefactor. Through his efforts and the supplying of current the industry will be improved and in some cases new industries previously unknown will arise. This is not only a direct benefit to the community, but even the towns and counties will be benefited by the increase in revenues, taxes, etc.

After the investigations are made, showing the amount of the energy that can be utilized, the possible field of consumption must be carefully mapped out. This field may include other central stations, either steam, gas or other waterpower plants, with which the new station has to compete. While it is known for what price the established plants sell their current, it might appear on the surface difficult to ascertain what the existing companies pay for the generation of the same. There are, however, several ways by which this information may be obtained, and with the help of an experienced investigator who is thoroughly familiar with plant installations, very close figures can be ascertained.

These figures are very essential as a guide for the new development, because the new arrival has to compete with or possibly sell current to established stations at a lower price than they can generate it. This might lead to the operation of the stations in parallel, or eventually the incorporation of the old with the new concern and the gradual acquisition of the competitor's field. All this can only be accomplished by deciding the question, who can generate power the cheapest?

Having arrived at the competitor's figures, the prospective field for current consumption must be thoroughly canvassed to ascertain the load on the plant and the price for which the current of the new undertaking can be sold. In analyzing the cost of the current to be sold, of course, different prices are charged, according to the amount, duration and time of load. Conclusions as to the cost of current can only be derived after trial load curves of the proposed plant have been plotted.

Such plants will be most economic in operation which have a practically constant load-factor, as otherwise much machinery has to remain idle during the twenty-four hours. However, in competing successfully with existing central stations or private plants the new arrival cannot afford to overlook would be consumers who require current for only a few hours each day, or possibly the week, and those which need emergency current in case their own plant should fail. That these consumers pay accordingly for the service rendered is but natural. It must, however, be borne in mind that the lower the price for current delivered the greater is the tendency to improve the load curve of the plant.

After the foregoing investigations have been made and the figures warrant an installation, the possible future growth of the locality, such as the increase in industrial districts, electric railroading, etc., must be well considered, since an increase of the community is naturally followed by an increase in consumers.

Many times hydro-electric plants have been installed with no provision for future extension; the dams are located in such sections of the rivers and are of such a design that an increase in storage supply or additional head is impossible. On the other hand, and to a still greater extent, plants have been installed at such sections of rivers or localities that the average water supply cannot be obtained during certain seasons of the year. While the former may be due to the failure to exercise sufficient foresight, the latter may be considered as negligence in proper investigation as to the watershed, etc. Under such conditions successful competition with existing plants would be a difficult proposition in the long run.

Waterpower plants do not in many cases have to meet with competition, as they may be the pioneers in the field. If other conditions are favorable to the development of a certain waterpower the hydraulic plant may be combined with a steam or gas-driven plant to take care of low water conditions and peak loads.

The equipment of the plant and the size of the units should be such that they can be run to their best efficiency throughout the day, that is, they must not be underloaded or overloaded too much. Reserve units must be kept in readiness to be thrown on the line when the demand calls for them. The tendency is to install as large individual units as possible.

In closing it may be said as a general rule that promoters and financiers look usually for large waterpower developments, while as a matter of fact small plants give a better and quicker return for the money invested.

[1] Consulting engineer, New York city.

Court Reserves Decision in New York City's Application to Examine Edison and United Electric Books.

Justice McCall, in the New York Supreme Court, reserved decision on the application of the city of New York for an order authorizing it to examine the books and plants of the New York Edison Company and the United Electric Light and Power Company.

The corporation counsel said that he desired the examination for the purpose of defending the suits brought by the two companies to recover about $500,000 for furnishing electricity to the city for the year 1903.

Counsel for the electric light companies said that all the information that could be obtained by such an examination was contained in the public records of the report of the Stevens investigating committee of 1905, and asked the court to deny the application.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

CHICAGO RAILWAYS.

The Chicago Railways Company reports earnings for the month of August and seven months (February 1 to August 31) as follows: August—Passenger earnings, $959,167; other income, $20,999; total gross, $980,166; expenses, $650,128; balance, $330,038; balance, 30 per cent of gross, $294,049; interest on property, five per cent, $144,250; net earnings, $149,799; city's share, 55 per cent, $82,389; company's share, 45 per cent, $67,409, as against $95,621 for August, 1907. February 1 to August 31—Passenger earnings, $6,128,269; other income, $132,514; total gross, $6,260,783; expenses, $4,287,024; balance, $1,973,759; balance, 30 per cent of gross, $1,878,233; interest on property, $971,230; net earnings, $907,003; city's share, 55 per cent, $498,851; company's share, 45 per cent, $408,152, which compares with $442,503 for the corresponding period of 1907.

SEATTLE LIGHTING COMPANY BONDS.

The Seattle Lighting Company recently sold $450,000 ten-year, six per cent debenture gold bonds, redeemable on any interest day, at 101. This is added to an authorized issue of $3,000,000 of five per cent bonds, which makes the authorized bonded debt of the company $3,450,000. The financial statement showing funded debt charges is as follows for the year ended July 31, 1908: Gross earnings $560,325; net (after insurance and taxes), $252,695; interest on mortgage bonds, $124,073; interest on debentures, $27,000; balance, surplus, $101,622. Net earnings for the year ended June 30, 1908, were $252,287 and for 1907, $218,972.

There is an equity in the property over and above all the first mortgage bonds outstanding of approximately $1,500,000, which equity stands as security for this issue of $450,000 debenture bonds.

PHILADELPHIA COMPANY.

The report of the Philadelphia Company and affiliated corporations shows earnings from all operations for the nine months ended September 30, 1908, as follows: January 1 to September 30: Gross, $12,261,314; expenses and taxes, $7,453,833; net, $4,807,481; other income, $193,834; total income, $5,001,315; charges, rent, etc., $3,351,513; balance, $1,649,802; preferred dividend, $225,000; surplus, $1,424,802, compared with $1,969,602 for the same months in 1907.

BOSTON ELEVATED.

The annual report of the Boston Elevated Railway Company for the year ended September 30, 1908, shows as follows: Gross, $14,074,696; expenses, $9,454,386; net, $4,620,310; total increase, $4,620,310; charges, $2,780,246; surplus, $840,064; dividends, $798,000; surplus, $42,064, which compares with $33,278 for 1907. The balance sheet as of September 30, 1908, shows assets of $35,128,644 and a surplus of $2,717,980, which includes $2,036,900 premiums received from the sale of securities in 1907 and $2,007,314 in 1908. The number of revenue miles was 51,625,143 and the passengers carried 273,132,584.

KANSAS CITY RAILWAY AND LIGHT.

The report of the Kansas City Railway and Light Company for the month of September and four months ended September 30, 1908, is as follows: September gross, $537,301; expenses, $289,330; September net, $247,971; charges and taxes, $155,181; September surplus, $92,790, as against $115,786 for September, 1907. Four months' gross, $2,113,843; expenses, $1,212,137; four months' net, $901,706; charges and taxes, $620,530; four months' surplus, $281,176, comparing with $394,937 for the corresponding period of 1907.

ELECTRICAL SECURITIES CORPORATION.

The Electrical Securities Corporation, which is the holder of mortgage bonds of certain electric railway, light and power companies, has issued its report for the year ended October 31, 1908. The profit and loss account shows as follows: Bond interest received and accrued, $292,279; dividends on stocks, $56,735; total, $349,014; collateral trust bond interest, $137,712; interest general account, $17,672; expenses, $52,811; total expenses, $208,195; net profit, $140,819; profits from sale of securities, $4,101; total net profit, $144,920; previous surplus, $868,885; total surplus, $1,013,805, decrease in value of assets, $402,594; baalnce, $611,211; preferred dividend, $50,000; profit and loss surplus, $561,211, as against $868,886 for the year 1907. The statement of assets and liabilities as of November 1, 1908, shows total assets of $8,166,893, compared with $7,443,826 for the previous year.

INTERNATIONAL RAILWAY COMPANY.

The International Railway Company of Buffalo, N. Y., report as filed at Albany for the quarter ended September 30, 1908, is as follows: Gross, $1,349,900; expenses and taxation, $798,102; net, $551,798; other increases, $6,052; total increases, $557,850; charges, $224,768; surplus, $333,082, as compared with $415,389 for the corresponding quarter of 1907. The assets are given as follows: Cost of road, $31,536,025; interest and dividends receivable, $7,291; material and supplies, $386,053; cash assets, $436,293; accounts receivable, $608,271; International Traction Company car trust license account, $1,349,389; funded debt of other corporations, $360,000; stock of other corporations, $61,200; special deposits, $106,852; prepayments, $62,526; grand total, $34,913,903. Liabilities—Funded debt, $10,858,000; current liabilities matured and unpaid, $164,739; current liabilities unmatured, $534,272; loans, International Traction Company, $4,672,593; reserve for replacement and renewals, $91,322; other reserves, damages, $190,136; stocks, International Traction Company car account, $697,249; real estate mortgages, $38,850; common stock, $16,320,500; corporate surplus, $1,346,239; grand total, $34,913,903.

The Crosstown Street Railway of Buffalo, which is controlled by the International Railway Company of Buffalo, reports for the quarter ended September 30 as follows: Gross, $167,933; expenses and taxation, $101,759; net, $66,174; charges, $37,175; surplus, $28,995, as against $38,088 for the same quarter of 1907.

FONDA, JOHNSTOWN AND GLOVERSVILLE.

Fonda, Johnstown and Gloversville's report, as filed at Albany, N. Y., for the quarter ended September 30, 1908, shows as follows: Gross operating revenue, $224,720; operating expenses, $100,205; net operating revenue, $124,515; other net revenues, $2,244; total net revenue, $126,759; taxes accrued, $8,250; operating income, $118,509; other income, $4,862; gross income, $123,371; charges, $85,907; net income, $37,464, as against $53,615 for the corresponding period of 1907. The cash on hand September 30, 1908, was $32,581; profit and loss surplus, $479,769.

AMERICAN TELEPHONE.

The net earnings of the American Telephone and Telegraph Company for October and ten months ended October 31, 1908, are as follows:

Month of October: Dividends, $2,516,541; interest and other revenues, $789,-

921; telephone traffic net, $491,887; real estate, $15,382: other sources, $81,-493; total earnings, $3,895,223; expenses, $164,305; net, $3,730,918; interest, $666,-100; balance for dividends, $3,064,809, which compares with $2,568,707 for October, 1907. January 1 to October 31—Dividends, $12,550,557; interest and other credits, $8,087,075; telephone traffic, net, $3,473,494; real estate, $135,516; other sources, $647,908; total earnings, $24,-894,552; expenses, $1,736,060; net, $23,-158,492; interest, $6,380,746; balance for dividends, $16,777,746; dividends, $9,-289,624; surplus, $7,488,122, against $5,822,790 for the same months of 1907.

NORTHERN OHIO TRACTION.

The report of the Northern Ohio Traction and Light Company for the month of October and ten months ended October 31 is as follows: October gross, $157,532; expenses, $90,238; October net, $67,274; charges, $43,779; October surplus, $23,-495, an increase of $9,274 over the corresponding figure for 1907. Ten months' gross, $1,579,081; expenses, $913,301; ten months' net, $665,780; charges, $435,-783; ten months' surplus, $229,997, as compared with $263,257 for the preceding year.

SUSQUEHANNA RAILWAY LIGHT AND POWER.

The Susquehanna Railway, Light and Power Company's report for the year ended June 30, 1908, shows as follows: Receipts from subsidiary companies, interest on bonds owned, etc., $551,479; interest on bonds and dividends on stocks of subsidiary companies, $244,980; balance available for dividends, $306,499; dividends, 131,632; undivided surplus, $174,867. The surplus available for dividends is equal to five per cent on the preferred stock and 2.5 per cent on the common stock.

During the year a sum in excess of one million dollars was authorized and expended for extensions, additions and betterments to the various properties, which expenditures were authorized to meet absolute requirements made necessary by increased business.

UNITED RAILWAYS OF ST. LOUIS.

The report of the United Railways of St. Louis for the month of October and ten months ended October 31 shows as follows: October gross, $949,914; expenses, $572,325; October net, $377,589; charges, $233,846; October surplus, $143,-743; ten months' gross, $8,810,538; expenses, $5,645,405; ten months' net, $3,165,133; charges, $2,321,176; ten months' surplus, $843,957, a decrease of $22,013 over the preceding year.

GALVESTON-HOUSTON ELECTRIC.

The report of the Galveston-Houston Electric Company for the month of September and twelve months ended September 30, 1908, is as follows: September gross, $91,790; expenses, $46,620; September net, $45,170; charges and taxes, $17,450; balance, $27,720; sinking fund, $2,670; September surplus, $25,-050, a decrease of $164 over September, 1907; twelve months' gross, $1,060,002; expenses, $620,378; twelve months' net, $439,624; charges and taxes, $209,812; balance, $229,812; sinking fund, $31,-427; twelve months' surplus, $198,385, a decrease of $6,393 as compared with the preceding year.

SEATTLE ELECTRIC.

The report of the Seattle Electric Company for the month of September and twelve months ended September 30 shows as follows: September gross, $385,946; expenses, $209,952; September net, $175,994; charges and taxes, $86,-001; balance, $89,993; sinking fund, $7,344; September surplus, $82,649, an increase of $15,839 over September, 1907. Twelve months' gross, $4,425,520; expenses, $2,670,185; twelve months' net, $1,818,335; charges and taxes, $965,519; balance, $852,816; sinking fund, $88,-579; twelve months' surplus, $764,237, a decrease of $20,641 as compared with the corresponding period of 1907.

DALLAS ELECTRIC.

The report of the Dallas Electric Corporation and subsidiary companies for the month of September and twelve months ended September 30 shows as follows: September gross, $95,842; expenses, $63,080; September net, $32,-762; charges and taxes, $24,623; balance, $8,139; sinking fund, $3,333; September surplus, $4,806; twelve months' gross, $1,148,061; expenses, $772,430; twelve months' net, $375,631; charges and taxes, $313,411; balance, $62,220; sinking fund, $40,000; twelve months' surplus, $22,220, a decrease of $3,376 as compared with the surplus for the previous year.

MINNEAPOLIS GENERAL ELECTRIC.

The report of the Minneapolis General Electric Company for the month of September and twelve months ended September 30 shows as follows: September gross, $81,898; expenses, $34,413; September net, $47,485; charges and taxes, $32,310; September surplus, $15,175; twelve months' gross, $973,993; expenses, $432,362; twelve months' net, $541,631; charges and taxes, $365,542; twelve months' surplus, $176,089, a decrease of $29,190, as compared with the figure for the preceding year.

INTERBOROUGH RAPID TRANSIT.

Interborough Rapid Transit report, as filed with the Public Service Commission, for the quarter ended September 30, 1908, shows as follows: July 1 to September 30—gross, $5,328,887; expenses, $2,675,709; net, $2,653,178; other income, $337,175; total income, $2,990,352; interest on funded debt, $500,000; property taxes, $87,627; special franchise taxes, $310,000; balance, $2,092,726; rentals, $1,998,429; discounts and expenses, $3,108; surplus, $91,189, a decrease of $115,902 over the corresponding quarter of 1907. The income accounts of the two divisions of the Interborough Rapid Transit Company, showing the amount contributed by each toward the quarter's earnings, follow: Main division—gross, $3,093,838; expenses, $1,-587,198; net, $1,506,640; other income, $129,330; total income, $1,635,970; property taxes, $72,627; special franchise taxes, $310,000; balance, $1,253,343; rentals, $1,462,656; deficit, $209,313. Subway division—gross, $2,235,049; expenses, $1,088,511; net, $1,146,538; other income, $207,845; total income, $1,354,-383; interest on funded debt, $500,000; property taxes, $15,000, balance, $839,-383; rentals, $535,773; discount and expense, $3,108; surplus, $300,502.

Purdue Students' Inspection Trip.

About seventy students, members of the senior class in the electrical department of Purdue University, were the guests of the Fort Wayne Electric Works Company on November 11. During the day after inspecting the Fort Wayne plant the party visited the plants of the Hoffman Street Lamp Company and the power plant of the Fort Wayne & Wabash Valley Traction Company. Prof. C. F. Harding, Prof. H. T. Plumb and W. T. Small, of the Purdue electrical faculty, accompanied the students.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER I. (PART IX.)—POLYPHASE CURRENTS.

CURRENT AND VOLTAGE RELATIONS IN THE Y SYSTEM.

The relation between the electromotive force generated in one coil of a Y or star-connected, three-wire, three-phase system and the potential difference between the two transmission wires connected to their terminals is determined as shown in Fig. 28. AO, OB and OC represent the three electromotive forces generated in each of the coils A, B and C of Fig. 25. They are 120 degrees out of phase with each other, just as the currents are. The potential difference between any two transmission lines is the resultant of the electromotive forces generated in the two coils connecting them, as represented in Fig. 25, printed last week. There, A, B and C represent the coils, and the potential difference between mains 1 and 3 is equal to the resultant of the electromotive forces generated in coils A and B. It is, in fact, equal to the difference between the electromotive force generated in A and that generated in B when the difference in phase between the two is taken into consideration.

Let OA in Fig. 28 equal the electromotive force generated in coil A and OB that generated in coil B. The sum of the two is equal and opposite to OC, but OB — OA is the resultant of OB and OF, since OF = — OA. If the positive sign represents action in one direction the negative represents action in the opposite direction. The resultant, therefore, of OB and — OA equals that of OB and OF, or OD. It can be shown mathematically that $DO = \sqrt{3}\ OB$.

If OB = E the electromotive force generated in each coil, and E′ that between two mains, or DO, then

$$E' = E\sqrt{3}.$$

The current flowing in the mains is the same as that flowing in the coils.

CURRENT AND VOLTAGE RELATIONS IN Δ SYSTEM.

If the lines AO, OB and OC of Fig. 28 be used to represent a current of strength I flowing in each of the coils of a three-phase, three-wire delta-connected system, then in a similar manner the current in the mains will be found to be $I\sqrt{3}$. The electromotive force between the mains is the same as that across the coils.

RECEIVING CIRCUITS FOR POLYPHASE CURRENTS.

Unless otherwise stated, it is always assumed that the load on a polyphase system is balanced; that is, equal amounts of power are drawn from each circuit. The method of connecting receiving circuits for accomplishing this is practically a reverse method of that of the generating connections. In a two-phase, four-wire system containing motors at the receiving end the windings of the latter would correspond to those of the generator, each of the two phases taking its share of the load.

In a three-phase system the motors would have three separate windings and each phase would take its share of the load.

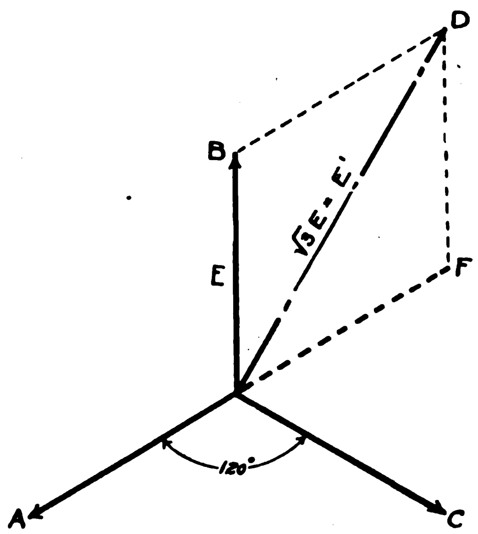


FIG. 28.—DETERMINATION OF ELECTROMOTIVE FORCE IN ONE PHASE OF Y-CONNECTED THREE-PHASE SYSTEM.

When electric lights are connected in a polyphase system they are so arranged that each phase carries the same number, thus maintaining the balance. For example, if twelve lamps are to be connected to a three-phase system, such as was illustrated in Fig. 25, four would be connected between mains 1 and 2, four between mains 2 and 3 and four between mains 3 and 1.

POWER IN POLYPHASE SYSTEMS.

The current flowing through each receiving circuit of a three-phase, Y-connected system is the same as that in the main, but the voltage is $\frac{1}{\sqrt{3}}$ of that between the mains. Representing the latter by E and the former by I, the energy delivered to one phase of the receiving circuit is $\frac{IE}{\sqrt{3}}$, and that delivered to all three phases is $\frac{3IE}{\sqrt{3}}$, or $\sqrt{3}\ IE$.

In the Δ system of connection, let the voltage between the mains, which is the same as that over the coils, be represented by E. The current flowing in the coils is $\frac{1}{\sqrt{3}}$ of that in the main, and the energy delivered to each phase of the receiving circuit is therefore the same as in the Y-connection, that is, $\frac{IE}{\sqrt{3}}$, giving a total of $IE\sqrt{3}$ for all three phases, as before. These calculations are made with the assumption that the load is not reactive, the power being factor unity. If this is not the case, then the total energy delivered is represented by

$$W = IE\sqrt{3}\cos\phi,$$

where $\cos\phi$ is the power-factor.

ECONOMY OF POLYPHASE TRANSMISSION.

Not only is there an advantage in the operation of motors from polyphase circuits as compared to the use of single-phase transmission lines, but there is also a saving in the copper necessary to transmit a given quantity of energy, as is shown by the following calculation:

The current in one coil of a delta winding of a three-phase generator is equal $\frac{1}{\sqrt{3}}$ of that of the current I in the line, as already stated. The energy absorbed in one coil equals $\frac{IE}{\sqrt{3}}$, where E equals the voltage between two lines, and the energy absorbed in all three coils equals $IE\sqrt{3}$. With the Y-connection the power delivered is the same as already stated. Let the resistance of one line be r, with a current I flowing, the loss in transmission in all three lines is $3I^2r$. Consider a single-phase system transmitting the same power and let x equal the resistance of one line; 2x is then the total resistance. The voltage being E, the current will be $\sqrt{3}\ I$, and the loss will be $6I^2x$. If the losses are the same in the single-phase and three-phase systems

$$6I^2x = 3I^2r,$$

or

$$x = \tfrac{1}{2}r;$$

that is, the resistance of one of the two wires of the single-phase system will have one-half the resistance of one of the wires of the three-phase system. It appears, then, that the total weight of copper required to transmit the same energy on a three-phase system is three-quarters of that required on a single-phase system.

[To be continued.]

Association of Car-Lighting Engineers.

Wednesday and Thursday Sessions. Election of Officers. Trip to Milwaukee.

Although its first convention, the meeting of the Association of Car-Lighting Engineers held in Chicago during the five days ending Friday, November 20, demonstrated by attendance and interest the important and useful part the association is to take in the railroad and electrical fields as the art of electric train-lighting progresses. The sessions of the convention were held in the German Room of the Grand Pacific Hotel, and a number of manufacturers occupied adjacent parlors with exhibits of a character interesting to the car-lighting engineers. The banquet in the hotel dining room on Wednesday evening proved the high-water mark in point of attendance, about 200 members, associates and guests being present.

Among the papers read and reports submitted during the first two days of the convention, as reported in full in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of last week, were the following:

Monday morning—"The History of Car Lighting," by Patrick Kennedy. "The History of Axle Lighting," by W. L. Bliss. Monday afternoon—Report of the committee on "The Care and Maintenance of Storage Batteries," by F. R. Frost, chairman. "Railway Train Lighting," written by the late A. H. Bauer in 1892. Tuesday morning—Report of the committee on "Straight Electric Lighting," by C. W. Bender, chairman. Report of the committee on "Organization and Systemization in Connection with Electrically Lighted Trains," by E. W. Jensen, chairman.

On Wednesday the association listened to the report of the committee composed of C. R. Gilman, Fred McGary and W. L. Bliss, on the subject of "Head-End Lighting of Passenger Trains."

A head-end system of electric train lighting, the paper defined as a system in which current for all the lamps in the train is derived from a comparatively large dynamo at the head end of the train. This may be, first, a steam-driven dynamo situated on the locomotive; second, a dynamo situated in the baggage car, operated by a belt from the car-truck axle; third, a steam-driven dynamo situated in the baggage car. The same general details go with each of these systems and each requires the storage battery as an auxiliary.

Taking up these systems in detail, there are:

First—Dynamo on locomotive, driven by steam turbine. There are at least two systems of this type on the market, worked out in detail and ready to demonstrate their efficiency as a means to electric-light trains. They are more or less automatic in their operation and aim to reduce the personal equation in the handling to a minimum.

Second—Large axle-driven dynamo situated in baggage car. This system is being worked out by one railroad, and its designer believes in it thoroughly. He is using a double-belt drive. Another arrangement of driving the dynamo has been worked out by a well-known car-lighting company. These systems are reducing the automatic features to a minimum, and this committee is inclined to agree with them, as past history, if observed, is not impressive as to the value of automatic devices operating in railroad service.

Third—Turbine-driven dynamo in baggage car. This system is more generally understood and is in use on quite a number of prominent railroads with fairly good results. In most cases it is being used in connection with gas or oil as an auxiliary light and has proven very economical.

A valuable feature of this report was an itemized statement of the expense incurred by a certain large railroad, operating 900 cars over 7,500 miles of track, in changing over to the head-end system of electric lighting, using turbines deriving steam from the locomotive boiler, and several large batteries in each train. The investment was summed up to be $577,139 for equipping 121 baggage cars with turbine sets and installing wiring and storage cells in other cars. This investment, while very large, the committee thought to be a fair estimate, and believed that no other system could be employed for the same amount. It has been in use for a number of years and has proven its reliability. A table submitted, showing the failures of this system on the Chicago, Milwaukee & St. Paul Railroad, operating 183 electrically-lighted cars in nineteen trains, indicated an average duration without light of only forty-one and one-half seconds per car per day.

The committee on lamps, composed of J. J. Hack, J. M. Schilling, A. J. Farrelly and Ward Barnum, had been instructed to gather information and data regarding the present lamp practice in car lighting and the latest development of incandescent lamps for this service, and to prepare a report on the comparative merits of carbon, tantalum and tungsten lamps. It was found that in the past the car-lighting lamp business was not sufficient to warrant any particular manufacturer to give the necessary attention for its development, especially inasmuch as there are now over twelve different voltages in use on the various roads, ranging from fifteen to 110 volts, and also a like variation in candlepowers.

The report submitted a number of tables showing volts, candlepower, filament, shape of bulb and useful life of a number of carbon, tantalum and tungsten lamps available for train lighting.

Tungsten lamps of low candlepowers cannot be made at present for the sixty-volt system, for the reason that the filament would be too delicate to stand the vibration of the car. However, tests on these lamps have been very satisfactory, and indications are that they may be used similarly to the carbon lamps for train lighting. Sufficient data have been obtained to show that should any fault develop it can be entirely overcome.

It was found impossible to place the tungsten support in the small G-12 bulb used in berth lighting, and to draw the neck small enough to be fitted with a candelabra base. Furthermore, lamps could not be made tipless. The snap lock of the berth receptacle is another feature that must be taken into account in considering the possibility of using tungsten as a high-efficiency berth lamp, on account of jar.

The committee of the lamp manufacturers appointed to investigate thoroughly the requirements of train-lighting lamps at about the same time the association's lamp committee was named, tendered the suggestion that it would be possible to change the voltage of the different systems now in use so as to reduce them to one or two standards, say, a range from twenty-five to thirty-two volts normal for the low-voltage standard and a range from fifty-five to sixty-two volts normal for a high-voltage standard. The next question arising would be the standard unit to be used in car lighting. Another matter is that of abolishing all special lamps excepting the berth lamp and perhaps two other types, these lamps to be used in all cases where special lamps are now used.

The lamp committee's report concluded with a number of curves furnished by the engineering department of the National Electric Lamp Association, showing comparative performances of carbon, tantalum and tungsten lamps. One of these was especially interesting and showed the saving of one twenty-four-candlepower tungsten over carbon and tantalum of equivalent candlepowers for various costs of power per kilowatt-hour.

Mr. H. C. Meloy's paper on "Illumination," tendered as the report of the committee of which he is chairman, contained the results of a number of tests of the illumination of car interiors with various kinds and arrangements of lights. The author advised the use of lighter colors for finishing the interiors of railroad cars.

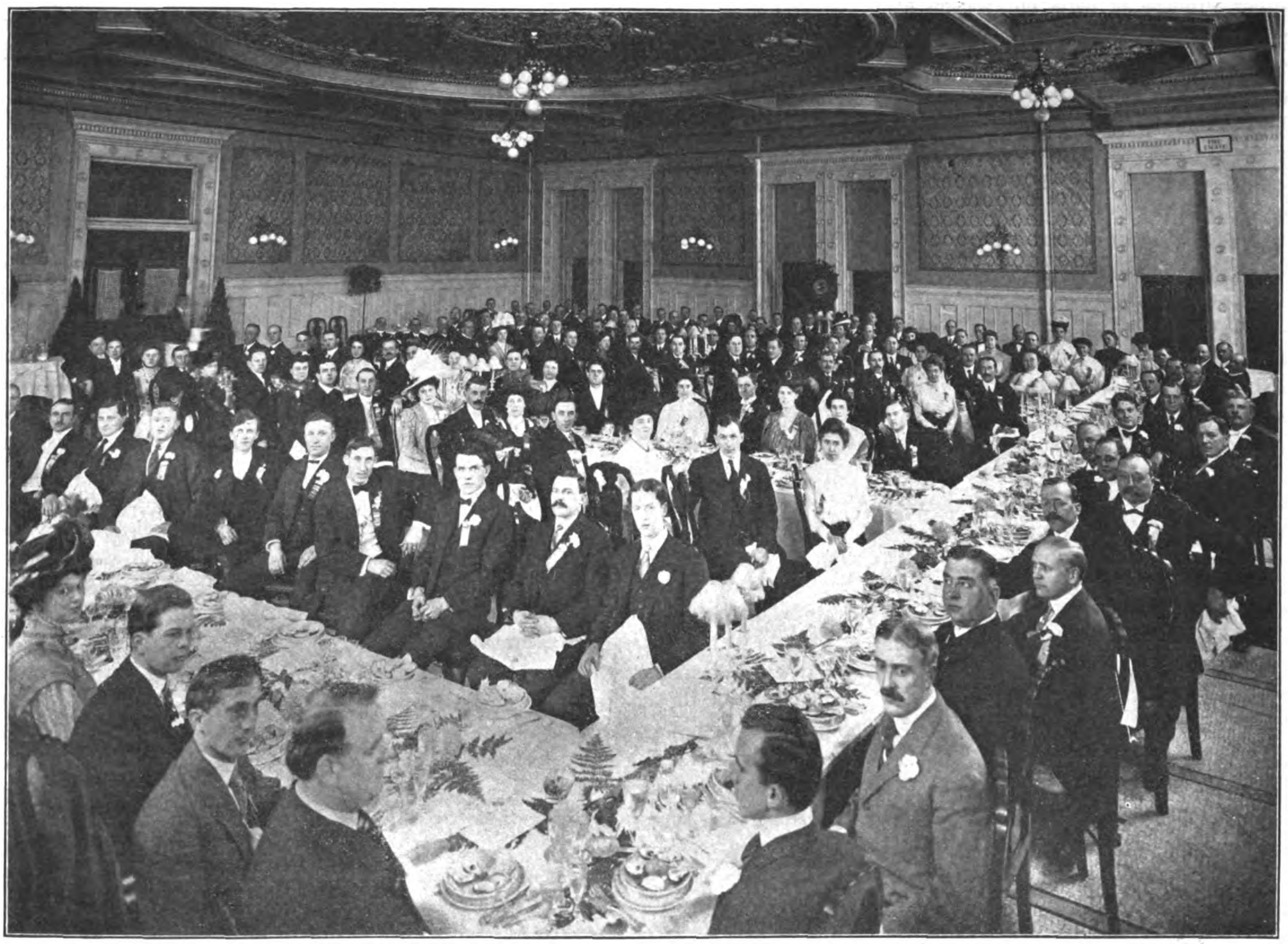
In response to the inquiries of a number of the members, W. E. Ballentine of the Rock Island Railroad recounted the experience of his company with Cooper Hewitt mercury-vapor lamps for lighting mail cars. At a cost of $5.35 per car-month for maintenance, these lamps, he said, gave an illumination 570 per cent greater than that obtained with gas. The average life of a tube in this service is 9,000 hours. The lighting system is carried out with fifty-five volts, and on account of the marginal property of the mercury-vapor tube, which prevents its operation unless a certain potential is impressed across the terminals, there is no danger of running down the storage cells to exhaustion or sulphation.

On Wednesday evening the annual banquet of the association was held in the great dining room of the Grand Pacific Hotel. Almost two hundred members, associates and guests attended and enjoyed the excellent and well-appointed service. Following the gustatory courses the banqueters listened to a number of toasts, with Godfrey H. Atkin, of the Electric Storage Battery Company, presiding at the speakers' table. Toasts were given as follows:

"Our Association," President A. J. Farrelly, Electrical Engineer, Chicago & Northwestern Railway; "Car Lighting from an Operating Standpoint," George H. Groce, Superintendent of Telegraphs, Illinois Central Railroad; "Small Beginnings," R. Quayle, Superintendent Motive Power, Chicago & Northwestern Railway; "Buyer and Seller," Colonel J. T. Dickinson, Bliss Electric Car Lighting Company.

The formal programme was interrupted by G. W. Murray, of the Southern Pacific, who, on behalf of the association, presented President Farrelly and Secretary Colegrove with handsome watch-fobs in recognition of their services to the organization.

On Thursday morning two papers remained for discussion by the convention and the executive session that had been planned was postponed until the after-



BANQUET OF ASSOCIATION OF CAR-LIGHTING ENGINEERS, GRAND PACIFIC HOTEL, CHICAGO, WEDNESDAY EVENING, NOVEMBER 18.

noon. The report of the committee on "Practicability of Electric Lighting of Steam-Railway Cars by Straight Storage Systems of Lighting," was presented by W. E. Ballentine, chairman of the committee of which C. J. Causland and R. C. Shaal were the other members.

The efficiency of the straight-storage system, say the committee, is higher than that of any of the other systems. The energy is generated with large, efficient units and is transferred to the lamps in the most efficient manner. There is neither slippage of belts nor wasted energy, as the greatest part of all the energy produced is utilized for the purpose intended. The battery is not overcharged when not necessary. In this connection we must also consider the fact that the straight-storage equipment is considerably lighter than the other equipments and does not utilize as much energy on the road. In the head-end system the energy is taken direct from the locomotive boilers to the generator, and in the axle system the energy is transmitted from the boiler to the engine, to the train, and through the belt to the axle machine.

The cost of maintenance depends largely on the simplicity and efficiency of the system. In the straight-storage system the power plant is stationary and at all times under supervision, which, naturally, will tend to make the maintenance low. The life of the power plant is much longer and the maintenance is much lower than in the other two systems where the power plant is applied to the train and carried back and forth, therefore being subject to considerable strain on account of the jarring. In the straight-storage system the battery is used to its best advantage and is subject to less abuse than with other systems. It will therefore give considerably longer life in this kind of service and will run with less attention. The battery does not receive constant overcharging and overdischarging, causing blowing out of the active material, sulphating, and buckling of plates. The battery is brought up on every charge to the normal point, and, as a rule, is not exhausted on discharge, which very frequently will happen in the other methods. The straight-storage method will work the battery in a regular routine, which naturally gives the most efficient results, and will seldom go to extremes in charging and discharging.

The principal advantage in operating a straight-storage system is the necessity of assigning cars to regular runs and of allowing a sufficient layover for the same between runs in order that the batteries may be properly charged. Ordinarily it takes from six to eight hours to charge the batteries, the time depending on the length of the previous run and also on the charging current available. The next objection to straight storage would be the time-factor, that is, the battery will give only a certain number of car-lighting hours, which makes it impossible to use this system on long through runs. Another serious objection is the impossibility of keeping a constant lamp voltage, which has tendency to greatly shorten the life of the lamps.

The straight-storage system of lighting, the committee concludes, is only practicable where the total car-lighting load, expressed in ampere-hours, does not exceed at the most seventy-five per cent of the rated capacity of the battery. In other words, this means that a factor of safety of at least twenty-five per cent must be allowed to take care of any contingency which might arise from some unknown cause.

A complete analysis of modern axle-driven generating systems was presented by Chester Terry, chairman of the committee on "Axle-Lighting." He described several well-known systems of axle lighting, giving a brief description of the methods of regulation and the distinctive features of the various devices as follows:

"The United States equipment has a shunt-wound generator with one and one-half kilowatts capacity at fifty or sixty volts. The generator regulation is accomplished by varying the pressure on a pile of carbon discs in the field circuit by means of a solenoid which carries the generator current.

"The Newbold device consists of a shunt-wound generator of 2.4 kilowatts capacity at thirty or sixty volts, and a regulator having a field rheostat which is operated by the pull of a solenoid core opposed by an adjustable weight, the action being for any increase in generator current to pull in more resistance in the field rheostat. The solenoid has two windings; one carrying the machine current and the other, which is wound in opposition to the first, carrying the lamp current, so that when the lamps are turned on, the generator output is increased in proportion to the lamp load.

"The Bliss Type F equipment consists of a shunt-wound generator of three kilowatts capacity at thirty or sixty volts, and a regulator which has two permanent resistances in multiple with each other, and in series with the field winding. Each one of these resistances is short-circuited by a carbon-pencil contact. The lower carbons are mounted on solenoid cores. The main winding of the solenoids carries the generator current and the second windings the lamp current. The solenoids thus control the pressure on the carbon-pencil contact and vary the degree of short-circuiting of the permanent resistances in the field circuit; the action being to maintain a constant generator current with an increase when the lamps are turned on. A permanent resistance being cut in series with the lamps when the generator starts to operate.

"The regulation in the Bliss bucker is accomplished by inserting counter-electromotive forces in the field circuit of the generator and in the lamp circuit. The bucker consists of a motor connected across the generator mains and mounted on the same shaft with the bucker proper. This is composed of an armature having two separate windings and two commutators, and is excited by a series field which carries the battery-charging current. The speed of the bucker is practically constant under a load, so that the counter-electromotive force in the field circuit and in the lamp circuit are very nearly proportional to the battery-charging current. It will thus be seen that the principle is to maintain a constant battery-charging current at all times in addition to supplying the lamp load direct from the generator. The current regulation effected is fairly close, but varies considerably for different train speeds, owing to the fact that successive increases in battery-charging current are necessary to cause corresponding increases in the counter-electromotive force in the field circuit. As the counter-electromotive force in the lamp circuit is proportional to the battery-charging current and is not dependent directly on the actual battery voltage, it is evident that variations of battery voltage during charge and from other causes previously mentioned will cause a considerable variation in lamp voltage.

"The Consolidated Type D equipment consists of a three-kilowatt generator at thirty or sixty volts, and the regulation is accomplished by a rheostat in the field circuit which is automatically operated to maintain a constant current with an increase proportional to the lamp load. The current regulation accomplished is very close and is constant for all train speeds. The lamp regulation is maintained with a variation of one to one-and-one-half volts, by means of an automatically operated rheostat in the lamp circuit. A high-resistance electromagnet is connected across the lamp circuit and operates by means of a small motor and suitable mechanical devices to cut in or out resistance in the lamp circuit on a very small voltage variation. This means of regulation is positive and maintains the lamps at normal voltage regardless of any change of conditions in other parts of the system. The only deficiency in this regulation is that its action is not instantaneous. When a considerable number of lamps are turned on or off a few seconds are required for the rheostat to readjust itself.

"An improvement on this regulator has recently been brought out which acts on the principle of a recording ampere-hour meter, and records the charge and discharge of the battery on a paper roll, giving a complete record of the performance of the apparatus as well as indicating the number of hours' charge in the battery at any time. It charges the battery at its normal rate until about twenty-five per cent overcharged, and then automatically cuts out the generator or cuts it down to a very small current, as desired. As soon as the lamps are burned for half an hour the generator is again cut into service. When there is but an hour's charge at the normal rate left in the battery, all lights except an emergency circuit are cut out, and when one and eight-tenths volts per cell is reached the lights are all cut out. The battery is thus charged at its normal rate and is protected from overcharge and overdischarge, which is certain to add materially to its life. No change of adjustment of the generator current is necessary when a car is transferred from a nearly all-daylight run to an all-night run, as the different conditions resulting are taken care of automatically."

An executive session, attended only by active members, was held on Thursday afternoon for the election of officers and the transaction of other business. The former officers and committees were reelected in nearly every case. The present list of the officers and the executive committee stands as follows:

President, A. J. Farrelly, Chicago & Northwestern Railway; vice-presidents, A. J. Collett, Union Pacific Railway, C. W. Bender, Pennsylvania Railroad; Secretary and Treasurer, G. B. Colegrove, Illinois Central Railroad.

Executive Committee—H. C. Meloy, Lake Shore & Michigan Southern Railway; A. C. Terry, "Soo Line; G. W. Murray, Southern Pacific Railway; O. W. Ott, O. S. L.; D. J. Cartwright, Lehigh Valley Railroad; C. R. Gilman, Chicago, Milwaukee & St. Paul Railroad.

A smoker on Thursday evening practically closed the convention, although a number of the members stayed over to visit Milwaukee on Friday, inspecting the factories of the Bliss Car Lighting Company, the Cutler-Hammer Manufacturing Company and the Allis-Chalmers Company, and the shops of the Chicago, Milwaukee & St. Paul Railroad.

The second annual convention of the Association of Car-Lighting Engineers will be held at Chicago, Ill., October 5 to 8, 1909.

Among the railroads represented at the convention were:

Illinois Central, G. B. Colegrove, E. W. Jansen, J. C. McElru, G. M. Crownover, F. G. Colwell, J. M. Barrowdale, A. L. Chapin, G. H. Groce, M. J. Clark; Chicago & Northwestern, A. J. Farrelly, W. S. Berry; "Frisco" System, R. N. Massey, C. A. Pinyerd; Southern Pacific, G. W. Murray; Lehigh Valley, D. J. Cartwright; Big Four, J. E. Gunnesse; B. O. & S. W., C. H. Charlton; L. S. & M. S., J. P. Puette, M. E. Seymour, H. C. Meloy, E. A. Humphrey; Missouri Pacific, R. W. Bowler; Pennsylvania, C. W. Bender, O. H. Davis, J. Cosland, C. Canstad; L. & N., J. R. Smith, S. Y. Culley; Union Pacific, A. J. Collett; "Alton," C. L. Abrams, J. F. Bigelow, C. W. Eisenmann; "Santa Fe," S. W. Everett, F. R. Frost; C., M. & St. P., C. R. Gilman, W. O. Davies, H. J. Frank, E. Hiscox; "Soo" Line, Chester Terry; New York Central, A. McGary; Burlington, Fred McGary, H. A. Gardner; Wabash, W. A. Hopkins; B. & O., J. D. Brown; Rock Island, W. E. Ballentine, G. H. Scott, F. E. Hutchinson; Northern Pacific, W. J. Bohan; Canadian Pacific, J. A. Shaw; C. & E. I., J. H. Burcham; New Jersey, M. C. Kershaw; Pullman Company, N. E. Lemmore; and other Members, W. R. Hungerford, Chicago; Dr. C. W. Gould; C. M. Perkins, Chicago; A. H. Darker, London, England.

The following manufacturers and supply companies maintained exhibits in the hotel parlors or had representatives on hand during the convention:

Westinghouse Machine Company, D. C. Arlington, S. B. Dusinberre, Edgar Lewis, L. L. Johnson; Storage Battery Lighting Company, E. H. Clare, Fred W. Hulme; Consolidated Railway Electric Lighting and Equipment Company, P. Kennedy, L. J. Kennedy, Thomas L. Mount, R. C. Haley, B. E. Erickson, C. A. Lathan, A. O. Jackson; Central Electric Company, J. M. Lorenz, J. E. Ham, H. W. Young, F. R. Bryant, Allen S. Pearl; Willard Storage Battery Company, T. Willard, W. D. Callinan, W. C. Egert; General Storage Battery Company, John L. Jones, S. D. Dixon; Gould Storage Battery Company, Dr. C. W. Gould, William A. Farbayne, J. Eisenwest, George C. Milne, M. R. Shedd, George R. Berger; Electric Storage Battery Company, E. H. Atkin, F. T. Rinder, H. E. Huet, I. B. Entz, H. B. Marshall; Bliss Electric Car Lighting Company, W. L. Bliss, J. T. Dickinson, N. T. Sherman, Louis A. Mann, Edwin Tover, Jr.; Holophane Company, V. R. Lansingh; A. & J. M. Anderson Manufacturing Company, William W. Hincher; Buckeye Electric Company, L. P. Sawyer; National Electric Lamp Association, S. E. Doane, W. F. Bauer, E. D. Strickland, J. R. Crowe, H. S. Hall, R. B. Clark; General Electric Company, F. W. Wilcox, J. Scribner, Henry Schroeder, G. C. Osborn; Western Electric Company, J. H. Delaney; International Electric Meter Company, Julian S. Jackson, W. W. Cheney; Bryan-Marsh Company, J. S. Corby, James B. Darragh; American Distributing Company, P. W. Hood; Columbia Incandescent Lamp Company, J. G. Boyd, C. D. Oldham, A. C. Garrison; Westinghouse Lamp Company, B. F. Fisher, Jr., J. M. Schilling; New York & Ohio Company, William R. Collins; Sunbeam Incandescent Lamp Company, T. J. Rider, Jr.

Wireless Telephone Litigation.

The Radio-Telephone Company of New York, N. Y., which operates the De Forest system of wireless telephony, has filed a bill in the United States Circuit Court, at Trenton, N. J., asking for an injunction restraining the Collins Wireless Telephone Company, of Newark, N. J., from infringing on patent rights granted to John Stone Stone, of Cambridge, Mass., for wireless telephones known technically as "space telephones." The Radio-Telephone Company also asks for an accounting. The De Forest company is operating under the patents granted to John Stone Stone, and these patents, it is asserted, cover the entire field of wireless telephony.

Armour Institute Branch, American Institute of Electrical Engineers.

A very interesting paper on the selection of a railway motor equipment was presented before this branch at a recent meeting by G. I. Stadeker. His method of attacking the problem, although simple, may be interesting to many not directly concerned in this class of work.

Having given certain requirements to meet, such as the weight of equipment, rate of acceleration, and schedule, a number of kinds of motors in use on similar installations may be considered in a preliminary determination of the required motor equipment. The tractive effort is calculated for full load at several gear ratios for each one. If any of these values correspond to the tractive effort necessary to produce the required acceleration these motors may be further considered, and speed-time curves, current-time curves and distance-time curves plotted for several gear ratios for each one, and from these the energy required to make the typical run, and the time of run with each gear ratio is determined. Watt-hours per run and time of run are then plotted against gear ratios. The proper gear ratio is that one which will make the run in the fastest time with the least power input. This should be determined for each motor under consideration and the energy required and time of run compared with similar determinations for other motors. The final choice of motor equipment is the result of this comparison. Having determined the gear ratio with any motor, before proceeding in comparison with other motors, it must be ascertained that the heating will not be excessive. The continuous rating or the service capacity curves furnished by some of the leading motor manufacturers make this possible.

A new system of plotting speed-time curves was described. The formula used in determining the time it will take a train to change its speed from any speed S to any other speed $S + \Delta V = S'$ is

$$t = \frac{M \Delta V}{.01098 A}$$

in which

M = mass in tons,

V = increment by which speed changes,

A = average tractive effort during change of speed,

t = time to change from S to S'.

Substituting a range of values of A, keeping ΔV constant, t is calculated, and the values so obtained plotted against A. Referring to the speed and tractive-effort characteristic of the motor under consideration, the average tractive effort exerted while the train increases its speed from S to S' can be obtained, and the time to complete this change obtained directly from the curve. This method has the advantage of simplicity of application, accuracy and elimination of error in calculation.

Ithaca Section, American Institute of Electrical Engineers.

The first meeting of the Ithaca section of the American Institute of Electrical Engineers for the college year was held October 30. The programme comprised an original paper by J. G. Pertsch on the general subject of "Alternating-current Line Losses." Mr. Pertsch gave a summary of the investigations which have led up to Ralph D. Mershon's latest work, with especial reference to the researches conducted locally by Professor Ryan. An abstract of Mr. Mershon's Atlantic City convention paper was delivered by W. K. Page. This was illustrated by lantern slides made for the occasion. The speaker brought out the essential features of the paper and led up to a very interesting discussion by the members present.

This meeting was the first held in accordance with the plan laid out by the local programme committee for the year. The plan is briefly as follows:

Alternate meetings will be occupied with discussions of the New York and other Institute papers and with addresses by prominent local and out-of-town engineers. One subcommittee, under the direction of Prof. F. Bedell, who is also chairman of the entire programme committee, invites and entertains speakers from outside. The other subcommittee known as the discussion committee, under the direction of L. F. Blume, arranges for the abstracts and discussions. In order that this committee may be familiar with the practical experience of the local members, a canvass of the entire junior and senior classes, comprising nearly six hundred men, has been made. Each student has been asked to write down on a printed form every detail of his practical experience. Then in preparing for a given discussion the committee goes over this record, picking out the names of men who have had experience along the line of the paper under discussion. This feature has already proved of the greatest value and was not very difficult to effect.

The discussion committee intends occasionally to try an original experiment by having different local members impersonate the engineers who have discussed the papers at the main Institute meeting. Each will endeavor to obtain the point of view of the speaker, and will be called upon by the name of the engineer whom he impersonates. Two objects will be gained by this procedure. First, the spirit of the New York discussion will be repeated, and second, the students will become familiar with the points of view of successful engineers.

At the present time there are three members and twelve associates connected with the Ithaca section. The secretary has signed the enrollment blanks for 138 students. Altogether the work starts out with good promise of success, largely increased enrollment and excellent interest.

Sidewalk Lighting of Underground Engine Rooms.

The development of the show engine room, with its enameled brick walls, artificial lighting and attractively arranged power units, has awakened a natural interest in the improvement of conditions which have hitherto been considered hopeless. Whitewash and daylight will work marvels in any place. In city plants in particular it is all too often considered that lighting without artificial means is an impossibility. But as a rule such engine rooms are more or less accessible to the transmission of daylight if proper arrangements are provided. The refracting prism has in many cases solved the difficulty by throwing the light far into hitherto dark and dirty corners. So, also, has the sidewalk-vault light, with its numerous lenses.

The effect of such methods is well shown by an illustration of an engine room situated beneath the sidewalk which recently appeared in *Power and the Engineer*. The room is not only lighted—it is fairly brilliant. The sidewalk construction, which was the work of the Aberthaw Construction Company, of Boston, Mass., consists of a series of circular lenses embedded in Portland cement. In form the lens is flat on top, the under side being cupped to refract the light, and the circumference ribbed to insure a joint with the cement. Twisted reinforcing rods are run between the lenses to give stability to the entire structure. This design provides the most essential features in such a sidewalk—namely, the opportunity to prevent leakage. But years of trial have shown that good workmanship, born of experience, is just as essential as the design in securing a result that is waterproof.

CHICAGO ELECTRICAL SHOW.

FOURTH ANNUAL EXHIBITION, AT THE COLISEUM, JANUARY 16 TO JANUARY 30. THE PROMISING OUTLOOK.

The outlook for Chicago's Fourth Annual Electrical Show, which is announced to open in the Coliseum, Saturday afternoon, January 16, and run until Saturday night, January 30, is the most gratifying in the history of these great trade expositions in America. With the show still two months away, more than seventy-five per cent of the space is sold and the list of exhibitors includes many of the leading electrical concerns of the United States and Canada. Much of the remaining space is tentatively disposed of, and there is every reason to believe that everything available will be under contract before December 15.

Chicago's electrical shows have already made their record. In the face of the so-called financial panic of a year ago the show was arranged and carried through to a point of success far beyond the anticipations of the directors, and the exhibitors as a whole declared the show to be greater in general results than any of the preceding expositions of the kind. This was also in the face of the fact that the directors had the courage to carry out a decorative scheme for the Coliseum, which cost in the vicinity of $25,000. The same idea of decorative arrangement will be employed this year.

While this year's show will be representative of every branch of the electrical field, efforts are being made to make the show still more comprehensive and representative as a whole, particularly along the lines of motor-driven working exhibits. Telephone apparatus and devices will be a leading feature, the telephone interests having contracted for considerable space. In the meantime it is hoped that everything new in the electrical world will be on view and that the show will not only be a trade booster but will be of educational value to the general public. Considering the fact that the Electrical Show represents a field which rolled up a volume of business in the United States amounting to $200,000,000 last year, the importance of the exposition may be estimated. Without an exception the exhibitors of a year ago, notwithstanding the business depression of that period, reported sales that more than paid for the time, money and material that they put in the show.

Among the companies that have already contracted for space are the following: Crane Company, Commonwealth Edison Company, Wagner Electric Manufacturing Company, Federal Electric Company, Cutler-Hammer Manufacturing Company, Pyro One-Light Sign Company, ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, McDowell-Stocker & Company, Shelton Electric Company, Lindstrom-Smith Company, Western Insulation Company, Murphy Electricity Rectifier Company, National Battery Company, Perfection Vacuum Cleaner Company, Chicago Fuse Wire and Manufacturing Company, Electric Appliance Company, the Excello Arc Lamp Company, Kellogg Switchboard and Supply Company, the Stoltz Electrophone Company, Stromberg-Carlson Telephone Manufacturing Company, Mathias Klein & Sons, Telephony Publishing Company, Manhattan Electrical Supply Company, Fort Wayne Electric Works, *Electrical World*, Benjamin Electric Manufacturing Company, *Electrical Record*, Central Electric Company, International Correspondence Schools, *Popular Mechanics*, McRoy Clay Works, National Electric Lamp Association, Chicago Pneumatic Tool Company, Electrocraft Publishing Company, Robbins & Meyers, Appleton Electric Company, United Pump and Power Company, *Popular Electricity*, Chicago Telephone Company, Swedish-American Telephone Company, Westinghouse Companies, Swedish Vibrator Company, Western Electric Company, Electrical Testing Laboratories, *Electric City*, General Electric Company, North Shore Company, Pacific Electric Heating Company, Electric Storage Battery Company.

Homer E. Niesz, under whose management the last two shows have been great successes, looked after the preliminary work of this year's show, but under the orders of his physicians he has been forced to temporarily abandon work. He returned from the New York show last month, was immediately taken ill and remained in bed three weeks. He is now recuperating at Hot Springs, Ark. In the meantime his work as the head of the show has been taken up by John C. Schayer, who is well and properly known in the electrical field. Mr. Schayer will direct the preparations for the coming show until the return of Mr. Niesz.

Block Signals for Indiana Railroads.

The first railroad convention to be held under the requirements of the Indiana law assembled in the State House at Indianapolis on November 10. A hundred or more delegates, representing the superintendents, operating managers and employes of steam railroads operating in Indiana, were present and took an active part in the proceedings. Union B. Hunt, chairman of the Indiana Railroad Commission, in calling the meeting to order, stated that the object of calling the railroad men together was to make a thorough study of railroad accidents and their causes, and to adopt methods to diminish the number of such accidents. The commission would recommend to the incoming legislature that laws be passed prohibiting the construction of any more grade crossings, and that the expense of separating grade at highway crossings and track elevation may be divided equitably. There are 10,000 unprotected highway crossings in Indiana on which about 100 persons are killed annually.

The commission called the railroad men's attention to a section of the transportation law passed by the last legislature, which provides that after July 1, 1909, the railroads in Indiana must be equipped with and have in operation an approved block system for the control of trains. The commission urged immediate preparation for carrying out this work, but it was stated that an extension of time would be granted where it was shown that an honest endeavor was being made to comply with the law. The commissioners stated that the law does not apply to electric roads, but they would recommend that the incoming legislature so amend the law as to require similar action upon the part of the electric roads.

New Subway Plan for New York City.

Joseph Caccavajo, an engineer, has submitted to the Public Service Commission his plan for the building of new subways in New York city. The matter was referred to the Committee of the Whole.

The plan, in brief, is that the owners of property along the line of the proposed subway shall form a company, each property owner taking shares in the company to an extent commensurate with his land holdings. It is estimated that a comparatively small sum would have to be subscribed for each lot owned, and that there would be raised by this means a sufficient amount to build and equip a subway system. It would be necessary to amend the law to permit the adoption of Mr. Caccavajo's plan.

The Fore River Ship Building Company's Yard.

The shipyard of the Fore River Ship Building Company, at Quincy, near Boston, Mass., although opened only a few years ago, has already become one of the most important plants on the Atlantic Coast for the construction of large ships, and it would be difficult to find one equipped more completely and embodying more of everything that is latest and best in engineering practice. Less than eight years old, it has already contributed notable additions to the navy of the United States.

Practically every part of a battleship, that most complicated mass of machinery, is constructed within the seventy-eight-acre enclosure. The Fore River shipyard is not the result of slow development. It has arisen almost full-fledged without the usual early stages of experiment and trial. Only the steel and the gray iron castings are brought into the yard in a semi-finished state. Even the electric equipment of the warships is now being manufactured upon the ground; and the engines, both reciprocating and turbine, are built and finished in the shops.

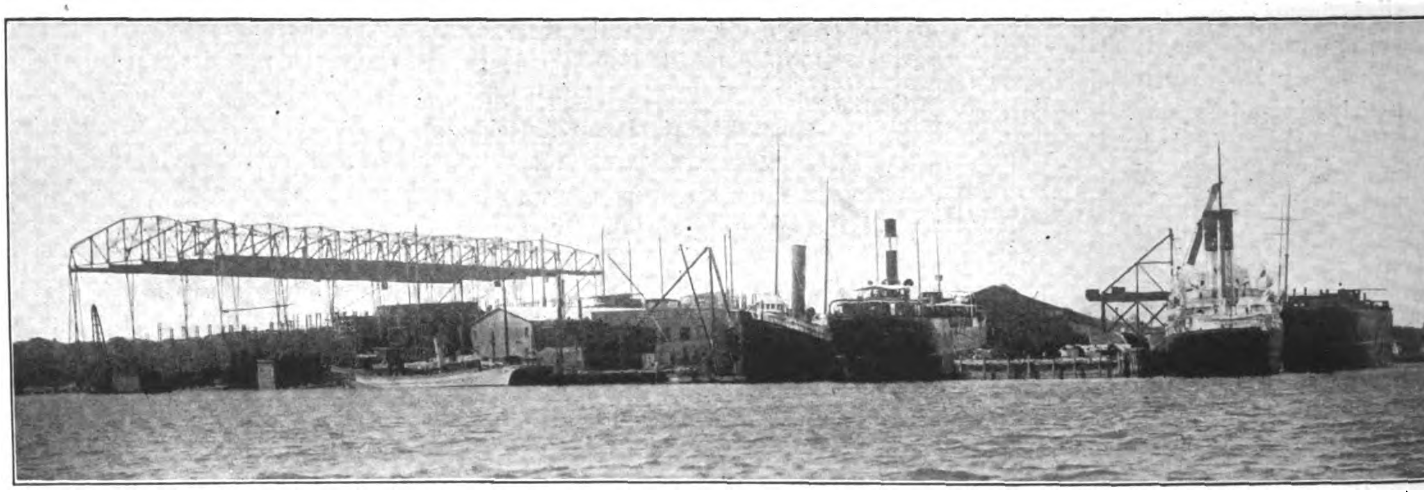
The plant is situated upon ground lying along the Weymouth Fore River, really an arm of Boston harbor and only ten miles from the city. The ground has a frontage of one and three-quarter miles. There are fifteen large buildings and a number of smaller ones, furnishing a floor area of nearly twelve acres. Some idea of the magnitude of the works may be gained from the statement that the normal number of men at work is something over 4,000, and that every conceivable labor-saving device is employed. There are about 275 electric motors for driving machine tools, cranes, etc., besides pneumatic ship tools, steam hammers and hydraulic presses.

The most conspicuous structure on the premises is the "ship house," which is merely a huge steel framework for carrying the great cranes, commanding every spot of the area enclosed and having a clear lift of about 100 feet, sufficient to carry material to any part of large vessels lying on the stocks within. This skeleton building is 490 feet long by 325 feet wide and is divided longitudinally into four bays, each equipped with a crane of nearly eighty-foot span. The spreading girders are not intended to support a roof; the form merely exemplifies an economical disposition of material for carrying the cranes.

Adjoining the ship house is the ship tool house, which is a large building containing practically every known arrangement for shearing, punching and forming plates and shapes into sections of a ship's frame or skin. The tools in this building are admirably arranged for convenience in handling plates of awkward sizes and shapes. The floor surrounding each punch and shear is as free from obstructions as possible, even all motors and wires being kept out of sight, and every large tool being surmounted by a swinging crane, so that the men have free access to the work in hand and are free to guide it in any direction.

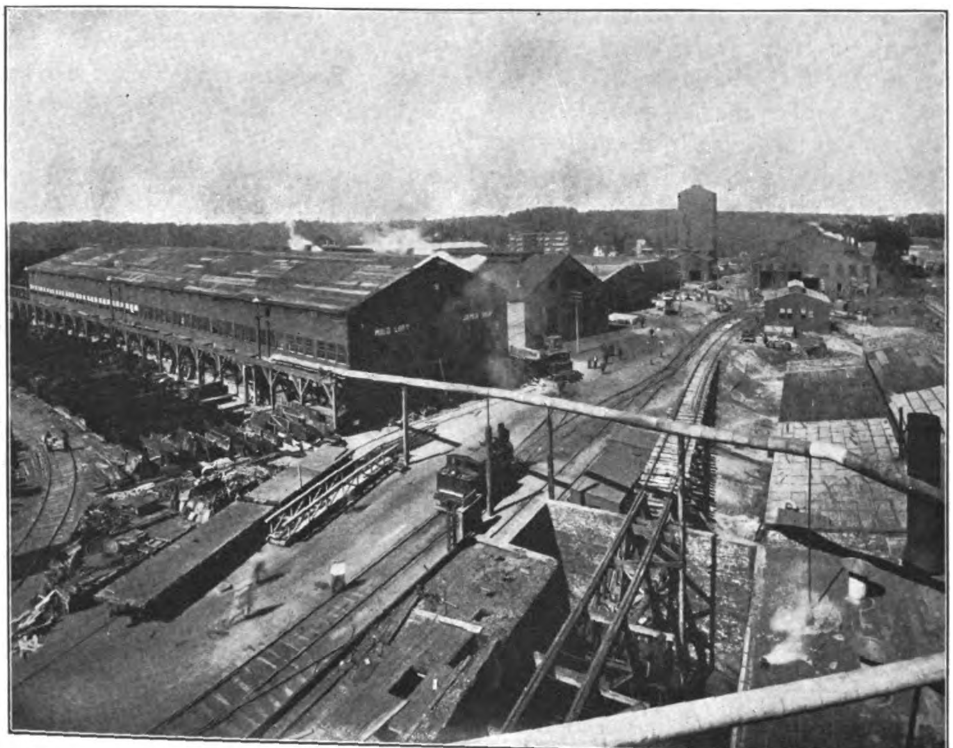
The main machine shop is remarkable for the number of tools of gigantic proportions which it contains. There are huge lathes for turning the crankshafts of the largest battleships, immense boring mills with revolving platforms flush with the floor, great planers large enough to monopolize the entire floor space of an ordinary custom machine shop, and in the side bays smaller tools of all sizes and for all purposes. In one end of the building the great engines of battleships are set up and fitted, later to be taken down and installed in the hulls of the steamers which they are to drive. A portion of the store building is fitted up for the manufacture of electric equipment for the vessels under construction. The pattern shop contains a full equipment of the usual woodworking machinery, the upper floor of the building serving as the mold loft, where the ships' plates are plotted and outlined.

A new blacksmith shop has been added to the plant. It contains some forty fires and a full equipment of hammers. The forge building is the third largest in the United States. Propeller shafts and parts of guns are forced under steam hammers. The annealing plant adjoins the forge. It contains oil-burning heating furnaces and vertical cylindrical annealing tanks for oil baths. There is a saw mill equipped with a large band saw for cutting the timber used in ships, also a brass foundry for casting brass valves and other bronze and brass parts.



VIEW FROM WATER FRONT OF THE FORE RIVER SHIP BUILDING COMPANY'S YARD, QUINCY, MASS.

The power house is centrally located and is a building 162 feet long by 65 feet wide. There are ten 6 by 16 feet return tubular boilers set in brick and operated at 125 pounds pressure. The boilers are fired by hand, and there are no high chimneys, the Sturtevant system of induced draft being employed. This draft apparatus is, with the exception of the main engines and air compressors, the only steam-driven machinery in the entire yard. For driving the machinery of the plant there is one 350-kilowatt generator driven by a horizontal steam turbine; one 300-kilowatt generator direct-connected to a compound condensing engine; and one 200-kilowatt generator also driven by an engine. For operating pneumatic hammers, drills, calkers, etc., used in ship work, there are two compressors, one having a capacity of 5,000 cubic feet per minute and the other delivering 1,000 cubic feet, both being operated by cross-compound engines. All the apparatus of the power house is of very simple construction, only one kind of current being generated for all classes of service—direct current at 240 volts. Current is generated for about 275 motors, varying in size from one-fourth to 100 horsepower, the major portion being supplied by the Allis-Chalmers Company, and also for about 4,000 incandescent lamps and 350 arc lamps.



THE YARD RAILWAY, MOLD LOFT AND BASIN, FORE RIVER SHOP BUILDING COMPANY, QUINCY, MASS.

VIEW IN SHOP OF FORE RIVER SHIP BUILDING COMPANY, QUINCY, MASS.

About seventy-five per cent of the motors are direct-coupled to the tools which they drive. Some of the remainder are belted, and in one or two cases counter-belted to obtain a high speed, this practice being almost entirely confined to woodworking tools requiring a different method of power application. There are a number of special motor-driven tools designed to facilitate ship-building operations. One of these is a counter-sinking machine, consisting of a motor geared to a drill stock which holds the tool, the whole being mounted on a hand barrow, so that the entire apparatus can be rolled over a plate placed in a horizontal position and the tool brought to its work by merely pressing down in the proper positions. While the aggregate load of all the motors in the yard is not far from 3,800 horsepower, the average load upon the generators is only about 2,400 amperes for both power and lighting, or about 800 horsepower. The load varies according to the number of tools actually in operation or in idleness, but the figures here given are a fair illustration of the economy of the system of power distribution and subdivision employed in the yard.

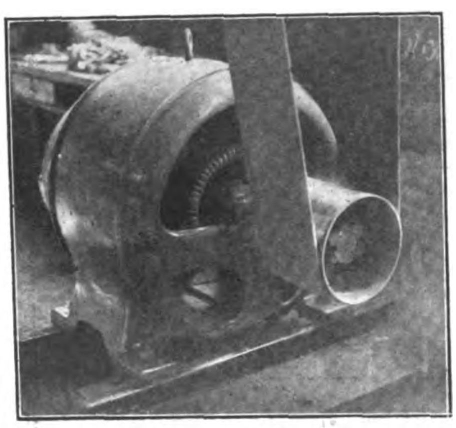
One of the most interesting features of the electric equipment of this shipyard is the system for speed variations. This is the Ward Leonard multiple-voltage system. The generator is operated on the two-wire plan, supplying the highest voltage, 240 volts, and on this voltage are operated all the constant speed motors, the crane motors and the lighting system of the yard. For variations of speed this voltage is divided into three by means of a balancer set located in the engine room and consisting of three similar machines mounted upon a common base. This enables pressures of sixty, eighty and 110 volts to be carried between the various pairs of the four wires. By proper combinations a number of pressures may be obtained, and, with the aid of a small range of shunt field regulation, a large range of motor speeds, the highest of which is six and one-half times the lowest, may be secured.

The current is distributed to the various buildings by means of about 1,000 feet of subway and nearly a mile of pole line. The average center of distribution in each building is about 500 feet from the power-house switchboard, and each shop has its own set of mains coming up through the floor to a distributing board and the feeders are led in various directions to the individual tools. The distributing center of the ship tool shop is placed in a gallery above the main floor, where the control apparatus of the various heavy tools is also located. One attendant standing in a position whence he can see the operations going on in any part of the shop controls all the ma-travel. There is an eight-horsepower parts, such as controllers and regulators, from the machines, where in this particular shop they would be especially liable to injury, to a place of safety. In this shop all circuits are run under the floor and brought to the machines through steel conduits, and there are no exposed wires anywhere in the neighborhood of the machines. In the subway the circuits are run in rubber-covered cables, manufactured by the Standard Underground Cable Company. These are simply fastened to wooden strips, which give sufficient insulation with the low voltage used and the dry atmosphere of the subway. At the center of distribution in the buildings the line is brought up in enameled "electro-duct" tubing, and there the main fuses and switches of the machines are placed.

To the casual visitor in the Fore River shipyard no one feature is more interesting than the great variety and number of electric traveling cranes used to facilitate the handling of material. The great crane which reaches every portion of the plate yard adjoining the steel tool shop is the largest of its kind in the world. It has a span of 175 feet and travels over 1,000 feet of track. The long driving axle is operated by a motor placed in the center of the span, and the lift has a capacity of about five tons. For placing equipment in ships already afloat there are six or more large cantilever cranes and one big folding jib gantry crane, which travels the entire length of the 1,000-foot fitting-out pier. This structure, which is conspicuous in all views of the yard, has no less than seven Allis-Chalmers electric motors. There are three hoist motors: One twenty-five-ton, another seventy-five ton, and one for the ten-ton falls at the end of the boom. The remaining motors are employed, one for crane travel, two for trolley travel and one for hoisting the boom.

In the large machine shop there are three great cranes, two of twenty-five-ton and one of fifty-ton capacity and about eighty-foot span and 520-foot travel. In the ship house are four, having a runway the entire length of the structure, that are capable of lifting a five-ton weight 100 feet vertically and depositing it at any point within the four sections. In the forge and annealing plants one seventy-five-ton and one twenty-five-ton cranes handle the immense ingots, crankshafts and gun parts with ease. Every shop has some form of overhead lifting apparatus wherever there is an opportunity to save time and muscular energy. In fact, the yard is the best possible field for the student interested in the evolution of the workingman from a mere source of energy to the active intelligence which directs and controls the energy developed by machines. It is difficult to find in the entire plant an example of "labor" in the old sense of the word, the mere play of human muscles.

All the large machine tools in which a variation of speed would be desirable are operated by Allis-Chalmers motors on the four-wire multiple-voltage system. In the main machine shop there is one of thirty



TYPE OF ALLIS-CHALMERS MOTOR USED BY FORE RIVER SHIP BUILDING COMPANY.

horsepower mounted upon a 120-inch Niles-Bement-Pond lathe of 108-inch swing; one of twelve and one-half horsepower upon a seventy-two-inch lathe of the same make; four of eighteen horsepower operating sixty-inch Fitchburg lathes; two of twenty-four horsepower driving forty-eight-inch Fitchburg roughing lathes; and four of eight horsepower operating one fifty-inch, two forty-eight-inch and one thirty-six-inch lathe, all of Fitchburg make. In the same shop one fifty-horsepower motor drives a sixteen-foot Niles-Bement-Pond boring mill; one of twenty-four horsepower is on a 120-inch boring mill of the same make; one of fifteen horsepower on a seventy-two-inch Pond boring mill; one of twelve horsepower on a sixty-inch Niles boring mill; one of nine horsepower drives a fifty-inch Niles boring mill, and one of twenty-five horsepower operates a ten-foot boring mill. There are two of four horsepower each on radial drills and two of forty-five horsepower on crank-turning lathes—an interesting machine on which the great cranks used in large ships are braced against distortion by gravity and the cutting-tool travel. There is an eight-horsepower motor for a multiple spindle drill and another of the same capacity for driving an eighteen-inch Niles slotter. A second Niles slotter, twenty-five inches, is driven by an eighteen-horsepower motor and a similar motor drives a Niles milling machine. A Newton cold saw is driven by an eight-horsepower motor. This shop contains a multiplicity of other tools and motors. Those here enumerated comprise only those operated on the four-wire multiple-voltage system.

In the ship tool shop the following machines and motors are operated on the same system: One twenty-four horsepower driving an angle beveling machine; two of four horsepower, each on double-ended shapers; and one of one-and-one-half horsepower to operate a testing machine for bending and breaking strains. In the storehouse is a four-horsepower motor for operating a Newton cold saw. In the electric machine shop two motors of four horsepower drive a sixteen-inch lathe and an American turret lathe, respectively. There is one of three horsepower to drive a thirty-inch drill press; one of one-half horsepower on another drill press, and a second motor of one-half horsepower for operating a coil-winding machine designed on the premises.

Boston Elevated to Increase Capital Stock.

At a special meeting of the Boston Elevated Railway Company it was voted to authorize directors to issue $6,650,000 capital stock at $110 per share to construct and equip the proposed Cambridge subway.

Before passing this vote, however, stockholders had previously authorized the rescinding of the vote of April 13, 1907, which authorized the issuance of $8,000,000 capital stock at a price to be determined by the railroad commissioners.

The $6,650,000 new stock will bring the total stock authorized up to $19,950,000.

The company has petitioned the railroad commission for its approval of the proposed increase.

The issuance of $6,650,000 of new capital stock will give Boston Elevated stockholders the right to subscribe for one new share for each two shares now owned.

Resolutions on the Death of Charles E. Trump.

At a special meeting of the Electrical Trades Association of Philadelphia, Pa., resolutions were adopted on the sudden death of Charles E. Trump, ex-president of the association, which occurred when he reached home shortly after attending the annual meeting of the organization, which was held at the Manufacturers' Club on the evening of November 5. The resolutions were accompanied by a letter from the retiring president, Charles M. Wilkins, addressed to C. Norman Trump, the deceased's son. Mr. Wilkins' letter was as follows:

The sudden death of your beloved father is a great shock to his friends in the Electrical Trades Association, of which he was a member and officer since the organization now more than thirteen years ago. The fact that he attended the annual meeting last evening, when he greeted his friends with cordiality, and his bright and cheerful spirit was so noticeable, makes it difficult for us to realize that he has been called away.

The members of the executive committee of the association have requested me, in their behalf, to convey to you and the members of his family their heartfelt sympathy in this hour of affliction. Your father was a man whom to know was to love, and his loss will be keenly felt by the members of the association and the electrical trade in general. As president for twelve years he endeared himself to his associates for the sterling qualities of his character; in all questions involving its welfare his judgment was sound, and if he erred at all it was in leaning toward the charitable side to the end that injustice should be done to no man.

A copy of a minute adopted by the executive committee, which will be suitably engrossed and sent later, is enclosed herewith, and it but feebly expresses the sense of loss and appreciation of regard for your father.

The resolutions adopted by the association at its special meeting on November 6 were as follows:

The members of the executive committee of the Electrical Trades Association of Philadelphia learn with great sorrow of the death of their former president and associate, Mr. Charles E. Trump.

Mr. Trump served the Electrical Trades Association as a member of its executive committee and president for twelve years, retiring one year ago. At the annual meeting, held on the evening of November 5, 1908, which Mr. Trump attended, he was again honored by election as a member of the executive committee. Mr. Trump's sterling character gained for him the respect and esteem of all with whom he came in contact, and as a mark of our love and regard we unanimously adopt the following RESOLUTIONS:

RESOLVED, That we bow to the will of a Supreme Power, and while grateful for the useful life vouchsafed to our late associate we are yet full of sorrow in our bereavement;

RESOLVED, That we hereby bear witness to the noble manhood of Mr. Trump, whose conception of duty was of the highest, and his aim in life was to be just to all men;

RESOLVED, That we tender our sympathy to the family in this hour of affliction, and that the past and present members of the committee attend the funeral in a body; and, further,

RESOLVED, That a copy of these resolutions be suitably engrossed and sent to his family, and a minute of the same be entered upon the records of the association.

Effect of the Purity of Water on Its Industrial Use.

In connection with an investigation of the quality of surface and underground waters in different parts of the United States, R. B. Dole, of the United States Geological Survey, has made an estimate of the saving that may be accomplished in the production cost of steam by use of a plant for softening water. He says:

"Analyses of Maumee River water, selected as a typical hard water, show that it contains incrusting solids amounting to 360 parts per million, 105 parts of which are suspended mud, etc., and the rest carbonate and sulphate of calcium, with some magnesium, a combination which inevitably forms a hard scale in boilers. If this water were used in a 1,000-horsepower boiler, 100,000 gallons daily would be required. In six working days 1,800 pounds of scale would be deposited in the boiler. In the following figures, the first set estimates the probable excess cost due to the use of bad water, while the second estimates the probable cost after purifying the water. The inference to be drawn from the difference in dollars and cents is obvious:

Cost with use of hard water.

Average coal consumption for 1,000-horsepower boiler, 48 tons a day. 48 tons of coal at $1.50 is $72. Estimated saving in fuel on this water due to use of treated water is 5 per cent. Five per cent of $72 is $3.60 per day, or, for 300 working days	$1,080.00
Cleaning boiler, at $8 per week	416.00
Repairs for tubes, etc	200.00
Boiler compounds	250.00
Coal for raising steam after cleaning, 104 tons at $1.50	156.00
Seven and one-half per cent depreciation on boiler plant costing $15,000	1,125.00
Total	$3,227.00

Cost with use of softened water.

Ten per cent interest and depreciation on softening plant costing $3,500	$ 350.00
Boiler repairs	50.00
Chemicals at 1 per cent. per 1,000 gallons	300.00
Coal for raising steam after cleaning, 16 tons at $1.50	24.00
Five per cent depreciation on boiler plant costing $15,000	750.00
Total	$1,474.00

"The total saving in a single year is, therefore, $1,753, practically half the cost of installing a softening plant."

Remote-Control by Electric Waves.

An interesting apparatus recently constructed by two engineers of Nuremberg, Germany, Messrs. Wirth and Beck, allows, through the medium of electric waves, any levers to be thrown forward or backward, upward or downward, steering wheels or cocks to be turned in a right-hand or left-hand direction and electrical apparatus to be thrown in or out of circuit. In fact, it provides a means of controlling the most varied machines from a distance without there being any material connection between them and the operator. The idea of using Hertzian waves is, of course, not new, says the London *Times* Engineering Supplement.

At demonstrations recently made of this apparatus before the Nuremberg Society of Natural History and other societies the experimental table contained a plant for receiving electric waves similar to those used for wireless telegraphy, connected to the radio-telegraphic controller and the accessory apparatus actuated by the latter.

In another room was installed a radio-telegraphic sending apparatus susceptible of being tuned up to the receiver, and actuated by electromagnetic waves from the apparatus installed on the experimental table. No connecting wires were provided between the sending and receiving apparatus.

Whenever a lever connected with the sending apparatus was adjusted to various positions the apparatus corresponding to these was actuated. A number of electric lamps were thus lighted in any order desired, or in groups, and a small steam-engine was started, reversed or stopped, while electric bells and motors were actuated, powder mines exploded and a revolver fired rapidly.

While torpedoes can be employed so far only over small distances, it is claimed that it will now be feasible to provide them with a far greater driving power, thus directing them toward their goal with safety and from many miles distance.

Land and sea mines have frequently been exploded by electricity transmitted by extensive cables between the operator and each of the mines. The same operation can now be effected through electric waves, that is, by wireless means, provision being made so that only the mine in question is exploded. This firing of mines through electric waves is likely to be adopted advantageously by several branches of industrial activity.

BOOK REVIEWS.

The four books referred to below belong to the well-known series of compact handbooks on various branches of technology published by Dr. Max Jänecke of Hanover, Germany. In each book the elementary principles underlying the subject are first discussed with the aid of simple mathematics only. Practical applications of these principles are then considered. While the Continental practice is mostly dealt with, there is enough of universal interest in each of the volumes to make them of value to German readers anywhere.

"Die Elektrizität auf den Dampfschiffen" ("Electricity on Steamships"). E. Bohnenstengel. Third edition. 124 pages. 4½ by 7 inches. 117 illustrations. Price, in paper, 1.8 marks; in cloth, 2.2 marks.

The aim of this book is to make the captain and other officers familiar with the operation of the electrical devices they have to deal with. After a short introduction on the theoretical foundations the author treats of dynamo-electric machinery, storage batteries, lamps, auxiliary apparatus, distribution systems, conductors, annunciators, telephones, signaling devices, wireless telegraphy and telephony.

"Die Elektrizität als Warmequelle" ("Electricity as a Source of Heat"). Dr. Friedrich Schoenbeck. 104 pages. 53 illustrations. Price, in paper, 1.6 marks; in cloth, 2 marks.

In this book the subject of electric heating is dealt with concisely from all points of view. The laws of electrically developed heat and its units are clearly explained and defined, as is also the calculation of resistance conductors. The various methods of converting electrical energy to heat are described. Applications of electric heating are then considered for cooking and heating in the home and shop, heating of rooms, electric furnaces and their electrochemical products, laboratory apparatus, measuring instruments, electric welding and soldering, ignition, medical and other miscellaneous purposes.

"Handbuch fur den Bau und die Instandhaltung der Oberleitungsanlagen Elektrischer Bahnen" ("Handbook on the Construction and Maintenance of Overhead Line Equipment of Electric Railways"). Arthur Ertel. 336 pages. 294 illustrations. Price, in paper, 4.2 marks; in cloth, 5 marks.

This is a comprehensive compendium on trolley-line construction. The planning and calculation of the working conductor and feeder systems are explained and illustrated. Various types of overhead equipment are described and their construction considered in detail. Special attention is given the layout of curves, crossovers and crossings, the provision for joint use of poles for telegraph or telephone service, catenary construction for high-speed service, trolley construction in tunnels and on bridges, signaling systems, sectionalizing, etc. The maintenance is considered under the sub-heads of periodical inspection, breakdowns in service, repair wagon and tools, regulations. The book is a valuable one for railway engineers, superintendents and foremen.

"Ruhende Umformer" ("Stationary Transformers"). Victor Bondi. 144 pages. 104 illustrations. Price, in paper, 2 marks; in cloth, 2.2 marks.

The fundamental problems relating to transformers form the subject of this book. An excellent idea of its scope may be obtained from the main topics considered, which are the magnetic field, generation of electromotive force, single-phase and polyphase currents, properties of alternating currents, characteristics of single-phase and of polyphase transformers, design and construction of transformers, connections, special transformers, installation of transformers.

"How to Build up Furnace Efficiency." Joseph W. Hays. Chicago. Published by the author. 48 pages. 3½ by 6¼ inches. Supplied by the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for 50 cents.

In this handy little book the author treats of the most vital problems in boiler-room practice. Methods of firing and draft regulations are discussed in detail as well as all points bearing on coal economy. A careful study of flue gases is made and the author strongly recommends a systematic analysis of the flue gases, preferably with a hand instrument and automatic sampling vessel. The style of the author is so clear that even an ordinary fireman will find much of profit in this book, if he is interested in its title.

Success of Inspection Work.

The Fire Underwriters' committee on fire protection engineering has made a report to companies on the recent meeting of the Western Association of Electrical Inspectors, held in Chicago, October 20, 21 and 22. It is reported that interest in the work of the association has increased, and members are continuing to exhibit a broader conception of the electrical hazard and are seeking the best method of accomplishing its removal. The principal difficulty experienced has been where individual inspectors disagree with existing rules, and when feasible such differences of opinion are made the subject of reports by special committees which are subsequently discussed and the result submitted to the electrical committee of the Underwriters' National Electrical Association, in the form of proposed amendments to the National Electrical Code. The general tendency has been to raise the installation standard rather than lower it. More care is being exercised in discriminating against unapproved materials and devices; members are becoming more familiar with the fire dangers existing in defective electrical fittings through tests carried on during the meetings held in Chicago, these experiments proving the most effective means of impressing upon inspectors the need for careful scrutiny of this detail of the electrical equipment. That the association is meeting, to some extent, the every-day needs of the electrical inspector is evidenced by the large number of applications for membership received from inspectors located in Pacific Coast territory and Canada. The indications are that the work of the organization will be vigorously pressed during the coming year.

Proposed Chicago Building at Alaska-Yukon-Pacific Exposition.

An option for an advantageous site for a Chicago building at the Alaska-Yukon-Pacific Exposition, to be held at Seattle, Wash., in 1909, has been secured by the Chicago Association of Commerce and a special committee has begun the preliminary work of ascertaining the representation desired by merchants of the city.

The building and its maintenance as planned will cost $60,000, although the structure can be enlarged if this scale is found inadequate. It will contain reception rooms, offices and a big lecture room. Only about $25,000, it is believed, will be needed for the building, and the remaining sum is to be devoted to a publicity campaign.

The impossibility of representing even a small per cent of Chicago's industries by an actual display of goods is admitted. Instead, the committee has outlined the plan of installing a lecture platform and an all-day series of moving pictures and stereopticon slides showing how Chicago goods are made, with a lecture demonstrating their qualities.

Frederick Bode, president of Gage Brothers, is chairman of the committee which has the enterprise in charge.

The exposition opens June 1, 1909, and closes October 16.

Tripod for Lighting Fixtures.

By the invention of new devices and the improvement of old appliances the work of wiring a building for electric lights or power has been greatly facilitated and its character decidedly improved. A simple device of this kind has been invented by Edwin A. Emery, of Galva, Ill. It is a tripod for supporting electric-light fixtures, and was patented a month ago. It is designed to lessen the labor of hanging such fixtures and to provide for their ready adjustment, so that they will hang plumb.

The accompanying drawings illustrate the construction of this device. Fig. 1 is an elevation of an electrolier or chandelier secured to a ceiling by one of the new tripods, the canopy being withdrawn to reveal the tripod; Fig. 2 is a detailed plan view of the tripod; and Fig. 3 is a central sectional view thereof. In these drawings, 1 designates the stem of the electrolier and 2 the canopy for covering the tripod 3. The latter is made in two parts, one comprising a plate 3^a having curved arms 3^b converging toward each other and the other consisting of a smaller plate 3^c having curved diverging arms 3^d spaced similarly to the arms of the first part. The arms 3^d normally engage the inner faces of the arms 3^b, and are secured thereto by screws. The passages 5 for these screws in the arms 3^b are larger than the shanks of the screws for the purpose of adjustment. The plate 3^c has a screw-threaded passage 6 through it to receive the stem of the electrolier.

Practice has shown that when a fixture is secured to a plastered ceiling it will nearly always be out of plumb, owing to unevenness in the surface of the plaster. When the ordinary one-piece tripod is used the only way to remedy this is to loosen the screws holding the tripod to the ceiling and wedge it down with washers or pieces of cardboard or other material. This requires time, and at best gives only a botch job when finished. When Mr. Emery's tripod is used, as soon as the fixture is secured to the ceiling, the adjusting screws 4 may be loosened to permit the fixture to plumb itself or be plumbed, after which the screws may be tightened, making a good, firm job.

If desired, the upper or main part of the tripod may be screwed to the ceiling or wall first, and the electrolier or bracket having the smaller part of the tripod screwed upon it, may have its arms inserted between those of the main part and turned until the screws 4 can be put in and tightened. This also makes it convenient if the fixture has to be taken down for repairs, as none of the screws that hold it to the ceiling have to be disturbed.

It has been noticed with the old-style tripod that the wiremen fasten the fixture to it before installing it. When this is done the starting of the screws through the plaster will cause it to crumble and fall down within the canopy, which has

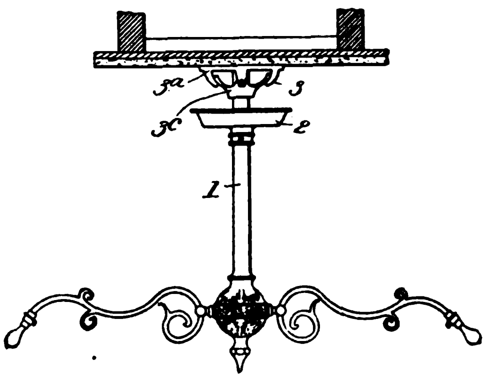
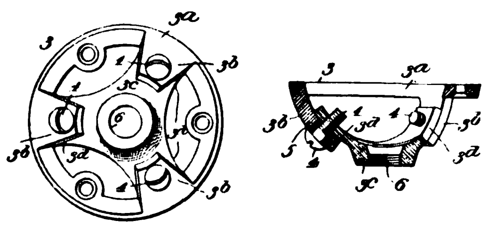


FIG. 1.—ELEVATION OF ELECTROLIER.

been dropped down on the stem, as illustrated, for instance, in Fig. 1, to permit access to the screws. Then, when the canopy is slipped up into place, the plaster will lodge between the canopy and stem and scratch the casing of the latter, removing the lacquer and causing it soon to tarnish. By employing this tripod



FIGS. 2 AND 3.—DETAIL PLAN AND CENTRAL SECTION OF TRIPOD.

and screwing the upper or main part on first, this can be avoided. Of course, the old style of tripod can be put up first, but in screwing the stem of the fixture into it at least six turns are required, and the wires in the stem are liable to become short-circuited.

Central Electric Railway Association.

The regular bi-monthly meeting of the Central Electric Railway Association, embracing the interurban lines of Indiana and Ohio, was held at Lima, Ohio, November 18. The meeting was marked by excellent attendance and interest, and the subject taken up brought out a more general discussion than has characterized the meetings heretofore. F. T. Carpenter, president of the association, after congratulating the members upon the large attendance, introduced Mayor Becker of Lima, who graciously welcomed the members of the association to the city.

The first topic of the session was "The Possibilities of Electric Lines Hauling United States Mail in Competition with Steam Roads." A number of members who discussed the question testified that from experience in carrying mail upon their lines the proposition had not proved a financial success. It was asserted, however, that the electric lines have not yet had sufficient experience in carrying the mail to decide just what the possibilities of such service might bring forth.

The second subject, "The Claim Department," was presented in an address by Frank Tallmadge, president of the Frank Tallmadge Company of Columbus, Ohio. The definition of what a claim department should be constituted the basis of Mr. Tallmadge's address. He urged that it be properly organized and systematically developed and operated.

"Railroad Crossings" was the subject of a paper presented by W. C. Sparks, superintendent of track and roadway for the Indiana Union Traction Company, Anderson, Ind. The increased weight of interurban cars has caused the engineering department no little trouble to maintain crossings under the constant hammering of heavy locomotives and cars, and engineers and manufacturers have been called upon to build a crossing that will stand up under a service of this sort. Mr. Sparks described the two types of railroad crossings in use and told how they should be constructed and the best plan for keeping them in repair.

The concluding subject of the programme was that of a general discussion of the "Effect of Financial Depression on Earnings of Interurban Roads and Lessons to Be Learned from Experiences of the Last Twelve Months." This discussion took the form of an experience meeting, and the reports varied largely with the local conditions met by each speaker. The extent of the depression during the past few months was not discouraging, and the future, as expressed by those participating in the discussion, is held to be quite optimistic. Great results are in store for the development and increasing operation of electric railways in this country, it was said.

After authorizing the new mileage book to be placed in commission over the electric lines of Ohio and Indiana after January 1, the association set its next meeting for Indianapolis, January 28, and adjourned. S.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

EFFECT OF CONNECTING ELECTROLYTIC DETECTORS IN SERIES AND IN PARALLEL.

This is a communication by M. Jegou to the French Academy of Science. In his experiments he made use of electrolytic detectors with interchangeable anode points, the sensitiveness of which was perfectly well known. The tests made showed clearly that the connection of two or more electrolytic detectors in series is always detrimental to their sensitiveness, a group of detectors so connected being considerably less sensitive than the most delicate one of the group. Care was taken in these experiments to choose the current source, so that the critical tension was always applied, which naturally varies considerably with the number of detectors joined in series.

The investigation of the parallel grouping of the detectors is of much greater interest, as it was shown that the most sensitive one determined the sensitiveness of the group. In this instance the critical tension remained the same. It would seem that the grouping of two or more electrolytic receivers in parallel might be employed with advantage in practice, as a much greater constancy in the sensitiveness of the receiver may in this way be attained; for if the sensitiveness of one of the detectors should accidentally be lowered the general sensitiveness of the receiver will not be at all affected in view of the property mentioned, and in order that this condition may be permanent it is sufficient for only one of the group of detectors to be intact. It is assumed, of course, that care has been taken to use detectors of nearly equal sensitiveness in the group. Furthermore, the connection in parallel has the advantage that the electrolytic points are more seldom burned by powerful waves, emitted by the station itself, for instance. The explanation of the phenomenon seems to be as follows: When the effects on the receiver are extremely feeble, only the most sensitive one of the group of detectors will operate, but when the effects are stronger, the others will operate at the same time. The energy is then divided among the various points of the receivers, and is sufficiently weakened to prevent the burning of the points in many instances.—*Translated and abstracted from La Lumiere Electrique (Paris), October 24.*

THE CONFERENCE ON UNITS AND STANDARDS.

Prof. S. P. Thompson, in a critical résumé of the work of the International Conference on Electrical Units and Standards recently held in London, calls attention to the discrepancies that it was hoped this gathering would eliminate. Thus, while the Chicago Electrical Congress of 1893 had secured international agreement on the definitions of the ohm, ampere and volt, and these units had been generally adopted, some countries had also legally adopted concrete standards not absolutely consistent with the defined units. The real object of calling the conference was therefore to extricate several countries from the difficulties created (a) by the adoption of all three units, instead of two of them, as equally primary; (b) by the confusion between units and standards, and (c) by the discovery of the error of one-tenth of one per cent in the voltage of the Clark cell. In tracing the history of the ohm it is interesting to note that from determinations of the specific resistance of mercury in terms of the absolute ohm made by Lord Rayleigh and others with an accuracy of three or four in 10,000, the length of a column having the prescribed cross-section, mass and resistance is nearer to 106.26, or 106.27 centimetres, instead of 106.3 as adopted in 1893. Mercury columns can now be set up that will not differ from each other by more than a few parts in 100,000. The accuracy with which two resistances can be compared with one another is now far higher than even this, being within three or four parts in 10,000,000. It was expected, therefore, that the International Conference would ascertain with accuracy what the length of the representative column really is, whether 106.26, or 106.27, or 106.3. Until this value should be ascertained by experiments of a refinement comparable to those made in the other lines of advance, any fixing of the final figure could but be arbitrary and not scientific. The adoption of the definition of the ohm as the unit of resistance "which has the value of 1,000,000,000 in terms of the centimetre and second," and then giving its length as 106.300 centimetres, is certainly not consistent, for if the figure 3 is in doubt, what is the use of adding the two zeros.—*Abstracted from the Times Engineering Supplement (London), October 28.*

A CONTRIBUTION TO THE KNOWLEDGE OF THE MERCURY-VAPOR ARC AS A RECTIFIER.

In the rectifier bearing the name of Cooper Hewitt the rectified current flows through the arc in the direction from the mercury to the iron electrode; if the iron electrode is replaced by one of carbon, the rectified current retains the same direction. In experiments made by the author, Dr. Johann Sahulka, at the Electrotechnical Institute in Vienna, in 1894, with the mercury-vapor-light rectifier the alternating-current arc was formed in free air between iron or carbon as one electrode and mercury as the other, and the current flowed in exactly the opposite direction from that which it takes in the Hewitt rectifier, namely, from iron or carbon to mercury. In the Hewitt rectifier the arc is formed in an evacuated space. Doctor Sahulka states that this peculiar influence of air pressure on the behavior of the rectifier is nowhere mentioned in technical literature, and for this reason he calls attention to it and to his work on the effect of the mercury-vapor arc as a rectifier, which was published in the *Zeitschrift fuer Elektrotechnik* in 1894. He continues: "I formed the arc by dipping an iron or carbon electrode into mercury contained in a porcelain vessel and then lifting it a little. The escape of the resulting mercury vapor was prevented by a protecting case with glass walls. In consequence of the great heat an incandescent drop formed at the end of the iron electrode, which would frequently fall off and cause disturbances in the measurements; therefore I replaced the iron rod by a carbon electrode. In tests made between a carbon electrode eleven millimeters in diameter and mercury in free air, with an alternating current of 105 volts and forty-two periods, the rectified current amounted to about sixty per cent of the alternating current. The reason that in my experiments a rectified current is obtained which flows in a direction opposite to that in the Cooper Hewitt rectifier I explain as follows: It is well known that an arc can exist only when the vicinity of the cathode is sufficiently conducting; this requirement does not need to be fulfilled for the anode. In my experiments an incandescent drop forms at the end of the iron electrode, which, when the current sinks to zero, can give off its heat only with difficulty, as it is surrounded by a gaseous medium on all sides. The drop therefore remains at a very high temperature when the current value is zero and sends out conducting vapors, so that its vicinity always remains a good conductor. The mercury is heated to the boiling point when the current reaches its maximum value and sends out conducting vapors; but the heated spot cools very rapidly when the current sinks to zero, as it can easily give off its heat to the uncooled portion of the mercury and the vaporization ceases in consequence of the cooling. When the alternating current flows in the direction from the mercury to the iron electrode it can pass easily on account of the good conducting property of the vicinity of the latter. The mercury is then also vaporized and a heavy current is able to come into existence. But if the current is flowing in the opposite direction it can pass only with difficulty, or eventually not at all, on account of the low conductivity of the cooled mercury electrode. In my experiments, therefore, the rectified current has to flow in the direction from mercury to iron. The conditions remain the same, when the iron electrode is replaced by one of carbon, as the point of the carbon becomes incandescent upon the formation of the arc and cools very little on account of its poor conductivity. The Cooper Hewitt rectifier consists of an evacuated vessel which is provided with a mercury and two iron electrodes. The latter are connected to the secondary terminals of a transformer, while the mercury electrode is joined to the center of the transformer winding through a resistance. In consequence of the good conductivity of the gaseous medium the arc spreads through the entire vessel and the solid electrode is, therefore, heated very little, while the mercury is easily vaporized on account of the low pressure in the vessel, and its vicinity has a better conductivity than that of the solid electrode. If the rectifying effect of the iron-mercury vapor arc were examined in differently evacuated spaces the result would probably be that the reversal of the rectified current takes place when the conductivity of the medium has been so far reduced that the so-called thread-like arc replaces that occupying the entire vessel. But in this case the rectifier can operate only when an incandescent drop has formed at the iron electrode, the vapors from which make its vicinity conducting.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), October 22.*

A DIRECT AND ALTERNATING-CURRENT GENERATING GROUP FOR AN ELECTRIC RAILWAY.

A direct and alternating-current generating group, which was exhibited at the recent Exposition in Marseilles, possesses some original and interesting features. The set comprises a hydraulic turbine coupled to a double-current generator, and is intended to supply current for the Villefranche and Bourg-Madame electric railway in the Eastern Pyrenees. The turbine is built to operate under a head of 400 meters and furnish about 1,100 horsepower at a normal speed of 575 revolutions per minute. Its shaft is horizontal and the buckets are of the Pelton type, although of a special construction. They have the shape of spoons and are all coupled together in a crown bolted to the center disk. Two rings shrunk hot around the buckets insure resistance against centrifugal force. The water enters the turbine in a vertical direction from below. The bronze nozzle is equipped with a hydraulically balanced regulating tongue, which is actuated by a speed governor of great precision operated under oil pressure. The characteristic feature of this governor is that there is no permanent water pressure in the auxiliary motor, but only at the instant when regulation of the angular speed takes place, and its value is always proportionate to the resistance furnished by the turbine buckets. The regulation insured by this apparatus and a 5,000-kilogramme flywheel is so perfect that the speed variation does not exceed four per cent from the normal under a change of load up to fifty per cent. The turbine is provided with a pressure regulator, which opens a compensating orifice in a branch pipe. All the inlet valves of the turbine and pressure regulator are located in the basement in order to avoid any discharge of water in the machine hall, and are operated by auxiliary hydraulic motors controlled electrically from the switchboard. The direct and alternating-current generator is coupled to the turbine by an elastic sleeve. It is designed to furnish direct current at 800 to 850 volts, or three-phase current at 600 volts and twenty-five periods a second. Though rated at 850 kilowatts, it is capable of withstanding momentary overloads of fifty to sixty per cent. The machine is of the stationary inductor type, drum wound, built up of sheets of high permeability and a low coefficient of hysteresis, reducing the losses by heating. The sheets are insulated by paper to prevent the formation of Foucault currents. The armature winding consists of carefully insulated electrolytic copper bars shaped on a form so as to be interchangeable. The direct-current commutator is made of copper segments insulated by micanite. The brushes are of carbon and are sufficient in number to withstand the heavy overloads without undue heating. Auxiliary poles mounted in series with the armature insure a perfect and sparkless commutation with the brushes in a fixed position. A resistance connected in parallel with the winding of these auxiliary poles permits the regulation of the current flowing through it to the proper value. The polyphase current collector consists of six bronze rings, each connected to a fixed point of the armature; the brushes are of copper sheet. The cast-steel inductor has eight main pole projections of thin iron sheets and eight auxiliary poles of cast steel. The poles carry a shunt and a series winding. The turns and size of the copper in the series winding are so chosen that the tension of the machine rises from 800 to 850 volts between no load and full load. The group forms part of the equipment of the abovementioned railway power station, which contains four identical generating sets and also transformers giving a secondary pressure of 20,000 volts. A high-tension transmission line feeds five substations, in which step-down transformers and rotary converters are installed for furnishing direct current of 800 to 850 volts to the third rail. The use of double-current generators at the central station has made it possible to dispense with one substation, since the generators can also feed the third rail direct. A constant pressure at the various feed points for the third rail is insured by a suitable relation between the compound excitation of the rotary converters and the self-induction of the transformers and transmission line.—*Translated and abstracted from L'Industrie Electrique (Paris), October 25.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Indirect Illumination.

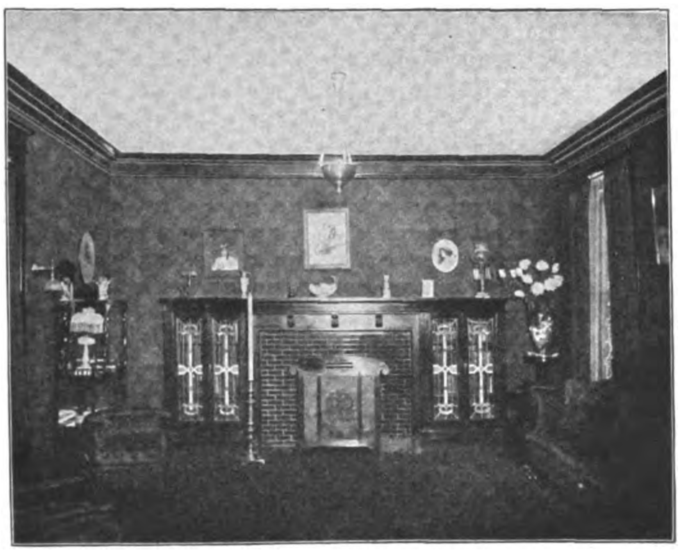
At a recent meeting of the Chicago Section of the Illuminating Engineering Society, Augustus D. Curtis read a paper entitled "Indirect Illumination," and described a system of diffused, reflected interior lighting which has been developed but a short time. This system makes commercially available a practical method of indirect illumination, and has been commented upon very favorably, not only by electrical engineers and central-station men, but by optical experts, who view with alarm any increase in intrinsic brilliancy and the present tendency toward over-illumination.

This system of lighting affords a light of high candlepower at low cost, and a reflecting surface which gives its first reflection of light toward the ceiling without material loss or absorption. Where gas is used, the necessary candlepower and economy are found in using the higher-grade incandescent-mantle burners. Where electricity is used, the high-efficiency tungsten lamp makes it an ideal source of light for this indirect system of lighting.

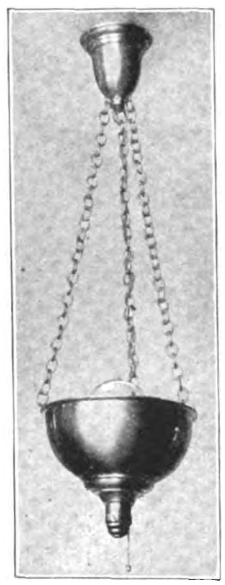
The reflecting surface of the reflector surrounding the lamp or mantle offered no difficulties, as this has been marketed for several years under the somewhat misleading name of "X-ray." Reflectors of this type consist of a single piece of blown glass coated on the outer side with pure silver, giving a reflecting surface of high efficiency. The silvering is protected on the outside by coats of elastic enamel.

The correct shape of the inverted reflector for throwing the rays of light to the ceiling without shadows has been the result of considerable calculation and experimentation. The perfected design is of a bell-shape, and contains peculiar circular and vertical corrugations. Being fire-glazed, the exposed glass surface is easily cleaned with a soft cloth.

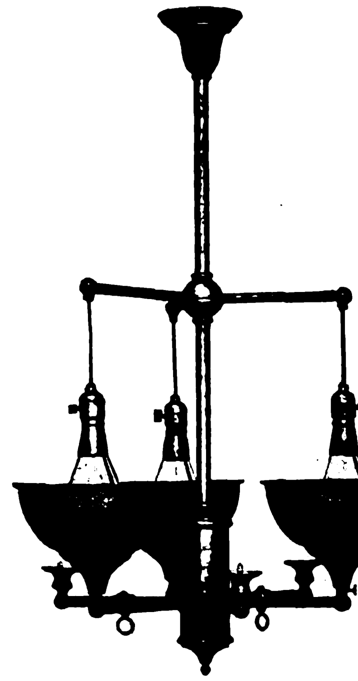
The bell-shaped corrugated, silvered reflector is fitted in a spun-brass casing. On gas fixtures, this casing rests on the base of the mantle like a globe. With electric fixtures the casing can be either suspended by chains or supported from below. A great variety of ornamental designs can be worked out utilizing these units. Where gas or electric chandeliers are already in use, this system of lighting can be readily adopted. Unless the chandelier arms are very heavy, it can be applied where the sockets are pendent, as the arms do not cast any shadows on the ceiling, because the light comes from so many directions that the effect of shadows is neutralized. These lighting units should be used at or near the center of the room, though side lights can be, and have been, used, with satisfactory results.



PARLOR FIFTEEN BY FIFTEEN FEET ILLUMINATED BY A ONE-UNIT FIXTURE CONTAINING SIXTY-WATT TUNGSTEN LAMP.



ONE-UNIT CHAIN FIXTURE WITH TUNGSTEN LAMP, TIP UPWARD.



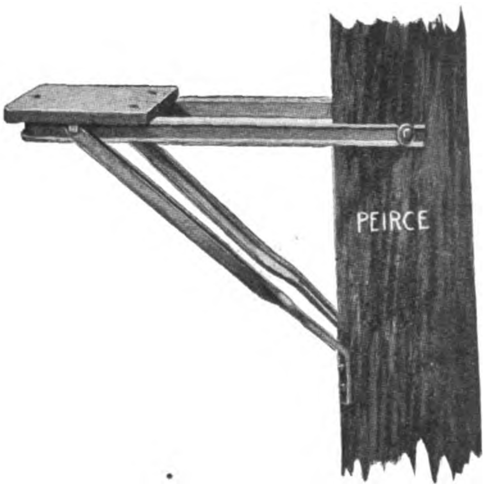
SHOWING HOW THE LIGHTING UNITS CAN BE USED IN MULTIPLES.

Used in Brass Spinning or Casing Shown in Above Illustrations of Lighting Units. SILVER-PLATED REFLECTOR.

A number of installations utilizing this method of lighting have been in use for a some time among professional and business men in their residences and offices. Without exception they are enthusiastic in their praise of the system, and are so impressed with the eye comfort derived that they would not go back to the old system of direct lighting except under protest. These fixtures can be installed in single units or in multiples, either straight electric, straight gas, or combinations of electric and gas. A unit of one reflector and one 100-watt tungsten lamp or a good gas-mantle burner gives a fine illumination in a room up to fifteen feet square. The cost is reasonable, being, on an average, from one-half to one cent per hour.

Pole Seats.

The Peirce Specialty Company, Elkhart, Ind., has developed a number of styles of pole seats to meet all conditions. The braces and frames are made of one-inch by one-half-inch channel steel, and the seat is attached to the pole so that there is no shearing strain on the bolts.



PEIRCE POLE SEAT.

The braces have rugged shoulders on which the frame rests. Five men can safely stand on the cheapest seat made by the Peirce company. It is stated that five men have not only stood but have jumped up and down on this seat. The seats are galvanized and stand the American Telephone and Telegraph Company's test. Galvanized seats are recommended

PEIRCE POLE SEAT, WITH LIVE LOAD OF OVER 850 POUNDS.

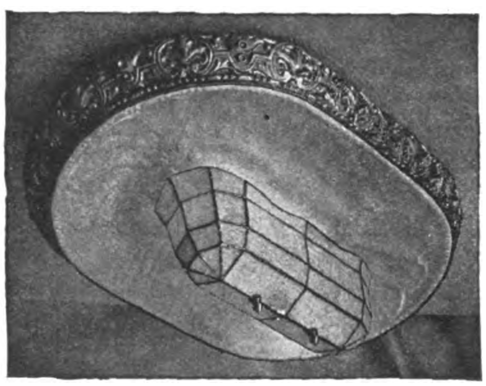
as being cheaper in the long run, and these are shipped ordinarily unless painted seats are preferred.

The accompanying illustrations show the method of attaching the seat. The seat illustrated herewith is thirty-six inches long, and the platform is made of one and one-eighth-inch creosoted cypress, attached to the frame with three countersunk, wax-sealed, galvanized bolts. The other illustration shows the seat standing the test of a live weight of over 800 pounds.

The Extension Diffuser.

The extension diffuser illustrated herewith has been designed to meet the demand for an incandescent fixture embodying the esthetic as well as the scientific principles required for high-grade lighting. It was originally designed by the General Electric Company, Schenectady, N. Y., for use on railway cars, but is especially adapted and recommended for store lighting, and for installation on low ceilings.

As will be noted in the accompanying illustration, the construction of the outfit is remarkably simple; the appearance neat and pleasing. The diffuser can be easily installed on any ceiling where a small flat space can be provided, or it can be suspended from open-work construction. It is readily adapted for recessing, so that the outer edge is flush with the ceiling line.



GENERAL ELECTRIC COMPANY'S EXTENSION DIFFUSER.

The diffuser is held in place by the suspension rods, from which the shade is hung, and the heavy dull finish makes it difficult to distinguish it from plaster. The shade is of white opalescent art glass, strongly bound together, and is specially constructed for rigidity. The glass used in the shade is selected and arranged so as to give maximum diffusion with the minimum absorption of light.

At the present time the extension diffuser is made in two sizes only, the three and six-light; both, however, being adapted for use with tungsten, tantalum or Gem lamps. The larger shades are made in two different styles, known as the deep and the shallow types. The shallow shades are used with lamps of sizes up to and including forty-watt tungsten, forty-watt tantalum, and forty-watt Gem. The deep shades are necessary for use with lamps up to and including 100-watt tungsten, 80-watt tantalum, and 125-watt Gem. Clear-glass lamps only should be used, as the light is thoroughly diffused by the upper and lower shades.

The distribution of light from the extension diffuser is not symmetrical about the vertical axis, as in most lighting units. At angles approaching the horizontal the diffuser emits more light laterally than longitudinally. This is of special advantage in stores when the equipments are installed longitudinally over the center of the aisle. The maximum light being thrown out toward the counters and stock shelves, very little light is thrown directly in the eyes of the customers. The efficiency of the extension diffuser, when compared with other lighting units, is relatively high, especially in consideration of the excellent diffusion.

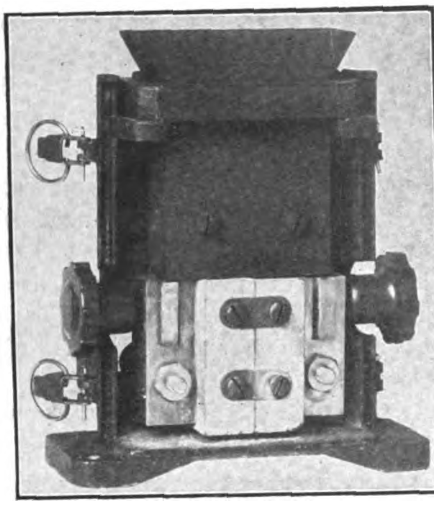
New Orders for General Electric Company.

The General Electric Company reports among recent orders for railway apparatus the following:

The Seattle Electric Company, Seattle, Wash.—Fifty four-motor GE-80 (forty horsepower) car equipments, four 1,000-kilowatt motor-generator sets converting sixty-cycle 13,200-volt current into 600-volt direct current, provided with direct-connected exciters, and four 1,000-kilowatt sixty-cycle 13,200-volt air-blast transformers with blowers, together with the switchboard apparatus. The Denver City Tramway Company, Denver, Colo.—Two 500-kilowatt twenty-five-cycle rotary converters and seven 185-kilowatt oil-cooled transformers. The Sioux City Traction Company, Sioux City, Iowa—Thirty GE-81 (thirty horsepower) railway motors. The Washington Water Power Company, Spokane, Wash.—Twenty four-motor GE-80 car equipments two four-motor GE-73 (seventy-five horsepower) car equipments, with Sprague-General Electric type M control. The Pittsburg Railways Company, Pittsburg, Pa.—One 400-kilowatt engine-driven generator and three 200-kilowatt sixty-cycle rotary converters. The Western New York Construction Company, Buffalo, N. Y.—Eight four-motor GE-204 (seventy-five-horsepower commutating pole) car equipments, with Sprague-General Electric type M control.

Magnetic Blow-Out Fuse Box.

When circuit-breakers were first installed on street cars the motormen regarded them with great favor, and the management has appreciated that they materially reduced the expense for fuses. But gradually the motormen began to find it so easy to throw in the handle of the circuit-breaker that it has become a very frequent occurrence to overload the motor and trip the breaker. This is not only unnecessary, but is frequently a cause of fright to the passengers. The loud report and the flash frequently cause suit for damages to be brought against the company for real or fancied injuries. This careless handling of the controller does more than merely frighten the passengers, for the excessive flow of current causes heavy strains on the motor windings, which may cause injury to the motor. It is thus seen that it has become too easy a matter for the motorman to reset the protective device on his car.



MAGNETIC BLOW-OUT FUSE BOX.

For such reasons large railway companies are equipping their cars with a simple type of fuse in addition to the standard circuit-breaker. This fuse has been recently developed and placed on the market by the Westinghouse Electric and Manufacturing Company, and is of the magnetic blow-out form, which overcomes the objections to the use of the old fuse box.

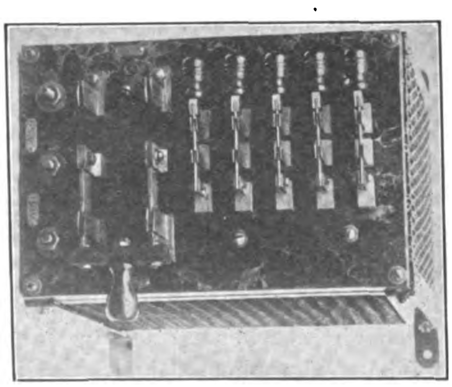
The general design of this fuse box is similar to that of a street-car circuit-breaker, in that it has an all-metal case with the live parts entirely enclosed. It is intended to be placed under the car. The main current is carried by a short copper strip extending down from the terminals in the form of a loop. This loop passes through an arc chute which is supported inside of laminated punchings, thus providing an efficient magnetic blow-out. The blow-out is produced by the ribbon itself without any exterior coils whatever, as a single turn of the ribbon through the iron circuit provides ample magnetism to blow out the arc formed when the ribbon melts. As shown in the illustration, the fuse box is exceedingly compact.

The fuse box will carry 400 amperes continuously without overheating, while the fuses are rated at from 250 to 600 amperes, and are so constructed that they will blow in thirty seconds on 100 per cent overload of this rating. New fuses may be readily inserted by turning the insulating handles on each side of the box without opening the case or using any tools whatever. For the purpose of repairs the sheet-iron front of the box may be readily removed. The arc chute is a single piece and may be readily and cheaply replaced.

This fuse box, while intended primarily for street cars, is not confined to them exclusively, but may be used on industrial motors wherever enclosed fuses would be unsuitable for any reason.

Plating Rheostats for Line Control.

The Ward Leonard Electric Company, Bronxville, N. Y., has designed a complete line of plating rheostats for line control. This is a unique and new design for this apparatus and it offers great possibilities. It is designed for single-voltage and double-voltage control. The accompanying illustration shows a rheostat for line control of the double-voltage type, to be used on a five and ten-volt circuit either on one leg of a three-wire circuit having five volts on each leg or upon the total ten volts. There is a main-line switch (fused when so desired), which, closed in one direction, gives any current from one to forty amperes on ten volts, and when closed in the opposite direction gives eighty amperes on five volts. This gives thirty-one steps of control on either voltage. Each switch with its resistance is designed to be connected across the full five or ten volts, respectively. The various numbers of steps are obtained by using the switches singly or in parallel. As the resistances are designed for the maximum voltage that can be applied upon them, burn-outs are impossible. These rheostats are designed for any capacities and voltages.



PLATING RHEOSTAT FOR DOUBLE-VOLTAGE LINE CONTROL.

Columbia Incandescent Lamp Display.

The accompanying illustration shows a display of incandescent lamps made by the Columbia Incandescent Lamp Company of St. Louis, Mo., in Parlor K of the Grand Pacific Hotel, Chicago, at the recent convention of the Association of Car-Lighting Engineers. This company was represented at the convention by a large corps of salesmen, a list of whom is given in connection with the report of the closing sessions of the convention, which appears on other pages of this issue.

COLUMBIA LAMP DISPLAY AT CONVENTION OF ASSOCIATION OF CAR-LIGHTING ENGINEERS.

Want Seattle Subway Franchise.

Etlinger & Company, of London, and Charles A. Debenditty, of Amsterdam, have applied for franchises to construct eight miles of subways in the business and residence district of Seattle, Wash. The plans provide for a system to cost $6,000,000 and to be completed in less than three years.

A 60,000-Volt Direct-Current Transmission System.

The power transmission system which has been recently installed for the city of Lyons, France, is worthy of note not only from the considerable scope of the enterprise, but also from the fact that it differs from the usual methods employed for this class of work. The source of power is a hydraulic plant which is located on the Isère River, lying at a distance of 110 miles from Lyons. Not only is the distance one of the longest which has yet been employed on the Continent for a power line, but the voltage is also one of the highest, this being nearly 60,000 volts. Instead of using the three-phase system for the power line, this latter is operated on the direct-current system according to the method brought out by M. Thury and used in several cases by the Industrie Electrique firm of Geneva, notably in the St. Maurice-Lausanne power transmission plant. Owing to the progress which has been made it is now possible to use a higher voltage for this method than heretofore, but the present standard of 60,000 volts is not the limit, as it is proposed to double this amount when it comes to increasing the station, and this will be done by grounding the line.

To obtain this high voltage with direct-current generators these are coupled in series. A unit of the station consists of a Piccard-Pictet turbine of 1,600 horsepower, to which are coupled four generators upon the same shaft. These four machines in series give 14,400 volts and they are run at 300 revolutions per minute. As the plant now contains four turbine units of this kind, by coupling all the four units in series we obtain 57,600 volts, which is used directly on the power line. Each of the single generators is a six-pole machine of the Thury type and is rated at 270 kilowatts. It furnishes a current of 3,600 volts and seventy-five amperes. On the exterior these machines resemble the usual form of railway generator, and there are two of them mounted on a common foundation plate with two outer bearings. Electric couplings are used between the two pairs of double generators and between the latter and the turbine.

Where the 57,600-volt power line reaches the city there is a first substation located in the suburbs at Vaulx-en-Velin which receives the direct current in a set of motors and delivers three-phase current. This plant has at present three high-voltage direct-current motors of 800 horsepower each, and they are coupled to three-phase alternators. All the direct-current motors are connected in series, while on the three-phase side the alternators are connected in parallel. From this plant the three-phase current is sent by an underground line to a second substation, which is located in the central district of the city. It is designed to produce direct current for the tramway lines, and to this end it has a number of three-phase motors, each coupled to a 600-volt direct-current generator.

Public Utilities Commission Proposed in Illinois.

In the forthcoming session of the Illinois legislature Sam. A. Ettelson, state senator from the third senatorial district, will introduce a bill creating a state commission of seven members, to have comprehensive jurisdiction over all steam and electric railroads, street railways, electric and gas lighting and power companies, telephone and telegraph systems and other public-service corporations. The bill is based largely on the act that Governor Hughes of New York secured the passage of, through the legislature of that state, creating the two public-service commissions that have become so well known.

Only one commission is proposed in Illinois. It is to supersede the present railroad and warehouse commission, but have greatly increased powers in every way. It is to supervise the issues of stocks and bonds by these companies, the regulation of rates and quality of service given the public, and prescribe methods of accounting and reforms of administration and operation. The plan would limit the power of regulation of public utilities now vested in local civic authorities and is therefore approved by many of the public-service corporations that see in it a method of eliminating many petty burdens now imposed on them by municipal councils and other local officials.

On the other hand, Senator Ettelson's proposal has started a lively agitation among the opponents of any curtailment of home rule, and they point out, as an illustration, the excellent results being secured in Chicago as the effect of the traction-settlement ordinances now being carried out under the direction of the board of supervising engineers. As the legislature does not meet till January the agitation of the subject will doubtless bring out many strong arguments for and against the measure.

Improved Facilities for Northwestern Elevated.

The Northwestern Elevated Railroad has completed its terminal at North Water and North Clark streets, Chicago. It has been built over the tracks of the Chicago & Northwestern Railway from Wells to Clark streets and is used about two hours a day during the morning and evening rush to permit a number of trains to be run without entering the Union Loop. It thus not only relieves the congestion on the loop but provides terminal facilities for the road in case of accident to the Wells street bridge or inability to use the loop. Each of the four elevated railways now has a stub terminal of its own near the loop district for auxiliary and emergency service. The new terminal has two tracks with a loading platform between them and two discharge platforms on the outer sides. It was put into service on November 17, practically two weeks before the schedule time of completion and within three months of the breaking of ground. The Brennan Electric Construction Company had the contract for the entire equipment. The Northwestern Elevated Railroad has just put into service a special funeral train, leaving the new terminal at 1 p. m. daily and running direct to Calvary Cemetery.

Monorail Road for New York City.

The first monorail road for the carriage of passengers in the United States is to be built between Bartow station the New York, New Haven & Hartford Railroad and Belden Point, City Island, and will take the place of an old horse-car line. The Public Service Commission has given permission for changing the motive power, and Bion L. Burrows, president of the American Monorail Company, announces that the construction work will begin soon.

Electricity on Southern Pacific.

Advices from California state that the Southern Pacific Company has made application to the authorities in California for permission to convert its present steam operated roads in Berkeley, Cal., and vicinity, for electric transportation.

The Southern Pacific Company has applied for a franchise for that purpose, and the application states that work will be commenced in four months, and completed within two years at a total expenditure of not less than $2,000,000.

Standards of Technical Publicity.

Under this title, Walter B. Snow, publicity engineer, of Boston, Mass., presents an interesting picture of American methods in a recent article in the *American Exporter,* from which the following is quoted:

"In America, above all other countries, publicity is recognized as the handmaid of business success. The fact is fundamental that no sale was ever made in the wide world unless the buyer first learned that the seller had something to sell. No less fundamental is the fact that no legitimate business was ever based upon the ignorance of its customers.

"The high standard of technical publicity which today prevails in America is the result of relatively rapid development; a token, doubtless, of the insatiable energy of its people. It expresses a recognition of the fundamental principle of all advertising—that in the broadest sense it should be considered as an investment and not as an item of expense. The advertiser should not ask, how much does it cost, but how much does it earn?

"America's leadership in publicity has been marked by the educational feature. This is especially true of advertising to and by manufacturers. The country teems with trade journals devoted to the technicalities of particular trades, and to the details of manufacture and sale. In those particularly devoted to engineering, in the widest acceptance of the term, are to be found the best examples of technical advertising. Here the manufacturer, or perchance the engineer, may speak his own language to men who understand its technicalities. What is more, he may be assured that he will find readers. Rare, indeed, is the case where manufacturers or engineers worthy of the name are not subscribers to one or more journals in their particular field. Such subscribers, particularly among the manufacturers, are also advertisers in some of the trade or technical journals which reach the consumers of their products. As a consequence a considerable number of publications in varied lines pass under the eyes of each manufacturer who advertises. From one class of publications he learns what other manufacturers produce that might be helpful to him in the conduct of his office and shop; from others he is able to judge of conditions in the various industries for which his products are destined.

"All this is entirely independent of the vast volume of advertising in the so-called popular magazines, whose name is legion. Here, also, the educational element in construction and wording of the 'ad' is still pronounced. Though it be less technical, the motif of the advertisement is the same; the illustrations are explanatory; they make clear the design or use of the given article; the description is simple and lucid, it tells the reason why.

"Nowhere else are trade papers prepared and published with such care as in America. From the editorial standpoint the leading engineering papers are of exceptionally high order. The presentation of excellent illustrations, both in the reading and advertising columns, is made possible by the use of high-grade paper and careful printing. The half-tone process of reproduction may therefore be employed without fear that the effect of fine engravings will be lost in the printing. Some papers go so far as to request original half-tones for use in the advertising columns.

"The leading papers maintain staffs of advertising writers at the service of their advertisers without charge. In every way they study to encourage the advertiser to exert his best efforts in the presentation of his products. The result is greater frequency of change of copy than occurs in any other class of journals. So good from a technical standpoint is some of this advertising that readers have been led to collect and preserve it for its educational value."

Wireless Experiments with Balloons.

Radio-telegraphic communication with balloons has successfully been maintained in several instances recently, notably by the Condor, which rose from Brussels and exchanged signals with a station erected on the tower of the Palais de Justice, of Brussels. The aeronauts also easily overheard signals sent from the French military station on the Eiffel Tower. The possibility of such signals had long ago been established; danger was, however, feared from the sparks. The first person systematically to experiment in this line, says London *Engineering*, was Hergesell, who, while cruising on the ocean, sent up unmanned balloons from the ship. The balloons were fitted with small receiving apparatus, tuned to different wave lengths on the different balloons, and the arrangement was such that the signal would open the valve of the respective balloon. Hergesell succeeded in bringing certain balloons down again at will at a distance of ten nautical miles.

Mexico to Double Duties on Lamps.

The department of finance of the Mexican Government has submitted to the Congress a bill which revises and increases the import duties on a number of articles. The duty on incandescent electric lamps is increased from eleven cents per kilogramme, gross, to twenty-two cents per kilogramme, gross. Incandescent electric-light globes are now being manufactured in Mexico, and it is understood that the object in doubling the duty is to protect the new home industry. The bill provides that the duty on machinery and apparatus shall continue at $1.65 per 100 kilos, gross, but the following clause, which will be appreciated by importers of machinery, has been inserted:

"The ensemble of pieces constituting a plant of machinery, in whole or in part, may be imported in separate lots, subject to the rate fixed in this schedule, provided that the department of finance so decides in view of the circumstances in each case, and the requirements laid down by the same department be complied with."

Electric-Lighting Equipment for Automobiles.

Among electrical patents issued on November 3 was one granted to Fred. R. Babcock, of Chicago, which covers a lighting equipment for gasoline and steam automobiles. The device is essentially a miniature train-lighting system, much simplified in detail.

From the standpoint of the motorist, the arrangement serves to turn a small portion of the gasoline used in the engine into electricity, which may be used for lights, ignition and any electrical devices desired, and thus limits the supplies required for the car to gasoline and lubricants. The advantages resulting from the elimination of acetylene and kerosene oil, combined with the well-known superiority of electric lights, indicate that this equipment will prove very popular among the automobile fraternity.

Philadelphia Lighting Contract.

The Philadelphia Electric Company was the only concern to submit proposals for the lighting of the city in 1909. Its figures range from twenty-five to twenty-eight cents a light per night, according to location. There are at present 12,000 electric lights throughout the city. The cost of maintenance for 1909 will be $1,182,791.

Current Electrical News

CONTINENTAL EUROPE.

PARIS, NOVEMBER 14.—The new electric tramway line which has been installed in Switzerland to connect the localities of Schwyz and Seewen is noteworthy from the fact that it is operated upon the three-phase system. The electrical outfit of the line is furnished by the Brown-Boveri firm. Should the line be completed according to the present plans it will run from the latter point as far as the town of Brunnen, which lies upon the Four-Cantons lake. Owing to the high gradients which the road possesses, the three-phase system is an advantage here. Current is supplied from a distant turbine plant at 8,000 volts, forty cycles, and a transformer station located near the traction line serves to reduce the voltage to 500, which is used upon the car motors. For the overhead line the road uses a double trolley wire and the car has two trolley poles mounted on the roof. The motor cars are of the tramway type, with the body mounted on a single truck with two axles. The cars each carry thirty-four persons and with the electric outfit weigh about ten tons. The track is of the standard narrow gauge, one metre.

Some of the mining companies, instead of transporting peat, lignite or a poor quality of coal, are now erecting plants for burning this combustible upon the spot and distributing the power in the form of electric energy. A large plant is now in operation in the north of Italy on this principle at San Giovanni-Valdarno in the Tuscany province. It owns rich lignite deposits in this region, but as the lignite contains forty to fifty per cent of water it became difficult to operate the deposits, owing to the cost of transportation compared with the low heating quality of the material. The company decided to erect an electric plant and a power line in order to utilize the product upon the spot and to deliver current over a wide extent of country. The power plant is built near the mines and the combustible is brought by rail to the furnaces. It is first dried partially and is then burned under the boilers. The latter are of special construction so as to consume the half-dried material, and this was found preferable to a previous drying of the lignite, even though the boiler plant had to be built on a larger scale for the purpose. An automatic feed system is used for the furnaces. In the dynamo room are installed the engine and alternator sets, using Westinghouse three-phase alternators of 1,500 kilowatts. These machines are designed for 6,000 volts and fifty cycles, and they are excited by two 130-kilowatt generators. For raising the voltage there are used Oerlikon transformers of the single-phase type, which are connected in groups of three, in order to furnish the three-phase line current at 33,000 volts. The transformers and high-tension switching apparatus are mounted in a series of fireproof cells, which are closed by iron sliding doors. There are at present five high-tension lines starting from the station. One of these lines has about sixteen miles length and reaches Florence. A second line runs further on for a distance of thirty miles to Prato, and a third line runs to Siena at eighteen miles distance.

In order to secure a supply of current for the city of Seville there has lately been erected a power plant which no doubt has the highest voltage yet used on this side of the water for three-phase current. An eighty-foot head of water is obtained from the Guadiaro stream in the Malaga province, with a supply of 4,000 litres per second during eight months of the year. The station building will contain four principal units of 1,500 horsepower each; at present there are three of these units erected. These are three-phase, 5,000-volt alternators working at 410 revolutions per minute and forty cycles. A bank of transformers raises the voltage for the line to 52,000 volts. The power line for this high voltage is of the most modern construction and, like the rest of the plant, is installed by the Oerlikon firm of Zurich. It runs for seventy-five miles through the provinces of Malaga, Cadiz and Seville, and in the region of the Berrueco mountains it reaches an altitude of 2,400 feet above sea level. For the line there are used 1,550 iron-work poles with wood cross-arms. The poles are spaced 240 feet apart on the average, but a maximum distance of 380 feet is often reached. Some of the longer spans reach as high as 1,400 feet. On the poles there are at present two power lines of three wires each using a five-millimetre wire. Along the line there are three substations besides the Seville station. The latter contains the transformer outfit which is needed for the city supply at 3,500 volts. A. DE C.

GREAT BRITAIN.

LONDON, NOVEMBER 12.—A very voluminous report has been issued by the committee on tramway brakes which was appointed about three years ago by the Tramways and Light Railways Association. This committee was the outcome of a series of serious tramway accidents, due to the failure of the brakes to act, and it has received some assistance from the Board of Trade. As testifying to the complete and thorough nature of the investigation which has been carried out it may be mentioned that particulars were obtained of over 5,000 cars, 3,625 being single truck and the remainder double truck. Sixty of the cars were fitted with regenerative control, all had the hand-wheel brake, nearly 3,000 were fitted with the rheostatic brake, about 1,300 with magnetic track brake, 900 with electric short-circuit brake and 120 had a pneumatic track brake. Particulars are given of the very numerous varieties of brake which were investigated and tested by the committee and the causes of accidents are considered in detail. The conclusions of the committee are that all cars should be fitted with two brakes, one of which should be a power brake, although where the traffic is light and the maximum speed slow both may be manually operated. In all accidents, of course, the human element has been an important factor and it is recommended that on all tramway systems there should be a man responsible for the state of the brakes on every car and that a frequent and systematic examination of all brakes should be made. Probably the most useful portion of the report is the section containing particulars of a very large number of tests upon various brakes and sanding apparatus.

Official statistics just published go to show that there are now 216¼ miles of railway in Great Britain worked solely by electricity and 162 miles partly worked electrically. The corresponding figures for a year ago were 197¼ and 157½ miles, respectively. The energy consumed during the past year amounted to 213,675,447 kilowatt-hours, compared with 159,581,401 for the previous year. It is also of interest to note that there are now eighty-six electric locomotives, 806 motor cars and 1,275 trailer cars in use upon these railways.

The manufacturing firm of Bruce, Peebles & Co., which is the agent in this country for Ganz & Co. of Buda Pesth, and which was forced to go into voluntary liquidation last year, has now been reconstructed and a new company is to be formed with a capital of $1,250,000. Creditors and old shareholders are offered stock in the new undertaking upon certain terms which will involve a considerable loss.

Some British and continental capitalists are reported to have joined hands for the purpose of erecting an electric power station in Fiume, Austria, of a capacity of 36,000 horsepower.

It is confidently expected that a result will be arrived at during next week by the committee now considering the bulk electric supply scheme for London. G.

EASTERN CANADA.

OTTAWA, NOVEMBER 21.—From an engineering standpoint, the Ontario hydro-electric power-transmission line from Niagara Falls, 110,000 volts, is the most important of the power-transmission systems of over 40,000 volts in operation and under construction. Work on this system commenced on the 18th inst.

The Montreal fire and light committee has recommended the City Council to offer the Montreal Light, Heat and Power Company a ten-year contract at the following figures: For arc lamps, $75 per lamp per year; for sixty-five-candlepower incandescent lamps, $36, and $24 for thirty-two-candlepower lamps. The proposal also stipulates that the system of lighting now in use shall be replaced by the most modern ones.

The electrification of the Grand Trunk Railway's workshops at Point St. Charles is the latest development of the company's economic policy. The effect of the introduction of electrical equipment in the shops at Stratford and Battle Creek has been to give the management direct practical proof of just what the advantages of electrifying the larger central shops would be. The power required for the purpose of operating the electric plant will be produced from the company's own turbo-generators from coal that it will transport from the mines.

During the coming week there will be several conferences in Montreal between the directors of the Mexican Light and Power Company and representatives of the London house of Sperling & Co. in regard to the leasing of the company to the Mexican Tramways Company. It is now the general belief that the parties favoring the leasing project with the latter company have sufficient proxies to control the actions of the directors, but in view of all the facts, as reported, it is doubtful if the lease, as outlined, will be carried out over the heads of the strong board of directors, who are opposed to the transaction as being unfair to the power company's interests. Should the majority interests, however, undertake to force this lease on the power company the resignation of the directors of that company will likely follow.

One of the best indications of the growing use of electricity is found in the record of the Shawinigan Water and Power Company of Quebec. At present this company is delivering to the city of Montreal 20,000 electric horsepower. As the power was first delivered in 1903, this shows a yearly increase of about 4,000 horsepower, an amount of energy which would, in many cases, operate the entire industries of a city of considerable size. The Shawinigan Company, with its 350 miles of transmission lines reaching from Shawinigan Falls in various directions, is today one of the most complete electrical systems in the world. The power house of this plant is situated about eighty-five miles from Montreal and the company's development is practically completed for 100,000 horsepower. W.

WESTERN CANADA.

Winnipeg, November 21.—The Manitoba Telephone Commission is now making arrangements with the Saskatchewan government to connect the two government systems at a point a few miles east of Sinclair, Man. At the same time the Alberta government is arranging to make connections with the Saskatchewan system at a point on the boundary between the two provinces. The Kootenay Telephone Company, a newly incorporated concern with a capital of $200,000, announces it will at once commence the construction of long-distance telephone lines through the Crow's Nest Pass and connect with the Alberta system on the boundary line between Alberta and British Columbia. This will give the people of Winnipeg, Man., and Nelson, B. C., and the intervening towns telephonic communication.

According to an announcement made by Hon. Robert Rogers, provincial minister of public works, the rates charged for telephones in Manitoba will be reduced at the beginning of the year. He is also authority for the statement that the profits for the first year of operation of the system under government ownership will amount to $200,000.

Since May last the government of Alberta has added 600 miles of long-distance lines to its provincial telephone system. There are now 1,400 miles of long-distance line under operation by the government and 165 exchanges, against thirty-five in May last. The department of telephones is now planning a number of other lines to be built next year, connecting up the smaller towns and villages in the province.

At Cannington Manor, Saskatchewan, the farmers are organizing for the purpose of building a rural telephone system. Estimates provided by the provincial department of telephones show that a system can be installed at an average cost of $35 per mile, including one telephone per mile. Work will commence shortly.

According to H. N. Ruttan, city engineer, the pumping at the city wells in Winnipeg can be done at a great saving by the use of electricity instead of steam. It is probable arrangements will be made with the Winnipeg Electric Company to furnish the necessary power until such a time as the civic plant at Lac du Bonnet is in operation.

The Dominion Messenger and Signal Company is the name of a new organization in Winnipeg which is applying to the city for the right to receive alarms of all fires by a wire connected with the central fire hall. The company has already secured the privilege of using the conduits of the Manitoba Telephone Commission for its wires. The objects of the company have not yet been disclosed. R.

IMPORTANT DEVELOPMENTS.

ELECTRIFIED OPERATION OF SOUTHERN PACIFIC RAILROAD POSSIBLE—A rumor has been current for some time that the properties of the Great Western Power Company, which were supposed to be allied with the Western Pacific interests, had passed under Harriman control, and that the Southern Pacific's local lines in Alameda County were to be operated by Great Western power, using the plant now under construction at Fruitvale Avenue as an auxiliary. A dispatch from Reno, Nev., declares that the Fleishhackers have secured control of the Truckee River General Electric Company, and that Harriman is behind the Fleishhackers in the deal. The presumption is that the Southern Pacific road from Sparks, Nev., is to be operated by electricity, as it has been hinted a number of times that this would eventually be done. A.

STANISLAUS POWER COMPANY BEGINS OPERATION OF 100,000-VOLT LINE IN CALIFORNIA—Work is progressing rapidly on the new power plant of the Stanislaus Electric Power Company in Tuolumne County, California. The first unit, supplying power in the neighborhood of the plant, was started about a month ago. At present two units, with a capacity of about 13,000 kilowatts, are in operation. The remaining units, which will bring the capacity to 20,000 kilowatts, are now in place, but the final work necessary before they can be started up will take about three weeks more. The transmission line, operating at 100,000 volts, is now in use. Under a temporary arrangement, the power is delivered to the lines of the Pacific Gas and Electric Company at Mission San Jose, which is at present the end of the Stanislaus company's line. It will be several months before the line can be extended into San Francisco, and until that time all the power will be sold to the Pacific company. As soon, however, as the line can be completed, the power will be marketed independently in San Francisco and vicinity. A.

SUIT TO DETERMINE LIABILITY FOR INTERFERENCE OF POWER CIRCUITS WITH TELEPHONE LINES—The case of the Citizens Telephone Company against the Fort Wayne & Springfield Traction Company, filed in the Adams County Circuit Court during the past week, is one of great importance to the electric companies operating in Indiana. Several years ago the commissioners granted a franchise to the telephone company for a right-of-way between Decatur and Fort Wayne. The company put up its poles and wires, which were used successfully for several years. The Fort Wayne & Springfield Traction Company later obtained a right-of-way from the commissioners to run its electric line over the same route, and shortly after the traction line began to operate its high-tension transmission system, it was found that the alternations in the power circuit induced noise in the telephone lines, rendering them useless. The telephone company was compelled to move its lines from two to eight miles from the traction line in order to avoid interference, and for the cost of this the telephone company asks judgment from the interurban company. S.

ELECTRIC LIGHTING.

SLIDELL, LA.—The Slidell Light and Ice Company is to install an electric-light plant.

LINDSAY, OKLA.—The city contemplates issuing bonds to construct an electric-light plant.

MOBRIDGE, S. D.—An electric-light franchise has been granted to E. E. Empey, H. B. Miles and others.

AUSTIN, TEX.—The Board of Regents of the University of Texas contemplates the erection of a power plant.

MAYFIELD, O.—The Mayfield Water & Light Company has increased its capital stock from $10,000 to $20,000.

LITTLE ROCK, ARK.—The Little Rock Railway and Electric Company will expend $75,000 in increasing the capacity of its plant.

MUSCATINE, IOWA.—J. C. Sodini has leased the Electric Park and will convert it into a "White City" amusement park for next year.

GARY, IND.—It is announced that the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., will establish a branch factory near Gary. S.

SUPERIOR, WIS.—The Northwestern Lighting Company has been incorporated with a capital stock of $15,000 by E. M. Prindle, Theodore Hanson and Louis Hanitch.

NAUVOO, ILL.—The Nauvoo Electric Light and Power Company has incorporated with a capital stock of $5,000. The company consists of local capitalists.

SANTA CRUZ, CAL.—The City Council of Santa Cruz is working on a proposition to issue bonds for the reconstruction of the municipal electric-lighting system.

ANN ARBOR, MICH.—Coach Yost, of the Michigan football team, has had Ferry Field strung with electric lights and an hour of practice is held every evening after dark.

LA CROSSE, WIS.—The La Crosse Water Power Company announces that it will be prepared to generate current for light and power at the plant at Hatfield by December 1.

SONORA, CAL.—The Tuolumne River Power Company has been incorporated at Sonora, with a capital stock of $500,000, by C. D. and W. M. Shaw, C. F. and F. H. Cross.

TWILLINGATE, N. F.—Frederick S. Palmer of Boston, Mass., has obtained a franchise for an electric light and power plant at Twillingate, which he will install this winter.

EVANSVILLE, IND.—Plans are being made by the Evansville Gas and Electric Light Company for improvements costing nearly $400,000. A turbo-generator set will be installed. S.

LAPORTE CITY, IOWA.—The electric light and water plant was damaged by fire to the extent of $3,000 last week. Fire of unknown origin was discovered at 10 o'clock in the morning.

DOWNEY, CAL.—J. R. Gordon has obtained a franchise for furnishing electric light to the town of Downey. He will install a distributing system, covering a territory eight miles square.

LUDINGTON, MICH.—The Interurban Electric Light and Power Company of Ludington has filed articles of incorporation for a capital stock of $100,000 with the secretary of state at Lansing.

HOQUIAM, WASH.—The Grays Harbor Light and Electric Company, of Hoquiam, will shortly install a large amount of new equipment, making material improvements in the lighting service.

COLUMBUS, OHIO—The Middletown Light and Power Company has been incorporated by B. L. Murphy, Charles W. Elliff, Asa McBride and William Sullivan, with a capital stock of $100,000.

HUSUM, WASH.—An electric-light plant to cost about $15,000 will be installed at Stevenson, in Skamania County, deriving power from Rock Creek. The plant is promised to be in running order by December 15.

SPOKANE, WASH.—Jerome Drumheller has organized a company at Spokane with the purpose of developing 10,000 horsepower with a 500-foot head of water, a short distance above the mouth of the Moyie River. Work has already begun on the development. The power will be disposed of for the development of mining and lumbering in northern Idaho. A.

EBANO, MEXICO—The Mexican Petroleum Company will install a hydro-electric plant in its oil field at Ebano, in the state of San Luis Potosi. The company has an extensive industry at that place.

SCOTTSBURG, IND.—The City Council of Scottsburg has decided to install an electric-light and water works plant. As soon as plans are completed, bids for the installation of the plant will be received. S.

GRAND RAPIDS, MICH.—The illumination of Monroe street by series tungsten lamps, a continuation of the lighting scheme of Canal street, was completed, and the current turned on election night, November 3.

CHESTER, VT.—The local electric light company has contracted with the Claremont Electric Power Company for a supply of power developed by harnessing the Black River by the dam at Cavendish Gorge.

WESTPORT, CONN.—The Westport Light and Water Company is laying plans for a line through Green's Farms to Fairfield, and offers to lay out $10,000 on improvements if the Fairfield contract can be secured.

LOS ANGELES, CAL.—The city of Los Angeles, which is engaged in the construction of an aqueduct, will let contracts next month for a 750-kilowatt generator with the necessary equipment and a number of transformers.

DAVENPORT, IOWA.—Brady Street, between Second and Fifth streets, is to have a special illumination scheme, which is supported by a merchants' association. Iron posts surmounted by incandescent lamps will be used.

RED HILL, PA.—If a franchise can be obtained a power plant will be built in Greenville and lines run to Red Hill, furnishing electric light to both towns. East Greenville has had an acetylene gas plant for a year.

GRANDLEDGE, MICH.—Municipal ownership has been found a failure in Grandledge. At a special election the village has voted to sell its electric-lighting plant to the Commonwealth Light and Power Company of Jackson.

RIVER PARK, IND.—The town board of River Park has granted a fifty-year franchise to the Indiana & Michigan Electric Company, to extend its wires, supply street lights and furnish the inhabitants with light and power. S.

GREENVILLE, CAL.—The Round Valley Power Company is installing a plant near Greenville, where a fall of 900 feet is available. It is proposed to generate 2,000 horsepower, which will be sold for irrigation pumping purposes.

REDWOOD CITY, CAL.—The town of Redwood City is planning to extend its electric-lighting service into several residence towns which have recently been built up in the vicinity, and bids will soon be called in for the necessary supplies.

SALT LAKE CITY, UTAH.—The Wasatch Electric Service Company has filed articles. It has 20,000 shares at $1 each. The officers are: Tony Jacobson, president; Sam S. Porter, vice-president; Rob D. McCreery, secretary and treasurer.

LIGONIER, IND.—Municipal ownership of the electric-lighting system of Ligonier is not favored by the citizens. At a recent election the proposition to own and operate a municipal lighting system was voted down by a majority of 72. S.

CHANDLERVILLE, ILL.—The town of Chandlerville has issued its first bonds since its incorporation, to pay for the new municipal lighting plant, recently purchased for $7,000. The installation of the plant is to be completed by December 1.

OROVILLE, CAL.—H. O. Logue has filed several applications for waterpowers in Plumas County and declares that he will build electric power plants. The locations call for 15,000 inches of water on Nelson Creek, a like amount on Onion Valley Creek and 30,000 inches on the Middle Fork of the Feather River at Bidwell Bar, making a total of 60,000 inches. The water from

Nelson and Onion Valley creeks is to be conveyed through Bald Rock Canyon, a wild and rocky canyon that has never been explored by white men.

QUINCY, CAL.—H. O. Lague has been making numerous water locations in Plumas County, California, and it is now announced that he and his associates will build an electric-power plant. Water to the amount of 60,000 inches has been secured.

IOWA CITY, IOWA—The City Council is taking up the matter of electric lights, and maps, proposals, specifications and all other papers, etc., in the matter will be considered carefully by the city solicitor and others, and the Council will be ready for action next month.

OAKLAND, CAL.—A measure has been proposed to the supervisors of Alameda County for the creation of electric-light districts throughout the county similar to the sanitary districts now in existence, in order to relieve the county of the burden of providing lights upon petition.

SAN FRANCISCO, CAL.—The San Francisco Gas and Electric Company will within a few months house its general offices in a handsome new building. Contracts have just been let for the erection of a six-story and basement structure on Sutter street, between Powell and Stockton.

CUERNAVACA, MEXICO.—A large electric-light and power plant is being built in Cuernavaca by E. Conas, the treasurer of the State. The capacity of the new plant will be 1,600 horsepower. It will be used for lighting the city and supplying the tramway system, which is also the property of Mr. Conas.

WHITE SALMON FALLS, WASH.—Martin and J. T. Thompson are installing an electric-lighting plant at White Salmon Falls, to supply the town and the surrounding country. They are installing a 3,000-horsepower engine, and will have all the necessary equipment on the ground in a short time.

VALE, ORE.—The Vale Light and Water Company of Vale, Ore., has been reorganized, R. C. Carter of Baise purchasing a controlling interest in the company. The new president is authority for the statement that the lighting plant will be overhauled and new machinery installed.

LOS ANGELES, CAL.—Work has just been started on a large electrical plant, which will furnish lighting for the Benson Lumber and Logging Company as well as power for the street railway lines of the South Park & East Side Railway. The plant is being erected by the San Diego Wood Products Company, an offspring of the Benson Company.

TACOMA, WASH.—An ordinance is being drawn up by the city attorney of Tacoma for a municipal power project, the principal feature of which is the erection of a $2,000,000 power plant, with a capacity of 20,000 horsepower, on the upper Nisqually River. The plan includes the construction of a reservoir. The initial expense, according to the present plan, is to be met by a $300,000 bond issue. A.

DENVER, COLO.—A bond issue of $1,500,000 has been authorized by the Southern Colorado Power Company for the extension of its electrical transmission lines to all the principal towns in southeastern and southern Colorado and northern New Mexico. Construction work will at once begin along the line of plans already perfected. The central plant of this company is located at Trinidad, Colo., from which light and power will be supplied to all towns within a radius of sixty miles.

INDIANAPOLIS, IND.—J. W. Broady, of Indianapolis, is at the head of a company of manufacturers of central Indiana, who have selected a site for the construction of a power-generating plant in the coal fields near Sullivan, Ind. It is the purpose of these men to erect and equip a plant for the generation of electric power to be transmitted to Indianapolis, Anderson, Crawfordsville, Marion and New Castle. The completion of part of the plant is expected within the next six months. S.

CLEAR LAKE, CAL.—Representatives of the Clear Lake Railway Company, which is working on a projected electric railway line from Napa Valley to the principal towns of Lake County, and the Yolo County Consolidated Water Company are now in San Francisco, and a consolidation of the two concerns is contemplated. Such a deal would enable the railway company, by erecting a low dam at the outlet of Clear Lake, to store ample water to operate a power plant for its line the year round. A.

EL DURO, MEXICO—The Guanajuato Power and Electric Company, which established a large hydro-electric plant at El Duro, state of Michoacan, a few years ago, and built transmission lines to the Guanajuato mining district and city of that name and to other industrial centers within a radius of 150 miles, is making important enlargements and improvements to its great plant and system. It will have its new high-tension transmission line between Guanajuato and Penjamo finished by January 1. The improvements at the various sub-stations of the company will also be completed and ready for operation at that time. New oil switches for the new 60,000-volt line are also being installed. The section of the new reserve transmission line of the company between Guanajuato and Irapuato was recently finished. George W. Bryant, of Colorado Springs, Colo., is an owner.

OBITUARY.

MR. E. H. MIDDLETON, superintendent of the Chicago South Park electric-lighting system, was electrocuted November 22 in the power house at Fifty-eighth Street and Cottage Grove Avenue by coming in contact with a highly charged wire or bus-bar. Mr. Middleton was forty-five years of age, married, and lived at 5328 Jackson Park Avenue.

MR. JAMES FERGUSON, formerly superintendent of the Brooklyn municipal electric-lighting plant and latterly superintendent of the Safety Insulated Wire and Cable Company of Bayonne, N. J., died on November 15 at his home, 173 Hudson Boulevard, Bayonne, of kidney trouble. He was born in Nova Scotia forty-eight years ago and is survived by his widow, a son and two daughters.

MR. OLIVER WELDON BARNES, a civil engineer, who had been identified with railroad construction work in various parts of the United States for the last sixty years, died of pneumonia on November 14 at his home in New York, N. Y., at the age of eighty-eight years. He was engaged in his profession up to a few days before his death. Mr. Barnes was connected with the Pennsylvania Railroad, and it was he who settled the final location of the road from the Alleghany Mountains to Pittsburg, Pa. In 1885 he was a Croton Aqueduct commissioner, and in 1887 was chief engineer of the New York & Long Island Railroad Company. He was a member of the American Society of Civil Engineers, the Union League Club, of New York; the New England Society, and the Engineers' Club, of Philadelphia. He was born at Hartford, Conn., and at sixteen years of age went to Burlington, N. J., to take up his studies as civil engineer, which he completed in Europe. He returned to this country in 1847, and was appointed an engineer in the first corps which went out from Philadelphia to survey the western division of the Pennsylvania Railroad. He was in charge of the engineering for many railroads, including the Boston, Hartford & Erie. In 1871 he became president of the New York City Central Underground Railroad Company, then authorized to build a line from City Hall to Harlem. In 1872 this company passed to the control of the New York & Montreal Railroad Company. Mr. Barnes is survived by a widow, two daughters and a son. He was buried at Fishkill, N. Y., where he had a summer home for forty years.

DATES AHEAD.

International Independent Telephone Association. Annual convention, Chicago, Ill., December 1-3.

American Society of Mechanical Engineers. Annual meeting, New York city, December 1-4.

American Roentgen Ray Society. Annual meeting, New York city, December 28-30.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

American Association for the Advancement of Science. Annual meeting, Baltimore, Md., January, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

ELECTRIC RAILWAYS.

MISSOULA, MONT.—W. A. Clark is considering the establishment of an electric street-car line at Missoula. C.

DEADWOOD, S. D.—The Black Hills Traction Company expects to have its new electric-generating plant at Deadwood completed by December 1. C.

MARQUETTE, MICH.—The Ironwood and Hurley traction system, which extends from Jessieville through Ironwood and across the Montreal River to Hurley, is to be extended to Bessemer, Mich.

SEATTLE, WASH.—The Seattle-Everett Interurban electric railroad, operating between Seattle and Hall's Lake, has been absorbed by the Stone & Webster interests, and the road will be completed to Everett at once. A.

FRANKFORT, ILL.—The grading for the electric line of the J. & S. Railway along the twelve-mile stretch from Frankfort to Chicago Heights, will soon be completed. Material for the line and track construction is under way.

KALAMAZOO, MICH.—An electric railroad is to be built between Kalamazoo and Elkhart, Ind. This road was surveyed two years ago and much right of way purchased, but it then was dropped for a time. A syndicate has agreed to finance it.

LAWRENCE, KAN.—At a special meeting of the City Council granted a franchise for local service for an electric line to a company headed by W. R. Stubbs, J. E. Stubbs, A. Henley and C. E. Sutton. The company promises to begin work within thirty days.

EVANSVILLE, IND.—On account of the continued drouth it is now costing the Evansville & Southern Indiana Traction Company $800 per month for water to operate its system between Evansville and Princeton. The water is hauled in tanks to the power house in Fort Branch.

EVANSVILLE, IND.—The work of repairing the power house of the Evansville & Eastern Traction Company, at Evansville, has been completed. During the time the power house was out of commission the company operated its road by a locomotive, maintaining a two-hour schedule. S.

WHEELING, W. VA.—Another trolley line has been projected to connect Wheeling with Pittsburg. The new line will follow the West Virginia shore and will be a much shorter route than any that has yet been proposed. The new road will carry passengers over the existing lines from Wheeling to Chester, when the new line will start, with Pittsburg as the terminus.

SACRAMENTO, CAL.—Since the death of Henry A. Butters, president of the Northern Electric Railway Company, parties interested have proposed a combination of the contemplated Hotaling electric line from a point on the bay opposite Sausalito northeasterly to Sacramento, and the Northern Electric, which now extends from Sacramento to Chico, and which soon will be put through to Redding.

PEORIA, ILL.—Two interurban sleeping cars have been operated for eighteen months by the Illinois Traction Company with such success that more cars have been ordered. The first sleepers were put on as experiments, and the chief objection to them proved to be the noise and vibration caused by the motors and the air pump. These interfered with sleep. The new sleepers are made without these noisy accessories, and are run as trailers.

SPOKANE, WASH.—A meeting of stockholders of the Washington Water Power Company has been called for December 1, for the purpose of authorizing a twenty-per-cent increase of the capital stock, which is now $5,016,300, and an issue of bonds to the extent of $15,000,000. It is planned to expend about $2,000,000 a year for the next few years on improvements and extensions. The company now has a number of electric street-railway lines in Spokane, Wash., an interurban railway and an extensive transmission and distributing system, including stations at Spokane, Post Falls and Ross Park. Another important power station is now under construction at Little Falls, on the Spokane River. A.

FAYETTEVILLE, ARK.—Louis Moulton of Boston has applied for a street-car franchise to connect with an electric railway projected from Siloam Springs to Huntsville, Ark. G. T. Propper of Minneapolis also has a plan to build a belt line connecting with a road to Joplin, Mo. The latter contemplates using an old right of way granted for a steam road from Fayetteville east for a distance of six miles.

TOLEDO, OHIO—Curtis M. Steudell and Valentine H. Sorghner, of Chicago, have purchased the Michigan branch of the Toledo, Ann Arbor & Detroit Railway at forced sale, for $60,000. It is generally understood that about $500,000 has already been spent upon the unfinished project, and that it is worth far in excess of the sum paid by the new owners. It is bonded for about a million and a half dollars, and the bondholders will be heavy losers. H.

ELECTRICAL SECURITIES.

For the first time since election the market last week showed some abatement in speculative and investment activity, and public participation fell off, making for bearish conditions. Business, in general, continues to improve, and although there have been exaggerations of the expansion in some quarters, with consequent disappointment, the usual comment is quite satisfactory and optimistic.

Dividends have been declared upon the following electrical securities: General Electric Company; regular quarterly dividend of $2 per share, payable January 15 to stock of record December 3. Kansas City Railway and Light Company; regular quarterly dividend of one and one-fourth per cent on the preferred stock, payable December 1. Norfolk Railway and Light Company; semi-annual dividend of two per cent, payable December 5 to stock of record November 21.

ELECTRICAL SECURITIES FOR THE WEEK ENDED NOVEMBER 21.

New York:	*Closing.*
Allis-Chalmers common	14
Allis-Chalmers preferred	48⅜
Brooklyn Rapid Transit	53¼
Consolidated Gas	151
General Electric	152
Interborough-Metropolitan common	13
Interborough-Metropolitan preferred	33⅜
Kings County Electric	129
Mackay Companies (Postal Telegraph and Cables) common	76
Mackay Companies (Postal Telegraph and Cables) preferred	70
Manhattan Elevated	142½
Metropolitan Street Railway	30
New York & New Jersey Telephone	119
Western Union	65
Westinghouse Mfg. Company	92

Boston:	*Closing.*
American Telephone and Telegraph	130¾
Edison Electric Illuminating	250
Massachusetts Electric	55
New England Telephone	124½
Western Telephone and Telegraph pref.	75

Philadelphia:	*Closing.*
Electric Company of America	10¾
Electric Storage Battery common	41½
Electric Storage Battery preferred	41½
Philadelphia Electric	11⅝
Philadelphia Rapid Transit	22½
United Gas Improvement	91

The directors of the Philadelphia Rapid Transit Company have accepted the resignation of George H. Earle, Jr., as a director.

Chicago:	*Closing.*
Chicago Telephone	128½
Commonwealth Edison	108
Metropolitan Elevated preferred	43
National Carbon common	80
National Carbon preferred	112

PERSONAL MENTION.

MR. FRANK N. JEWETT has been appointed general sales manager of the Wagner Electric Manufacturing Company, with headquarters at the main office and factory in St. Louis, Mo.

For the past three years he has been district manager of the Wagner company, with headquarters in the Marquette Building, Chicago. Mr. Jewett was born in New York in 1870, and was graduated from Cornell University in 1893. After his graduation he was employed by B. W. Payne & Sons, of Elmira, N. Y., manufacturing boilers and engines. He spent two years in the experimental department of this company and one year in the sales department. He then became associated with the West Side Street Railway Company, of Elmira, and constructed its power house. Later he was identified with the firm of Evans, Almirall & Company, of New York, contractors for central-station heating and power plants, and in 1900 opened this company's western office in Chicago, retaining the position of western manager until 1906, when he accepted the position of district manager of the Wagner company. Through his connection with the central-station heating industry Mr. Jewett has a large acquaintance in the electrical fraternity and has made a deep impress upon all with whom he has come in contact throughout his entire career. His great knowledge of the requirements of the electrical industry, and his wide acquaintanceship, render him particularly well fitted to direct the sales organization of this important company.

MR. R. H. HARPER has been appointed chief electrician for the Fort Wayne Knitting Mills, Fort Wayne, Ind.

MR. WILLIAM ROBBINS McGOVERN has been appointed chief engineer of the Wisconsin Telephone Company.

MR. H. S. SALT has resigned as vice-president and general manager of the Dale Company, New York city, to take effect on January 1.

MR. W. C. EGBERT has been placed in charge of the Chicago office of the Willard Storage Battery Company, of Cleveland, Ohio.

MR. J. D. EDMONDS, formerly with the Western Electric Company, at Chicago, has been appointed to a responsible position in the operating department of the Sterling Electric Company, Lafayette, Ind.

MR. GEORGE H. FOLDS, for many years an officer of the Twin City Rapid City Transit Company, of Minneapolis, has been appointed general sales manager for the H. W. Johns-Manville Company, of New York. C.

MR. H. W. KENT, formerly superintendent of the British Columbia Telephone Company, has been appointed agent for the province of British Columbia for the Northern Electric Company. His headquarters are at Vancouver, B. C. R.

MR. JOHN H. JENNINGS, who has been superintendent of the Keene Electric Railroad, at Keene, N. H., has tendered his resignation, intending to go to Columbus, Ohio, to take a manager's position with the Ohio Railway Company.

CONGRESSMAN HENRY A. BARNHART, of Rochester, Ind., recently elected from the Thirteenth Indiana District, has taken a prominent part in the Independent telephone movement in Indiana, and was for a time the president of the Rochester Telephone Company.

MR. J. C. GIBSON, who has been division contract agent for the Central Union Telephone Company, with headquarters at Columbus, has taken charge of the Toledo exchange, succeeding F. Lukenbell, who after taking a vacation will accept a position in another part of the Bell territory. H.

MR. WILLIAM J. BAUGHMAN, superintendent of the Stanley-G.-I. Electric Manufacturing Company, Pittsfield, Mass., who has tendered his resignation to take effect December 1, has the selling agency for the General Vehicle Company of Long Island City, N. Y., manufacturers of auto trucks.

MR. HUGH J. McGOWAN, of Indianapolis, is included among those mentioned to succeed Senator Hemenway in the United States Senate. Mr. McGowan is president of the Indianapolis Street Railway Company, and is also president and general manager of the largest system of interurban lines in the state.

DR. CHARLES SIEMANS recently passed through Ottawa, Ontario, on his way from Japan to England. He has been in Japan making an inspection of the railways of that country for the Japanese Government with a view to their electrification. Referring to the proposal to electrify the Canadian Pacific, Dr. Siemens declared that electricity is bound to supplant steam on the railways. He was particularly interested, in his journey across Canada, to notice the profusion of waterpower along the line of the railway.

PROF. J. J. THOMSON has been honored by King Edward of England by conferring knighthood upon him for his extended investigations of the subject of electrons and corpuscles as well as other researches in experimental physics. Sir Joseph John Thomson, as he is to be known from now on, has held the chair of Cavendish professor of experimental physics at Cambridge University since 1884 and that of professor of physics at the Royal Institution since 1905. He is a fellow of the Royal Society and also has the titles D. Soc., LL. D. and Ph. D. He is president-elect of the British Association and will preside at its meeting next year at Winnipeg, Canada.

MESSRS. O. P. FRITCHIE and W. P. PFAFF arrived in Chicago last week and resumed their journey the next afternoon in an electric automobile, in which they are making a run from Lincoln, Neb., to Washington, D. C., and New York city. They desired to make the run from Lincoln to New York in twenty-one days, a distance of more than 1,800 miles. Mr. Fritchie is the manufacturer of the Fritchie electric automobile. Leaving Lincoln on October 31, the Fritchie made an average of seventy miles a day, striking roads in Iowa that were so deep in mud that in one or two places gasoline cars were laid up waiting for the highways to dry. In one stretch eighty-nine miles was covered in a day.

PROPOSALS.

ARC LAMPS, WINNIPEG, MAN.—F. E. Cambridge, city electrician, Winnipeg, Man., has been instructed to advertise at once for tenders for fifty arc lamps for street-lighting purposes. R.

FEDERAL BUILDINGS AT LAKE CHARLES, LA., ALTON, ILL., AND AMERICUS, GA.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until December 26 for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the Federal buildings at Lake Charles, La., Alton, Ill., and Americus, Ga., in accordance with specifications, which may be had from the custodians of the respective sites, or at the office of the Supervising Architect.

POSTOFFICES AT NILES AND SAULT STE. MARIE, MICH.—The office of the supervising architect, Washington, D. C., will receive sealed proposals until January 3 for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. postoffice at Niles, Mich., and for the construction complete (except elevator) of the postoffice at Sault Ste. Marie, Mich., in accordance with the specifications, which may be had from the respective custodians of site or from the office of the supervising architect.

ENGINEERING SOCIETIES.

ELECTRO TECHNIC CLUB, FORT WAYNE, IND.—The Electro Technic Club, of Fort Wayne, Ind., has announced its programme for 1908-09. A number of prominent men will address the club members on a variety of interesting subjects. The first meeting, held on November 17, was addressed by Prof. C. E. Reed, of the Case School of Applied Science, Cleveland, Ohio, on "Electrical Measuring Instruments." On January 5, E. A. Barnes, superintendent of the Fort Wayne Electric Works, will read a paper on "A Century of Steam."

TELEPHONE AND TELEGRAPH.

SYLVAN, WIS.—The Mill Creek Telephone Company has been incorporated with a capital stock of $3,000.

BEACH, N. D.—The Golden Valley Telephone Company will soon begin installing a telephone system here.

ELLENSBURG, WASH.—The Ellensburg Telephone Company has been incorporated with a capital stock of $10,000.

BOVEY, MINN.—The Mesaba Telephone Company has been granted a franchise for a local exchange at Coleraine and Bovey and will install at once.

COTTONWOOD GROVE, NEB.—The Cottonwood Grove Mutual Telephone Company has been incorporated with a capital of $700 by John Henry and others.

IOWA CITY, IOWA—The Johnson County Telephone Company of this city has reorganized and contemplates the expenditure of about $35,000 in improvements.

ATLANTA, IND.—The Aroma Farmers' Telephone Company, of Atlanta, Hamilton County, has incorporated to build a telephone exchange and system. Henry Carpenter, J. G. Swift and S. E. Billhymer are incorporators.

B. F. Jacobson of Bella Coola, B. C., is making arrangements for the construction of a rural and local telephone system in and around Bella Coola. Construction work will commence as soon as the necessary supplies have been obtained. R.

ROCKWELL CITY, IOWA—P. C. Hoeldoegel of this city, president of the International Independent Telephone Association, has expressed his opinion that the independent telephone companies in the state of Iowa will spend more than $6,000,000 in improvements during the coming year.

FERGUS FALLS, MINN.—The Council of Fergus Falls, Minn., has named a committee to consider the matter of installing a municipal exchange. The Northwestern Telephone Exchange Company had proposed to rebuild the local exchange and raise the rates, and this aroused the idea of a municipal movement.

PERKINSVILLE, IND.—The Farmers' Telephone Company, of Perkinsville, has been organized and will install a local exchange, extending the lines to Frankton, New Lancaster, Elwood and Noblesville. Arrangement has been made with the Central Union Telephone Company for toll-line connection. Charles Harvey, of Elwood, is president of the new company, and F. E. Haworth is secretary.

CINCINNATI, OHIO—The Cincinnati & Suburban Bell Telephone Company has decided to increase its outstanding capital through the issuance of $282,500 treasury stock. The new stock will be given to stockholders at par at the ratio of one share for every twenty-four held. The books close December 14 and the new stock will be allotted on January 4. The present market value of the stock is 175.

EVANSVILLE, IND.—A convention of representatives of the Cumberland Telephone Company and associate companies was held in Evansville November 12. About 100 officials connected with the Cumberland system from southern Illinois, eastern Kentucky and southern Indiana cities were present. J. C. Symmes, superintendent of the Nashville-Evansville district, called the convention to order. During the afternoon session George B. Hall, superintendent of the Evansville-Louisville district presided. After a protracted discussion of a number of questions relating to special features of telephone management and operation the closing address was made by General Manager Leland Hume, who expressed keen appreciation and satisfaction over the attendance and success of the meeting and predicted its results would better the service of the entire system. S.

EDUCATIONAL.

CLARKSON SCHOOL OF TECHNOLOGY—The trustees and faculty of Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., announce the founder's day exercises and twelfth anniversary, on Tuesday evening, December 1, in the assembly hall, at 8 o'clock. The founder's day address will be delivered by Samuel Wesley Stratton, director of the Bureau of Standards, Department of Commerce and Labor, Washington, D. C.

INDUSTRIAL ITEMS.

THE WESTERN ELECTRIC COMPANY, Chicago, will open headquarters in Minneapolis at 114-122 Third Street N. on December 1.

THE UNIVERSAL ELECTRIC STORAGE BATTERY COMPANY, Chicago, announces that its factory and general offices have been merged and that the address of both hereafter will be 65 North Peoria Street, Chicago.

THE JENNEY ELECTRIC MANUFACTURING COMPANY, Indianapolis, Ind., has increased its capital stock from $450,000 to $600,000, and has notified the Secretary of State that the place of business and plant will be removed from Indianapolis to Anderson.

THE WESTERN MACHINE COMPANY, Indianapolis, Ind., has incorporated with a capital stock of $60,000 to establish a plant to manufacture engines, boilers, machinery, tools and electrical and mechanical appliances. George J. Schlotzauer and C. H. Scholl, directors.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., through James J. Wood, announces that since the election $150,000 worth of orders has been booked. The company is increasing its force and facilities gradually, and soon expects to be working beyond its old schedule.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, Chicago, Ill., announces that it has on hand a good supply of electrical toys and novelties for the holiday season. Special catalogues devoted to these specialties will be sent to those interested in this line upon request.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., issued a special bulletin under date of November 16, covering the line of special lamps for train-lighting purposes. This bulletin was prepared especially for the convention of the Association of Car-Lighting Engineers, held in Chicago last week.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., announces that the Wabash Railroad Company has awarded it a contract for supplying the Fort Wayne, Ind., locomotive repair shops throughout with Wagner polyphase motors. Motors of from ten to forty horsepower capacity constitute this order, and they will be used for driving all kinds of machine tools.

THE MASSACHUSETTS CHEMICAL COMPANY has recently established new quarters for its Boston office at 185 Summer Street, opposite the South Station and across the street from its old location at 170 Summer Street. E. W. Furbush, general manager of the company, usually spends the mornings at the factory at Walpole and the afternoon at the Boston office. Louis O. Duclos, the general sales manager, will make his headquarters at the new offices.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., announces that another large manufacturing plant, the Estey Organ Company, Brattleboro, Vt., is to install electric drive throughout its works. The company has just placed with the Crocker-Wheeler Company an order for fifty-seven induction motors, ranging from one-half to seventy-five horsepower, together with seven transformers and a switchboard. Current will be purchased from the Connecticut River Power Company.

THE SOUTHERN ILLINOIS ELECTRIC COMPANY, East St. Louis, Ill., announces that it has taken over the business of the American vibrator. During the four years this vibrator has been manufactured about 6,000 have been sold. The American vibrator is constructed to produce rotary vibration and has a regulating screw which enables any one of six speeds to be applied. Its efficacy is based upon the principle of producing perfect blood circulation to restore health, in the treatment of nervous diseases, rheumatism, lumbago and numerous other complaints. Since October 1 the Southern Illinois Electric Company reports that it has sold 260 machines and orders are coming in rapidly from all parts of the world. The company is sanguine of a decided increase in the next few months and these sales, in addition to its electric railway supply, lighting and contracting business, enable it to report prosperous conditions.

THE MINNEAPOLIS STEEL AND MACHINERY COMPANY, Minneapolis, Minn., has secured the contract to install a new power plant for the Manhattan City and Interurban Railway Company, of Manhattan, Kan. The installation will include an eighteen by thirty-six inch heavy-duty Twin City Corliss engine, two sixty-six-inch by eighteen-foot horizontal return tubular boilers, one 200-kilowatt generator, together with switchboard, feed-water heater and purifier, boiler-feed pump, etc.

THE BROWN HOISTING MACHINERY COMPANY, Cleveland, Ohio, manufacturer of automatic hoisting and conveying appliances, has issued a new catalogue, which covers thoroughly its well-known products in this line. "Brownhoist" grab buckets for handling coal, ore, limestone, etc., are pictured in use on many different types of machines. The "Brownhoist" single-rope buckets for application to existing machines having but a single-drum engine are also described and illustrated, and automatic dumping tubs, shovel buckets, etc., are shown.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a new folder describing Type B knife switches which conform to the National Electrical Code standard. A complete list is given of the current capacities, combinations and prices. Another folder illustrates the use of the Matthews guy anchor, showing the method of placing the anchors in constructing pole lines. An eight-page circular issued by the company describes the construction, application and installation of the new General Electric multi-catch sockets. Several advantages are claimed for these sockets over the older forms.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has prepared a number of little folders and fliers telling about its low-voltage and miniature lamps. One of these that is particularly seasonable describes decorative lighting outfits. The use of these outfits is certain to increase so long as lights are used in connection with Christmas greens, because of the ease with which these outfits can be installed, and, above all, the safety with which they can be used. General Electric outfits are made in sizes containing from eight to thirty-two lamps, and may be connected to any lamp socket by means of the standard attaching plug. Full description and prices are contained in folder No. 3710.

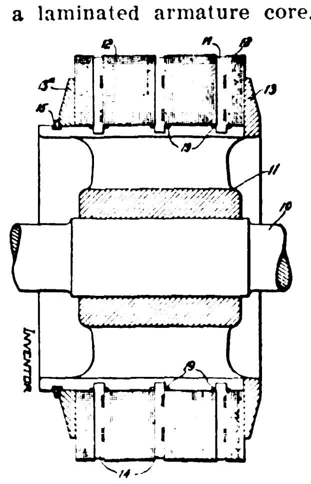
THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has issued catalogue E1, covering Ward Leonard circuit-breakers of single-pole types, in capacities up to and including 150 amperes. Although these single-pole overload circuit-breakers have but one handle they consist of two switches in series, so functionally related that the circuit cannot be held closed when an overload or short-circuit exists. Underload and no-voltage release circuit-breakers are shown for battery and motor protection. The catalogue announces that Ward Leonard circuit-breakers received the gold medal prize at the Paris Exposition, among circuit-breakers from all over the world, and that they received the highest award for exhibit at the Columbian Exhibition.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) November 17, 1908.

903,826. MANUFACTURE OF METAL-FILAMENT LAMPS. William C. Arsem, Schenectady, N. Y., assignor to General Electric Company. Filed March 16, 1907. The method of protecting a filament from deterioration in the presence of an electric arc consists of locally applying a jet of reducing gas enveloped in a jet of inert gas.

903,829. DYNAMO-ELECTRIC MACHINE. Bernard A. Behrend, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed January 31, 1906. Relates to the construction of separators between the sections of a laminated armature core.



903,829.—ARMATURE CORE SEPARATORS.

903,842. EMERGENCY TRAIN-STOPPING DEVICE. Philip Conniff and Franklin A. Pierce, Washington, D. C. Filed January 31, 1908. A circuit closer includes relatively movable contacts and a weighted member carrying the movable contact.

903,860. INCANDESCENT LAMP. John W. Howell, Newark, N. J., assignor to General Electric Company. Filed November 17, 1906. This method of sealing a tungsten filament to a conductor consists in drawing an arc from the end thereof to enclose the filament, the operation being effected within a protective envelope of carbon dioxide and in the presence of illuminating gas.

903,861. ARC LAMP. Charles C. Hughes, Philadelphia, Pa. Filed October 3, 1906. A thermo-expansive alloy member consists of 57½ per cent copper, 42 per cent nickel and one-half of one per cent lead.

903,871. ELECTRIC TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. Filed July 8, 1905. A cable telegraph system is provided with means for impressing alternate positive and negative impulses of practically uniform duration upon the cable.

903,875. SYSTEM OF ELECTRICAL INSULATION. Fred M. Locke, Victor, N. Y. Filed March 20, 1907. A modified suspension-type insulator consists of several petticoated insulators connected by supporting ties leading from the bottom section of each insulator to the top section of the one above it.

903,881. COMMUTATOR NECK OR LEAD. Ashley P. Peck, Milwaukee, Wis., assignor to the Bullock Electric Manufacturing Company. Filed November 9, 1905. The lead is composed of a number of strips of sheet metal fastened together, each strip being corrugated lengthwise.

903,892. FLUID-PRESSURE SYSTEM. William F. Schneider, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed April 29, 1907. An electrically controlled air-compressor system.

903,898. AUTOMATIC INDICATOR FOR TELEPHONES. Richard Sedgwick, Richmond, Ind. Filed July 29, 1907. An automatic telephone is provided with a series of figures to indicate the number which a person has called.

903,905. AUTOMATIC RAILROAD GATE. Eugene C. Smith, New York, N. Y., assignor to Lawrence S. Folger, New York, N. Y. Filed May 28, 1906. A motor lowers the gate when the track circuit is closed by the approach of a train.

903,923. METHOD OF AND APPARATUS FOR RELIEVING WIRE CIRCUITS OF ELECTROSTATIC REACTION CURRENTS. Nathaniel G. Warth, Columbus, Ohio. Filed September 16, 1907. A number of composite electromagnetic coils connect the circuit in multiple with the ground at intervals equal to half the maximum length of such a circuit capable of good transmission without a coil applied to it.

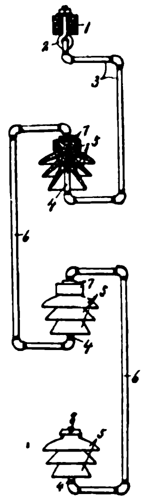
903,927. DRAWBRIDGE CIRCUIT CONTROLLER. Frederick A. Wendler, Elizabeth, N. J., assignor to the Hall Signal Company. Filed May 17, 1907. An electric coupling comprises two separable members adapted to have sliding longitudinal engagement with each other.

903,939. ANODE. Robert J. Wisnom, Virginia City, Nev. Filed May 7, 1907. Consists of a set of rods that can be connected by means of molten metal.

903,945. ELECTROMAGNETIC CLUTCH. Heinrich Ast, Vienna, Austria-Hungary, assignor to Vulkan Maschinenfabriks-Actien Gesellschaft, Vienna, Austria-Hungary. Filed June 15, 1906. One member contains a coil depressed into an iron rim.

903,951. PROCESS FOR THE ELECTROLYSIS OF LIQUIDS. Jean Billiter, Aschersleben, Germany. Filed August 3, 1908. The liquid is fed to the upper one of superposed electrode chambers that are separated by a diaphragm.

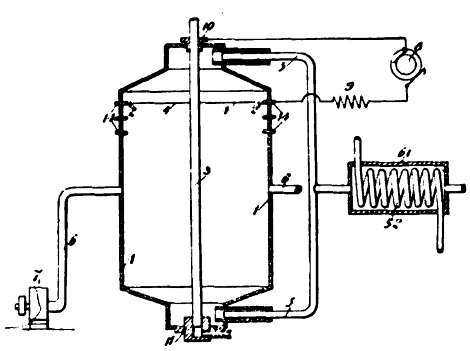
903,966. LAG INDICATOR. William H. Freedman, Burlington, Vt. Filed June 13, 1903. Renewed May 9, 1908. A phase indicator has a circular magnetic core with a polyphase winding thereon in series with the circuit.



903,875.—MODIFIED SUSPENSION-TYPE INSULATOR.

903,972. PIGTAIL BRUSH. Lee C. Hawley, Cleveland, Ohio, assignor to National Carbon Company, Cleveland, Ohio. Filed February 13, 1908. A brush has a transverse hole with a pigtail made of fine wire braided into tubular form, which is distended into intimate contact with its walls.

903,987. CONTACT DEVICE. Frank B. Klopf, New York, N. Y., assignor to Universal Safety Car Controller Company. Filed December 13, 1906. Comprises a casing and a contact member pivotally mounted on a carrier and projecting through an opening in the casing.



904,072.—NITROUS OXIDE PREPARATION.

904,001. ELECTRIC SECONDARY CLOCK. Horace B. McCabe, Chicago, Ill., assignor of one-half to Joseph E. Cochran, Chicago, Ill. Filed November 12, 1906. There are means for transmitting the movement of the magnet armature to a shaft.

904,011. OUTLET BOX. Erwin L. Pierce, Everett, Mass., assignor to Charles S. Knowles, New Bedford, Mass. Filed August 31, 1907. The box has an opening in its wall, an outer stopper partly punched from the body of the box and an inner stopper partly punched from the outer stopper.

904,018. ELECTRICAL SIGNALING SYSTEM. Joseph P. Sauer, Wheaton, Ill. Filed April 10, 1906. In combination with a section of track is a source of current, a controlling relay and an electrically actuated annunciator controlled by the relay.

904,031. TRAPPINGS FOR HORSES. Chelsea L. Warner, Cincinnati, Ohio. Filed June 2, 1906. An incandescent lamp is mounted on a strap. The wires lie between the top and bottom layers thereof.

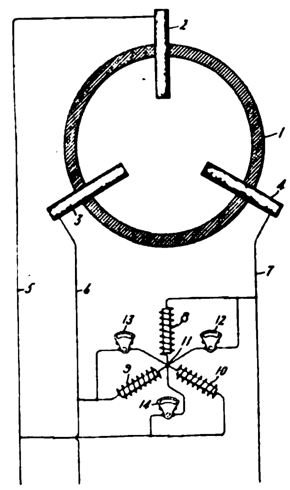
904,042. SWITCH-OPERATING MECHANISM. Robert Brown, Westminster, London, England. Filed July 25, 1906. In a sectional-conduit railway system each car carries a switch-actuating device projecting into the conduit.

904,069. INSULATOR. Willard H. Kempton, Trimble, Ohio. Filed December 16, 1907. The strain insulator has a cylindrical shell formed of longitudinal sections and vitrified insulating blocks extending through the ends of the shell.

904,070. PROCESS FOR EFFECTING CHEMICAL ACTION IN GASES. Dimmitt R. Lovejoy, Niagara Falls, N. Y., assignor to Walter E. F. Bradley, trustee, New York, N. Y. Filed February 18, 1903. The process consists in subjecting the mixture of the gases to the influence of a radio-active body and to the action of an electric arc.

904,071. APPARATUS FOR CHEMICALLY COMBINING GASES. Dimmitt R. Lovejoy, Niagara Falls, N. Y., assignor to Walter E. F. Bradley, trustee, New York, N. Y. Filed February 18, 1903. A combining chamber has electrodes mounted within, means for controlling arcs, means for conducting gases into the influence of the arcs and means for either liquefying or solidifying the gases.

904,072. PROCESS OF CHEMICALLY COMBINING GASES. Dimmitt R. Lovejoy, Niagara Falls, N. Y., assignor to Walter E. F. Bradley, trustee, New York, N. Y. Filed February 18, 1903. A process of promoting the chemical combination of nitrogen and oxygen consists in subjecting the gases to an electric arc and simultaneously refrigerating the nitrous oxides formed.



904,194.—POLYPHASE FURNACE REGULATION.

904,073. APPARATUS FOR EFFECTING CHEMICAL ACTION IN GASES. Dimmitt R. Lovejoy, Niagara Falls, N. Y., assignor to Walter E. F. Bradley, trustee, New York, N. Y. Filed February 18, 1903. Renewed March 23, 1908. This is a modification of numbers 904,070 and 904,072.

904,097. CONNECTOR. Mertie O. Spring, Schenectady, N. Y., assignor to General Electric Company. Filed November 12, 1904. Two terminals are each provided with a clamping face at one end that can be screwed together, the rear ends being protected by an insulating casing.

904,105. TELEPHONE-EXCHANGE SYSTEM AND APPARATUS. Dudley B. Wick, Jr., Cleveland, Ohio, assignor to the North Electric Company, Cleveland, Ohio. Filed September 8, 1904. In combination with the cord circuit is a control-relay having opposite windings governing supervisory signals partially.

904,115. STORAGE BATTERY. Rufus N. Chamberlain, Depew, N. Y., assignor to Gould Storage Battery Company, Depew, N. Y. Filed February 6, 1906. Relates to the construction of the top of a battery jar or tank and a cover therefor.

904,116. RAILWAY BLOCK-SIGNALING SYSTEM. Harry M. Coulter, Chicago, Ill., assignor of one-half to Alfred Stromberg, Chicago, Ill. Filed April 8, 1907. Each block contains a controlling relay in a normally closed track circuit.

904,128. ELECTRIC CLOCK. Robert D. Hickok, Atlanta, Ga. Filed March 27, 1908. In combination with the pendulum rod is an armature frame.

904,139. PROCESS OF MAKING FILAMENTS FOR LIGHTING AND HEATING. Georges Michaud and Eugene Delasson, Paris, France. Filed August 18, 1905. Consists in mixing together alumina and oxides of thorium, cerium and chromium, reducing this to the form of a fine powder, fusing the mixture in a fine stream, and finally forming the fused mas into a filament.

904,157. COMBINED TELEGRAPHIC TRANSMITTER AND TYPEWRITING MACHINE. Augustus G. Snyder, Ilion, N. Y., assignor to Wyckoff, Seamans & Benedict, Ilion, N. Y. Filed April 8, 1904. Includes a series of keys and printing means operated thereby and a series of reciprocatory circuit controllers for transmitting telegraphic signals.

904,185. ARC LAMP. Edward O. Dworak, Chicago, Ill. Filed July 16, 1906. In a regulator for arc lamps there is a pair of supporting tubes with sleeves adapted to slide therein for supporting the carbon rods.

904,194. REGULATION OF POLYPHASE FURNACES. Richard Fleming, Lynn, Mass., assignor to General Electric Company. Filed February 13, 1908. A substantially constant-voltage polyphase source has reactances connected at one end to electrodes and at the other end to a common neutral point and voltmeters connected in parallel with the reactances.

904,196. ELECTRIC IGNITER FOR EXPLOSIVE ENGINES. George A. Goodson, Minneapolis, Minn. Filed February 8, 1902. A magneto generator supplies current for the spark intermittently.

904,203. FUEL HEATER FOR EXPLOSIVE ENGINES. Harry Hertzberg, New York, and Abbot A. Low, Horseshoe, N. Y.; said Hertzberg assignor to said Low. Filed October 10, 1907. There are means for supplying current to a heating member composed of resistance material.

904,222. OSCILLATION-DETECTING MEANS FOR RECEIVING INTELLIGENCE COMMUNICATED BY ELECTRIC WAVES. Greenleaf W. Pickard, Amesbury, Mass. Filed March 11, 1907. Two massive electrical conductors having high thermoelectric power are pressed in contact with each other.

904,248. MEANS FOR REMOVING STATIC ELECTRICITY. William H. Chapman, Portland, Me. Filed February 18, 1907. A strip of non-conducting material has enclosed therein a conductor with portions extending to and terminating flush with the surface of the strip and presenting small points to the air.

904,263. PROCESS OF OBTAINING METALS FROM THEIR ORES. Karl Kaiser, Berlin, Germany. Filed June 22, 1906. Consists of heating raw materials in an electric furnace, then forcing air and finally a gaseous reducing agent into contact with the molten mass until the metals are reduced.

904,280. MAGNETIC SEPARATOR. Marcus Ruthenburg, Lockport, N. Y. Filed June 22, 1907. A vertical rotary shaft carries a magnet comprising opposed annular polar projections.

904,320. SWITCHBOX. Edward J. Dustman, New York, N. Y. Filed April 27, 1907. A wall switchbox has two separable sections arranged so as to allow inclination of one relatively to the other.

904,359. TROLLEY HARP. Joseph Pensis, Speers, Pa. Filed January 31, 1908. One prong of the harp is prolonged beyond the other and extends outwardly to form an arm supporting a trolley-retaining bar.

904,367. RELAY FOR TELEGRAPHS. James Scotland, Hearts Content, Newfoundland. Filed July 10, 1907. The relay has a cylindrical armor for the electromagnet.

904,369. INSULATING BUSHING. Louis Steinberger, New York, N. Y. Filed July 12, 1907. Comprises a number of cylinders, one being provided with a projecting portion which serves as a shed.

904,370. DISK-STRAIN INSULATOR. Louis Steinberger, New York, N. Y. Filed January 20, 1908. A pair of suspension members are separated and partially enveloped by a mass of insulating material provided with flanges extending in opposite directions.

904,415. WATCHMAN'S TIME REGISTER. George W. Ellis, Germantown, Pa. Filed July 3, 1908. An armature in connection with a magnet engages an arm to operate a shutter.

904,420. APPARATUS FOR COOLING ROOMS. Pauline Grayson, New York, N. Y. Filed May 29, 1907. An electric motor operates a circulating fan.

904,425. MEANS FOR AUTOMATICALLY OPERATING GAS OR OTHER VALVES OR ELECTRIC SWITCHES AT PREDETERMINED TIMES. Arnold Hare, Auckland, New Zealand. Filed July 10, 1907. A clock-controlled and spring-actuated time switch.

904,441. COMBINED TELEPHONE-EXCHANGE AND ALARM SYSTEM. John M. Latimer, Philadelphia, Pa., assignor to Consolidated Fire Alarm Company. Filed April 21, 1900. There is a local alarm-transmitting apparatus for establishing grounded connections with the telephone circuit.

904,458. JUNCTION BOX. John N. Scism, Syracuse, N. Y. Filed January 13, 1908. Comprises a shell having a closed bottom and an open top with a plate extending across the opening and removably secured to the shell.

904,462. INTERMITTENTLY DRIVEN MECHANISM ADAPTED FOR CONSTANT DRIVING. Horace H. Taylor, San Jose, Cal., assignor of one-half to Frank J. Mayhew, San Francisco, Cal. Filed July 13, 1907. An electrical circuit-controlling mechanism comprises a chamber and piston, a number of contacts and means actuated by the piston for connecting the contacts.

904,463. CLUTCH. Horace H. Taylor, San Jose, Cal., assignor of one-half to Frank J. Mayhew, San Francisco, Cal. Filed July 13, 1907. Two electromagnets are arranged to oscillate a clutch-moving lever into and out of action.

904,467. ELECTRIC-LIGHTING DEVICE. Clarence Wheeler, Rochester, N. Y., assignor to Metal Specialties Manufacturing Company, Chicago, Ill. Filed September 17, 1907. A hollow handpiece is provided with a metallic socket and a terminal.

904,476. ATTACHMENT FOR INCANDESCENT-LAMP SOCKETS. Henry H. Ham, Shrewsbury, Mass., assignor of one-half to Edwin W. Ham, Worcester, Mass. Filed May 12, 1906. Renewed March 19, 1908. A lamp socket is provided with a switch-operating chain and a movable arm keeping the chain out of contact with the lamp shade.

904,482. INCANDESCENT LAMP. John W. Howell, Newark, N. J., assignor to General Electric Company. Original application filed November 17, 1906. Divided and this application filed October 23, 1907. This is a modification of No. 903,860.

904,486. PROTECTIVE APPARATUS FOR SWITCHBOARDS AND THE LIKE. William Kaisling, Chicago, Ill., assignor to Frank B. Cook, Chicago, Ill. Filed October 5, 1903. A heat coil arrester for a telephone switchboard.

904,491. TROLLEY HEAD AND HARP. Charles E. Marks, Virginia Beach, Va., assignor of one-fourth to Algar M. Wheeler, Norfolk, Va. Filed September 6, 1907. The harp has a pair of guiding wheels at each side of the upper portion of the trolley wheel.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired November 24, 1908:

463,615. ELECTRIC CONTROLLER FOR ELEVATORS. W. Baxter, Jr., Baltimore, Md.

463,639. ELECTRIC MOTOR MECHANISM. S. E. Mower, New Haven, Conn.

463,671. ARMATURE CORE FOR DYNAMO-ELECTRIC MACHINE. E. Thomson, Lynn, Mass.

463,693. ELECTRIC MOTOR AND GENERATOR. I. E. Storey, Boulder, Colo.

463,704. ELECTRIC MOTOR AND DYNAMO. A. L. Parcelle, Boston, Mass.

463,711. ELECTRIC METER. A. Rechenzaun, London, England.

463,715. CONDUCTOR AND GUIDE FOR ELECTRIC-RAILWAY TROLLEYS. J. I. Conklin, Brooklyn, N. Y.

463,720. ELECTRIC ARC LAMP. W. S. Hays, Troy, Ohio.

463,761. SECTION INSULATOR AND LIGHTNING ARRESTER FOR ELECTRIC RAILROADS. E. Thomson, Swampscott, Mass.

463,762. ELECTRIC ARC INTERRUPTER. E. Thomson, Swampscott, Mass.

463,765. TROLLEY FOR ELECTRIC RAILWAYS. G. H. Alton, Lynn, Mass.

463,766. SWITCH FOR ELECTRIC RAILWAYS. F. O. Blackwell, Boston, Mass.

463,770. ELECTRIC CUT-OUT. E. W. Rice, Jr., Lynn, Mass.

463,793. SYSTEM OF ELECTRIC LIGHTING. E. J. Hodgson and J. W. Stearns, Jr., Denver, Colo.

463,802. ELECTRICAL TRANSMISSION OF POWER. H. W. Leonard, New York, N. Y.

463,808. ELECTRIC SUBWAY SWITCH. L. A. Fehr, New York, N. Y.

463,852. SYNCHRONOUS TELEGRAPH. C. S. Bradley, Yonkers, N. Y.

463,867. AUTOMATIC SAFETY CUT-OUT FOR ELECTRICAL CONDUCTORS. R. A. Morgan, Jr., Boston, and G. C. Bosson, Jr., Lawrence, Mass.

463,879. SEPARATOR FOR THE PLATES OF SECONDARY BATTERIES. C. F. Waldron, Boston, Mass.

463,955. ELECTRIC WIRE INSULATOR. H. F. Newell, Manchester, Va.

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CONTENTS.

CABLE-RATE REFORM IN ENGLAND.

Not in a long time have the people of Great Britain been so stirred as they now are over the agitation which is being led by Mr. J. Henniker Heaton's call for a universal two-cent charge for international cable messages. This redoubtable member of Parliament has arrayed himself against the great commercial interests operating the international cables connecting Great Britain and America, and, with characteristic zeal and pertinacity, has brought to bear the heavy ordnance of his logic and some startling figures to back up his contentions as the champion of the non-users of the cable systems.

Mr. Heaton claims that the cable systems are in the hands of monopolists; that the cables are arbitrarily left in idleness for a third of the time, so that exorbitant rates may be charged, and that the service as at present conducted is available largely to those business interests which must make use of it whatever the rate. In his analysis of the use of the cable he discovers that ninety-seven per cent of all the messages are from business houses, and that public participation in cable service is very small indeed. The capitalization placed upon existing systems, he says, is out of all proportion to their worth, and he makes the additional statement that if all the cable systems at present in use were wiped out it would be possible to reconstruct the whole system between the British Isles and America for $30,000,000.

It is a fact that the public will give hearty support to anything which appears to cheapen the price of a service, the question as to whether the cheapened service can or will be used not entering very largely into the decision. It is not only the general public, however, which is interested with Mr. Heaton in piling up a great wave of protest, for he has the support and influence of prominent men and women, and it may be noted also that a number of the influential papers of both countries are giving him more than ordinary encouragement.

When the proposition was at first brought up, those in charge of the destinies of the cable companies were inclined to pooh-pooh the idea, regarding it as highly chimerical. This can hardly be considered a safe procedure, however, for the people have realized that public clamor sometimes brings direct results. If a universal penny-a-word cable rate were established, with its burden of deficit—which, under present conditions, appears inevitable—thrown upon the Government, the cable companies would appear to be serving the people at large with less generosity than they are even now credited; for if the rate be exorbitant now, it is borne by those who use the service, while any burden of deficit carried by the Government would become a tax on the whole people. It does not appear reasonable either that a reduction to a penny a word would result in nearly so large a proportionate increase of common use as the projectors of this scheme have suggested, and the probability is that with a lower rate there would be a still greater monopoly of cable service on the part of business interests. It is all very well to say that commerce is throttled, but it takes more than the control executed by a few companies over sixteen cables to do much throttling.

The probability exists, of course, that with proper incentive and imperative necessity, the operation of the cable systems can be cheapened, and that in consequence of an increased demand, more continuous use can be made of the cables already in service. The prospect of adequate return upon a large investment may also influence the laying down of new lines of communication. Nothing is being done so well that it can not be improved upon. The only thing necessary is the expedient, and a decent and orderly procedure to secure its consummation. The cable industry has grown to vast proportions, and has required large expenditures of money, and those who originally invested took long chances of there ever being an adequate return. If there has been a monopoly, and if the rates have been higher than a reasonable return would seem to require in this direction, it appears reasonable to assume that a large tribute should be paid for the facility which has been developed. It is, of course, unreasonable to expect that the present conditions can continue indefinitely, for some time there must be an end to the exacting of unreasonable tariffs. If that point has now been reached, proper investigation will discover it, but the companies should, and, in all likelihood, will, resist any attempt by methods, confiscatory or otherwise, looking to a cheapening of service and an unprofitable end, whether the burden be borne by the Government or by the cable companies.

The proposition of government ownership of the international cable systems seems stupendous when the capitalization of the companies is reviewed. Between Great Britain, Germany, France and America there are sixteen working cables operated by six companies. The Western Union system is made up of the American Telegraph and Cable Company, with two cables; the Anglo-American Cable Company, with four cables, and the Direct United States Cable Company, with one cable. The Commercial Cable Company operates or controls seven cable lines—four of its own, two of the German Cable Company, and one land line for feeding the Commercial system. The other large transatlantic system is that of the French Cable Company, operating two cables—making up the quota of sixteen. The Mackay Companies, operating the Commercial Cable Company, has an authorized capital of $100,000,000; the American Telegraph and Cable Company, $14,000,000 outstanding; the Anglo-American Telegraph Company, a capitalization of $35,000,000; and the Direct United States Cable Company, a capitalization of $11,256,000. Adding in the capitalization of the Central & South American Telegraph Company, $8,000,000; the Mexican Telegraph Company, $3,000,000, and that of fifteen smaller companies operating international cables, the stock of which is largely held in England, amounting to $10,265,000, we have a total capitalization of $187,592,000. It is hard to arrive at a definite estimate of either the capitalization or value directly applicable to cable resources, because the capitalization of several of these companies is devoted also to land lines, real estate and other tangible assets. But the figures given are a close approximation of the magnitude of the problem involved.

The matter has not attracted the attention in this country that has been given to it abroad. When agitation such as this, however, gets away from reasonable restraint there is a possibility of unreason running rampant. The subject should be viewed in the broadest possible light, and intelligent publicity given to every phase, so that there may be no mistake made in arriving at a sensible conclusion.

THE NEW YORK STATE PUBLIC SERVICE COMMISSION REPORT.

The second volume of the report of the Public Service Commission for the First District of the State of New York on the work carried out during the first six months of its existence—the period ending December 31, 1907—gives some interesting information concerning the public-utility corporations included in the district under the commission's regulation. One of the points brought forward is that extension and improvement of transit facilities brings increased travel, apart from the natural increase in population. This means that as lines are carried into remote communities, and tributaries to main arteries penetrate into easy riding distances, the public automatically gets the riding habit. In Greater New York the statistics show that there was a daily average increase of 341,000 passengers in 1907, the whole year showing an increase of 124,505,734, including regular fare and transfer rides.

Four-fifths of the traffic conducted by the street railways of New York state is handled in the greater city. The number of passengers is almost equal to the entire number carried by the tramway systems of England and Wales.

One of the curious points noted is that on over 103 miles of electrically-operated surface lines and forty-four miles of horse-car lines, the average speed is seven-and-one-half miles an hour. This would appear to be pretty slow traveling, but it should be remembered that a large part of the traffic is in localities where passengers are picked up and dropped at every street corner for possibly four-tenths of the distance traveled, and that the stoppages are included in the over-all speed. The forty-four miles of horse-car lines is divided into several cross-town lines serving the various ferry terminal points, where for the amount of traffic and the short distance of the run it is not considered commercially practicable to install an expensive conduit system, such as is called for by the restrictive regulations in force in New York city against overhead construction.

Probably no city has suffered so much from transfer abuse as Greater New York, and this matter has been a bone of contention between the passengers and the railway companies for the last few years. When the proposition of universal transfers was first inaugurated there appeared to be a decided increase in the profitable traffic attracted to the lines. Very soon, however, the public learned to make the greatest possible use of the transfer system, and it is estimated that the abuse of the transfer system has made deep inroads into the revenues of the railway companies. A careful study of these conditions on the part of the railway operators has apparently revealed some illogical concessions in the establishment of promiscuous transfer points, and an effort is now being made to eliminate these as far as possible. The cutting off of such privileges on several lines in New York city has recently led to considerable antagonism on the part of the riding public, and several hearings have been held before the Public Service Commission, with, in one case, a decision against the company and an order to re-establish the transfer privilege at the disputed point, and the consequent refusal on the part of the company to obey the mandate of the commission. This is an interesting situation, which will only be relieved by a painstaking process of law.

The report states that there are fifty-one transfer passengers to each 100 fare passengers in New York city. Notwithstanding the increase in transfers, however, the experts on the commission have figured that this has not been at the expense of the railroads. They estimate that this growth has not been provided for in the establishment of higher car-mile figures, but has increased the passenger miles, which has resulted in the uncomfortable overcrowding of the cars in use. This has been deduced from the fact that while the receipts per passenger declined from 4.14 cents to 4.04 cents, the number of car-miles increased only 3.8 per cent; while the number of fare passengers increased 5.2 per cent, and the number of all passengers 7.9 per cent. The result is an apparent increase in the average passenger car earnings from 25.58 cents per car-mile in 1906 to 25.89 cents in 1907.

TUNGSTEN LAMPS VERSUS ACETYLENE PLANTS.

Acetylene-gas apparatus comes into direct competition with electric equipment where small lighting plants are wanted, due to the low first cost of the former.

While acetylene-gas plants are more commonly confined to single buildings or private grounds, they are also designed for general public supply in an increasing number of small villages, where there is no other gas or electric service. An illustration of this latter fact may be noted in a certain state where fourteen acetylene-gas plants are now engaged in general public supply, though there was not a single public plant of this sort in the state seven years ago. Acetylene plants for either public or private use compete much more directly with electric apparatus than with ordinary gas equipments, because the capacities of these plants are so small that coal or water-gas appliances are not suited to the purpose.

At the start, the use of tungsten lamps reduces the necessary capacity of boilers, engines, dynamos and wiring circuits by sixty per cent, if the comparison is made with 3.1-watt carbon-filament lamps, on a candlepower basis. In other words, an electric plant for 1,000 candlepower in incandescent lamps, corresponding to 500 lamps of sixteen candlepower, requires only forty per cent of the capacity in generating apparatus and conductors for tungsten as for carbon lamps.

Even where only one lamp per lighting point is wanted, so that the full benefit of the higher efficiency of the tungsten filament can not be obtained, the twenty-five-watt tungsten lamp enables the capacity of the generating plant and line to be reduced fifty per cent below the requirements for fifty-watt carbon lamps.

Comparatively little competition exists between electric and acetylene-gas plants engaged in public supply, but the conditions of such competition may be noted. Probably the most common price for acetylene gas from public plants is $15 per one thousand cubic feet, though the price ranges from about $12 to $20, and it requires the best grades of open burners to yield eighteen candlepower on one-half cubic foot per hour, or forty candlepower on one cubic foot. At $15 per one thousand feet, the cost of acetylene gas is thus 1.5 cents per hour at the forty-candlepower burner, and 0.75 cent per hour at the eighteen-candle burner.

Though a forty-candle tungsten lamp is not a standard size for interior use, it will do as well for comparison as any other, and would consume fifty watts. At ten cents per kilowatt-hour, the energy for this fifty-watt lamp costs 0.5 cent per hour, and the energy for a twenty-candle, twenty-five-watt tungsten lamp costs 0.25 cent per hour.

For the hourly cost of the tungsten lamp alone, a list price of $1.50 and an average life of 1,000 hours may safely be taken, as the discounts will fully offset any probable shortage of this average life.

This basis gives 0.15 cent as the cost of the tungsten lamp itself per hour of use, and this sum, added to the above figures for the energy consumed in each lamp, amounts to 0.65 cent for the forty-candlepower size, and 0.4 cent for the twenty-candlepower, per hour, as the total cost.

With acetylene gas costing 1.5 cents per hour at the forty-candlepower burner, and 0.75 cent per hour at the eighteen-candlepower, or about twice the cost of equal illumination with tungsten lamps, the failure of acetylene plants to compete successfully with electric in public supply is very plain.

As to isolated plants, the argument for acetylene apparatus is low cost of light compared with the price of electric service. Calcium carbide, from which acetylene gas is made, costs $70 per short ton, or 3.5 cents per pound, in the cheapest form made for use in acetylene-gas generators, and five cubic feet of the gas per pound of carbide is a very favorable yield. It follows that 0.2 cent per cubic foot is about the minimum cost of acetylene gas, for carbide alone, and this makes no provision for interest on the first cost of the generating plant, or for labor, repairs and depreciation.

The bare cost of carbide is thus 0.7 cent per hour for the forty-candlepower burner consuming one cubic foot, and 0.35 cent per hour for the eighteen-candle-burner using one-half cubic foot.

Compared with the above total costs of 0.65 cent and 0.4 cent per hour for forty and twenty-candlepower tungsten lamps, respectively, when operated with current sold at the rate of ten cents per kilowatt-hour, and lamp renewals extra, the cost of the carbide alone is 0.05 cent more for the one-foot burner, and only 0.05 cent less for the one-half-foot burner, per hour of lighting.

INDEPENDENT TELEPHONE CONVENTION.

TWELFTH ANNUAL GATHERING, AUDITORIUM, CHICAGO, DECEMBER 1, 2 AND 3.

The twelfth annual convention of the International Independent Telephone Association was held at the Auditorium Hotel, Chicago, during the last week. A total attendance of several hundred representatives of independent companies of the United States and Canada was predicted, and the roster of the registration committee early confirmed this estimate of the complete attendance, representing "4,000,000 telephones and 17,000,000 exclusive users."

The first convention session proper was called to order in the banquet hall of the Auditorium Hotel on Tuesday morning by P. C. Holdoegel, of Rockwell City, Iowa, the acting president. Following the invocation by the Reverend Frank G. Smith, of Chicago, the welcome of the city of Chicago was extended to the Independent telephone men by George M. Bagby, assistant corporation counsel of the city administration, acting for Mayor Fred A. Busse, who, though scheduled for an address, was unable to be present. The response was tendered by R. D. Critchfield, president of the Wisconsin Telephone Association. His address was quite impromptu, taking the place of Dwight E. Sapp, of Mt. Vernon, Ohio, who was unable to fill the place accorded him on the programme, but in convincing and unmistakable terms Mr. Critchfield urged upon the city of Chicago consideration of telephone connection with the large proportion of Independent telephone subscribers in the state and vicinity. The report of the secretary, Joseph B. Ware, of Grand Rapids, Mich., was lengthy and detailed, and gave a comprehensive history of the Independent movement during the past twelve months.

The afternoon session was given over to a technical and practical conference, at which the papers read partook of an operating and traffic character contrasted with the business and financial aspects of the morning's meeting. The technical meetings were in charge of Gansey R. Johnson, of Columbus, Ohio.

The first paper presented was that of Roy Owens, of Columbus, O., on "The Telephone Engineer in His Relation to the Telephone Business."

"The three divisions of telephone engineering," said Mr. Owens, "are, planning, constructing and maintaining. It is not uncommon to hear engineers say that they wish to devote themselves to construction and not to maintenance. Some of these are apparently indifferent to the planning. In these respects they are not giving themselves credit for being complete engineers. The planning is the really vital part of a telephone engineer's duty. One reason why more plants have not shown the result of poor design is that the demand for telephone service in years past has tended to outrun the capacity of the plants, so that even a poorly laid out cable system has found practically all of its cable pairs called for. As time goes by, however, and subscribers are more difficult to procure, the need of more care in the laying out of the plant will become manifest.

"The cable distribution is the most costly part of an engineer's work. A local telephone company may stand or fall with its degree of success in getting cable into those parts of its exchange district where cable will be in demand. The multiple-cable distribution methods somewhat widen the narrower limits within which cable distribution is flexible. The subway and pole lines must be so far complete that there is little demand for their flexibility. The switchboard terminals and the subscribers' lines and instruments have a large degree of flexibility.

"Care should be taken to have the most economical balance between the outside capacity and the switchboard capacity, which means that the former should be somewhat more than the latter."

J. H. Ainsworth, general manager Home Telephone Company, Dayton, Ohio, discussed "Some Economies in Handling Maintenance Men." His company has introduced a feature of requiring the repair men to report upon a printed slip whether repairs made are of a permanent or temporary character, as it is not always possible for a single workman to effect repairs of a permanent nature. If the latter is the case, the repairman is instructed to report so, but after the trouble is permanently remedied each man is held to strict account for recurring troubles in his district.

"Maintenance Economics" was the title of a brief paper read by G. E. Bickley, of Waterloo, Iowa. Any reasonable expenditure made to conserve the operation of the equipment, material or apparatus of a telephone system, is an economy, he said. Mr. Bickley also indicated a plan of postcard report of line inspections made in the course of other business, and advised, as well, the special inspection of the right-of-way, locating by chart possible prospective troubles.

The paper of J. P. Boylan, of the Home Telephone Company, Detroit, Mich., on "Handling Trouble," was read by B. H. Brooks, chief engineer of the same company. Careful tests by operators were advised to anticipate the discovery of trouble by the subscriber, and the author described a card system of filing this class of records. In explaining the difficulty often experienced in attempting to ring out on a short-circuited line, the writer described a form of relay designed to be placed in the generator lead to the position. This relay has an inductive winding shunted by pure resistance. The latter path may be opened by the armature picking up when an undue current traverses the relay winding. Thus normally the combined paths represent low impedance until the heavy short-circuit current actuates the armature, leaving only the highly-inductive winding in circuit, and at the same time lighting a pilot lamp in view of the operator.

The technical session was continued in the evening, but on account of the small attendance the papers presented were abstracted by the authors.

Frank F. Fowle, consulting electrical engineer, read an interesting and classical paper on "The Economical Development of Toll Territory."

"The purpose of this paper, as the title suggests, is a consideration of the principal factors in building up and developing a toll plant on a dividend-paying basis. There are naturally two divisions of the subject, namely, the projection of an entirely new plant in undeveloped territory, and the development of a plant already in existence; but the latter division of the subject grows out of the first, and undeveloped territory will be assumed as the starting point. Were there no previous experience in the toll business to furnish guidance in laying out a new plant in undeveloped territory, it would be necessary to proceed with the utmost caution; in fact, the whole development would necessarily be experimental and would involve a large financial risk.

"It is found that the public demand for toll service occurs in such ways that certain laws may be formulated which will express mathematically or graphically the volume of message traffic which will occur on the average under any given or known set of conditions. The design of a toll system divides itself naturally therefore into two parts, first the predetermination of the traffic, and second the layout of a plant which will provide the necessary facilities in the most economical manner; under the system of rates charged or to be charged it becomes apparent at once what portions of the proposed plant will be profitable at the outset, or, if the rates are not settled in advance, an estimate may be made of the plant charges and the operating costs to handle the traffic, as predetermined, upon which may be based a system of rates which will insure dividends from the outset."

Mr. Fowle had made a study of the traffic between different cities and towns, taking into account their population and the distance between them, under a fixed-rate schedule. It was found that the traffic volume in total messages per month in both directions between any pair of zones could be fairly represented by the formula:

$$T = .00022 \frac{P_1 P_2}{D^2}$$

where T = the total messages per month in both directions.
P_1 = population of either zone.
P_2 = population of the other zone.
D = distance between the zone centers, in miles.

The formula as written may be regarded as possessing sufficient accuracy for a development study. The range of distances and population in the instances upon which the calculations for the constant were based, was very large; no account was taken of the telephone development in the zones used for calculation, but it varied from something like one per cent up to eleven or twelve per cent, with an average of six to seven per cent.

Other formulæ were indicated for the determination of toll rates, revenue per message, etc., and a quantity of valuable cost and physical data was given. Mr. Fowle exhibited a number of interesting long-distance telephone plant load curves showing the distribution of calls throughout the week, the effect of a night half-rate on the service for different days, the relation between speed of service and circuit loads, etc.

Following his paper, Mr. Fowle was called upon to explain the action of loading-coils on a telephone line. In complying, he took occasion to discount the general fallacy that these coils introduce a condition of resonance into the circuit. On open construction the loading-coils are usually placed at the transposition points, about eight miles apart. On cables the distance varies from three-quarters of a mile to one-and-one-half miles. In some cases their interposition has the effect of increasing the transmission four or five fold, but this ratio of improvement decreases for the larger conductors.

George K. Gann, Lincoln Neb., in a paper on "Handling Long Distance Traffic," described the two recording methods most generally used and applicable to either large or small offices. These might be termed: (a) The direct ring-down method; (b) the order wire method.

"The direct ring-down method requires trunks from the 'A' boards in the local offices, terminating at the recording board in signals and jacks. These should be multipled in each position or section in offices where there are two or more. The method of operation is as follows:

"1. The subscriber removes the receiver from the hook, lighting the signal on the 'A' or local board.

"2. The 'A' operator takes one of the cords of an idle pair, plugs into the answering jack of the subscriber's line, and answers 'number.'

"3. The subscriber asks for 'Long Distance.'

"4. The 'A' operator takes the other cord of the pair, tests, and plugs into a jack of an idle trunk to the recording board and rings, thus lighting a signal on the same trunk at the recording board.

"5. The recording operator takes one of the cords of an idle pair, plugs into the jack of the trunk on which the signal has been received and answers, 'Long Distance.' She then secures and records the subscriber's call on a ticket and has it sent or carried to the proper line operator.

"The order wire recording method differs from the first in that the trunks to the recording board appear only in the 'A' and 'B' boards of the principal local exchange. Other local exchanges must secure connection with the recording operator by cutting in on the regular order wire to the principal office 'B' board, and asking for 'Long Distance.' The 'B' operator makes a trunk assignment in the usual way, establishing connection with a trunk to the recording board."

The technical and business sessions were continued during Wednesday and Thursday. On Wednesday evening the annual association banquet was held.

The Independent telephone convention was marked by an unusually fine array of manufacturers' exhibits on several floors of the Auditorium Hotel. Most of these occupied suites on the banquet-room floor, convenient to the convention hall. The exhibits included manual and automatic telephones and switchboards, wire, construction material, protective devices, batteries, conduit, tools and motorcycles.

The following exhibitors occupied hotel rooms or suites with complete expositions of their products:—

American Electric Telephone Company; Automatic Electric Company, Chicago; Century Telephone Construction Company, Buffalo, N. Y.; Chicago Telephone Supply Company, Elkhart, Ind.; Cracraft-Leich Electric Company, Genoa, Ill.; H. E. Cobb, Chicago; Frank B. Cook, Chicago; Corwin Telephone Manufacturing Company, Chicago; W. H. Couch, Boston, Mass.; Dean Electric Company, Elyria, Ohio; Duplex Metals Company, New York city; Electric Appliance Company, Chicago; Excelsior Supply Company, Chicago; Fibre Conduit Company, New York city; Fox & Borden Manufacturing Company, New York city; H. S. Green Battery Company; Holtzer-Cabot Electric Company, Brookline, Mass.; Illinois Electric Company, Chicago; Indiana Steel and Wire Company, Muncie, Ind.; Manhattan Electrical Supply Company, Chicago; Miller Anchor Company, Norfolk, Ohio; Monarch Telephone Manufacturing Company, Chicago; National Carbon Company, Cleveland, Ohio; North Electric Company, Cleveland, Ohio; Ohio Brass Company, Mansfield, Ohio; F. W. Pardee, Chicago; Pierce Specialty Company, Elkhart, Ind.; Homer Roberts Telephone Company, Chicago; St. Louis Malleable Casting Company, St. Louis, Mo.; Sterling Electric Company, Lafayette, Ind.; Stromberg-Carlson Manufacturing Company, Rochester, N. Y.; Swedish-American Company, Chicago; *Telephony*, Chicago; Vote-Berger Company, La Crosse, Wis.; Warner Electric Company, Muncie, Ind.; Westinghouse Machine Company, East Pittsburg, Pa.

Plan New Telegraph Company.

The revived plan of Chicago Board of Trade operators to establish an independent telegraph company and use independent telephone wires between Chicago, St. Louis and Kansas City, which was begun a year ago, is now again projected in the name of the People's Mutual Telegraph Company.

The promoter of the enterprise is W. S. Jackson, ex-president of the Chicago Board of Trade. An ordinance is asked of the City Council permitting the stringing of wires under the Metropolitan Elevated structure.

Electrification of Steam Railroad Terminals in Chicago.

The Illinois Central Railroad is not the only one making an investigation of the feasibility of electrifying its Chicago terminals. Since the agitation for the electrification of this railroad began a large number of other railroads entering the city have been quietly making more or less exhaustive studies of the problems as related to their lines.

The suburban residents along the Chicago, Rock Island & Pacific and the Chicago, Burlington & Quincy railroads are agitating electric service on these roads. The managements of these lines and of some others realize that it is a problem that will have to be faced in the near future. Since not only the patrons of the roads and their adjacent property owners, but the city authorities as well, have been determined to have the smoke nuisance produced by their locomotives abated, the success and economy of the electrification projects that have been carried out in the East have convinced the managements that electrification has advantages not only in satisfying the public clamor but in providing an efficient tractive power.

Aside from the Illinois Central Road these investigations have as yet been carried out very quietly. The manager of one of the western roads, which owns large terminals in the city, stated recently: "There is not the slightest doubt that the city will eventually pass an ordinance acquiring electrification of the railroad terminals. Such a measure could not with equity require electrification of freight terminals at this time, but would probably deal first with the passenger traffic. There are some roads which are in a fairly good position to electrify their passenger terminals when the proper time comes—the time when they know what the best system is." The purpose of some of these investigations is to find out which system, single-phase or third-rail, is best suited for their purpose. It is generally believed that the officials of at least one system entering Chicago were more in favor of electrifying its lines than the officials of the Illinois Central Railroad have been until recently.

The city authorities in considering this subject have referred to the corporation counsel for an opinion on the power of the city to produce the changes desired. The opinion has just been prepared and states that the city probably has no direct power to compel electrification of the steam railroads. However, it does have power to prohibit the use of steam as a motive power if it can be shown that its use is attendant with emission of smoke, soot, cinders or otherwise injuriously affects the public health, comfort or property so as to amount to a public nuisance.

At a conference held on November 30 between the city authorities and officials of the Illinois Central Railroad the progress of the work on the latter road was reported. Some fifty plats have been prepared of the trackage so as to enable the electrification project to be carried through with least interruption to traffic and with the best ultimate results. While the plans are being perfected and carried out the railroad has offered to equip its locomotives with oil or coke as a fuel so as to make them less objectionable to the public.

New York Electrical Society.

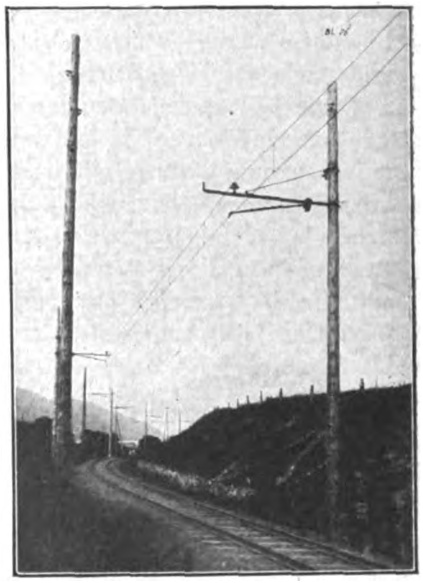
The two hundred and eightieth meeting of the New York Electrical Society, on invitation of the Electrical Testing Laboratories, was held at the laboratories, Eightieth Street and East End Avenue, Tuesday evening, November 24. Wilson S. Howell made a short address welcoming the society and explaining briefly the very wide range of work done by his company. While testing incandescent lamps is a very large part of their business, over 17,000,000 having passed through the laboratories last year, their work is by no means confined to testing incandescent lamps. Every possible design of lamp from the kerosene lamp to the latest development in arc lights is brought to them for test and measurement. All kinds of metals and composition material are tested, as well as measuring instruments of all kinds, shades and reflectors, insulators and insulating material; in fact, all material that goes into the construction of electrical apparatus is tested not only for the engineer and the manufacturer, but also for the purchaser. The point of Mr. Howell's remarks showing the wide range of their work was that the value of testing, both for the engineer and manufacturer, as well as the user of apparatus, is becoming more thoroughly appreciated.

Dr. Clayton H. Sharp gave a most interesting address, discussing apparatus for measuring spherical candlepower, the integrating sphere, methods of measuring illumination values, etc. After this address the members inspected the laboratories, where could be seen in operation every known form of testing apparatus. The members were also given a treat in the shape of an elaborate collation.

A NORWEGIAN SINGLE-PHASE RAILWAY.

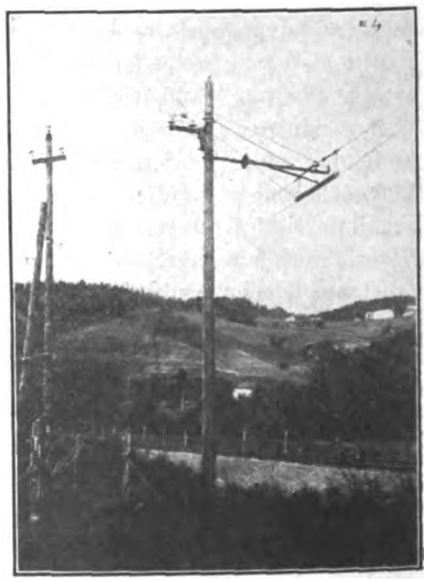
BY A. WEBSTER.

For some time past, a waterpower electric generating station has been in operation at Skjenald Fossen, near Thamshavn, in Norway, its object being to sup-



THAMSHAVN SINGLE-PHASE RAILWAY—OVERHEAD CONSTRUCTION ON CURVE.

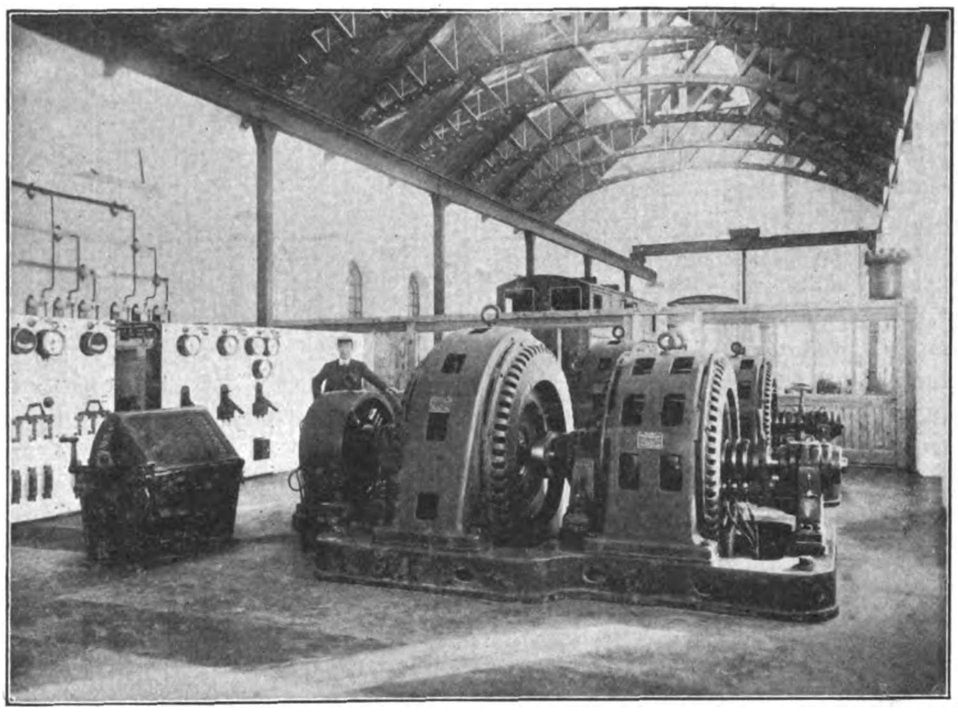
ply Thamshavn and the villages en route to Lokken, where there are a considerable number of mines. The district is also one much visited by tourists, and electric power being available, it is not surprising that an electric railway between these two points should be thought of. Two gentle-



THAMSHAVN SINGLE-PHASE RAILWAY—OVERHEAD CONSTRUCTION, SHOWING SECTION INSULATOR AND HIGH-TENSION SHORT-CIRCUITING SWITCH.

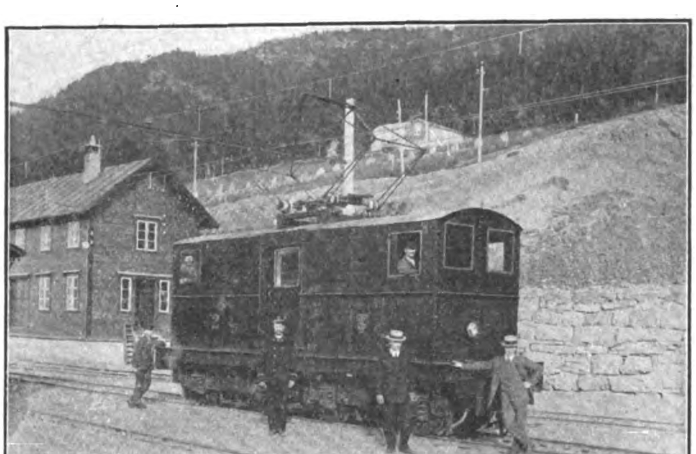
men interested in the district accordingly went into the matter and finally decided to place an order with the British Westinghouse Electric and Manufacturing

Company for the construction of a single-phase line. The order was placed and the line put into operation within twelve months, in spite of the climatic conditions prevalent during certain months of the year in this part of Norway. The line constitutes the first electric railway in Norway.

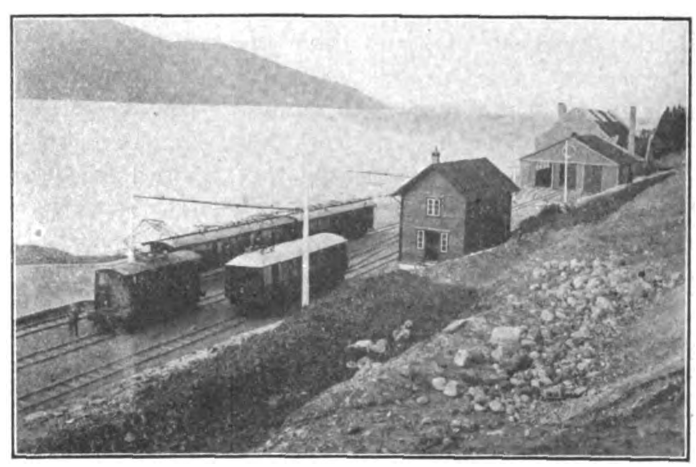


THAMSHAVN SINGLE-PHASE RAILWAY—MOTOR-GENERATORS IN SUBSTATION.

Thamshavn is some twenty miles distant from Trondjem, a well-known east-coast Norwegian watering place, and the railway is some sixteen miles in length to its other terminus at Lokken. The whole district is rich in minerals and timber, and so it is that arrangements have been made for dealing with large quantities of merchandise. In this connection there is a regular service of steamers between Trondjem and Thamshavn. The power station already mentioned is about five miles to the west of Thamshavn, and supplies three-phase current at 15,000 volts, fifty cycles, direct to the railway substation at Thamshavn, where transformation takes place to single-phase current at 6,600 volts, twenty-five cycles, for feeding to the overhead trolley wire. An interior view of the substation is shown.



THAMSHAVN SINGLE-PHASE RAILWAY—TWENTY-TON SINGLE-PHASE LOCOMOTIVE.



THAMSHAVN SINGLE-PHASE RAILWAY—TERMINUS AT THAMSHAVN ON ORKEDALS FJORD.

Metre-gauge track has been laid, flat-bottomed steel rails being fastened to wooden sleepers laid on ballast. With the exception of double track and sidings at the stations, the line is single throughout, there being very few difficult gradients or curves to contend with for the greater portion of the way.

The overhead construction consists of hard-drawn, grooved copper wire of sixty-five square millimetres section, suspended from a steel cable. As will be seen from the photographs, the insulators supporting the steel cable are carried on steel brackets attached to wooden poles, the spans varying from 150 feet to sixty-eight feet, according to whether the track is straight or curved. The normal height of the trolley wire above the track is 5.5 metres.

A feature of the rolling stock is the provision of a motor coach for first-class passengers the interior of which is divided into a vestibule and driver's compartment at each end and two salon compartments with a lavatory between. This car is fitted with two forty-horsepower motors. The rolling stock also includes three twenty-ton locomotives, one of which is illustrated, for hauling the freight and passenger trains. Each of these locomotives carries four forty-horsepower motors, mounted on two trucks. Both on the locomotives and the salon coach the current is collected by a pantagraph bow and passes through an automatic circuit-breaker located inside the driver's cab. There the high-tension wiring is reduced to only ten feet in the case of the locomotives. The four motors are arranged permanently in two groups, two in series, cut-outs being provided, by means of which either pair may be isolated when desired. These locomotives are designed to exert a tractive effort of 6,500 pounds at ten miles per hour and a maximum tractive effort at starting of 8,000 pouuds.

The substation forms part of the workshops at the Thamshavn terminus, and the plant installed consists of two 15,000 to 6,600-volt, oil-insulated, three-phase transformers and two 250-kilowatt motor-generators, capable of carrying an overload of 100 per cent for short periods. There is sufficient space, however, for an additional motor-generator to be installed. These units consist of a three-phase induction motor, fitted with slip-rings and liquid rheostat for starting, direct-coupled to a single-phase, revolving-field generator.

PUBLIC SERVICE COMMISSION, FIRST DISTRICT, STATE OF NEW YORK.

SECOND VOLUME OF REPORT FOR SECOND HALF OF 1907.

The second volume of the report of the Public Service Commission, First District, State of New York, for the first six months of its existence, ended December 31, 1907, has been issued. From figures compiled from statistics presented by the companies under its control the commission states that the number of car rides per individual in New York in 1907 was 317; in 1902 was 266, and in 1890, 234.

The report shows that every extension and improvement of transit facilities brings increased travel quite apart from the natural increase in population. In the last seventeen years the passenger traffic has more than doubled. The total number of passengers carried by all lines in the greater city in 1907 showed an increase of 124,505,734, an average daily increase of 341,000 passengers. This includes regular fare and transfer passengers. The increase in the regular fare passengers was 65,778,979, or about 180,000 per day.

New York city, with one-half of the population of the state, accounts for four-fifths of the traffic conducted by the street railways of the state, which in turn is almost equal to the number of passengers carried by the entire tramway system of England and Wales.

The number of rides per capita in New York city (317 in 1907) is larger than in any other American city, with the possible exception of San Francisco, and greatly exceeds that of any city in Europe.

The street railroads of New York city embrace underground, elevated and surface systems operated by electricity and steam and horsepower. The underground system, known as the subway, which is owned by the city and operated by the Interborough Rapid Transit Company, embraced at the end of June, 1907, twenty-two miles of road in Manhattan and the Bronx.

The total length of roads operated by the railroads and street railroads under the jurisdiction of the commission aggregated 763 miles. As most of the line is double-tracked, and some of it laid with a third and fourth track, the total trackage is more than double the length of the road. Including sidings and turnouts and reducing all tracks to single-track mileage the total length of track was 1,612 miles.

In the borough of Brooklyn the total trackage of the Brooklyn Rapid Transit system is 564 miles, and that of other companies fifty-five miles. The borough of Queens, on all surface lines except the Brooklyn Rapid Transit system, has 147 miles, while the borough of Richmond has seventy-three miles of steam roads and sixty-two miles of electric roads. Omitting bridge trackage and combining the mileage of Manhattan and the Bronx, the length of road in these two boroughs amounts to 321 miles, as compared with 282 miles in Brooklyn, ninety-six miles in Queens and sixty miles in Richmond.

The new mileage put into operation in 1907 (nearly seventeen miles of track) was only a small part of the mileage under construction. Excluding the work done upon the new McAdoo and Pennsylvania tunnels, the companies already in operation expended $4,700,000 upon construction and reconstruction.

While the proprietary companies in 1907 charged to their capital accounts more than $2,000,000 for cars, the number of cars reported available for service was smaller than in the preceding year. The total number of cars available was 10,009, but not all of these are in service at any time, as more than one-quarter are of the open type, and used only in summer. The subway reports 794 cars; the elevated in Manhattan and the Bronx, 1,503; the surface lines in Manhattan, 3,280, and the surface lines in the Bronx, 786. The total number of all cars available in Brooklyn was 3,050; in Queens 313, and in Richmond 283. The Manhattan surface lines had 349 less cars in 1907 than in 1906.

The fluctuations of travel are shown in a table giving the number of passengers carried each year on the Manhattan elevated roads since 1892. In that year, the total number of pasengers carried by the elevated was 213,692,745. In 1893, it increased to 221,407,197, but from that year on there was a steady decline until in 1899 the total was 174,324,575; an increase then set in and continued up to 1904, when the total was 286,634,195. Here another decline set in and the travel decreased until 1906 when 257,796,754 passengers were carried. In 1907 the figures showed 282,924,273.

The report says the decline from 1893 to 1899 is explained by the extension of the surface lines and the improved service they rendered by reason of the substitution of electric for animal traction. The second decline in 1904 was due to the opening of the subway, which took a great many passengers from the elevated, but in two years the elevated roads recovered virtually all the lost ground.

Transfers are shown to have increased during the year 1907. While the number of regular fare passengers showed an increase of 5.2 per cent, the number of transfer passengers increased 18.9 per cent. The smallest percentage of transfer increase was in the Bronx (5.6 per cent) and the greatest increase in Richmond, where the number of transfers nearly doubled. Of the total increase in transfer passengers, namely, 58,700,000, Brooklyn furnished seven-tenths, yet the use of transfers in Brooklyn is still less than that on the Manhattan surface roads. Of the latter there are fifty-one transfer passengers to each 100 fare passengers, while in Brooklyn the ratio is only thirty-five to 100, but in Brooklyn, the figures include both elevated and surface roads.

Military Telegraphers Dine.

On the evening of November 27 the Old-Time Telegraphers' Association and the Society of the United States Military Telegraph Corps tendered a banquet to Andrew Carnegie, to bid him Godspeed and celebrate his seventy-first birthday. The banquet was held at the Manhattan Hotel, New York city, and four of the original members of the United States military telegraphers who responded to the call by Mr. Carnegie on April 22, 1861, for operators, were present. These were Col. William Bender Wilson, Richard O'Brien, Jesse W. Crouse and David Homer Bates. There were twenty-six other veterans of the Civil War Military Telegraph Association present, together with a couple of hundred members of the Old-Time Telegraphers' Association. Col. Robert C. Clowry, president of the Western Union Telegraph Company, presided, and addresses were made by Thomas A. Edison, W. C. Brown, William R. Plum, Richard O'Brien, Mr. Bates, Colonel Wilson, William J. Dealy, Charles P. Bruch and Col. A. B. Chandler.

In closing the speech-making, Mr. Carnegie delivered a characteristic address, and expressed his appreciation of the tribute paid him by his old comrades.

After songs by Miss Leila L. Morse, granddaughter of Prof. Samuel F. B. Morse, inventor of the telegraph, all joined in this song to the tune of "Auld Lang Syne:"

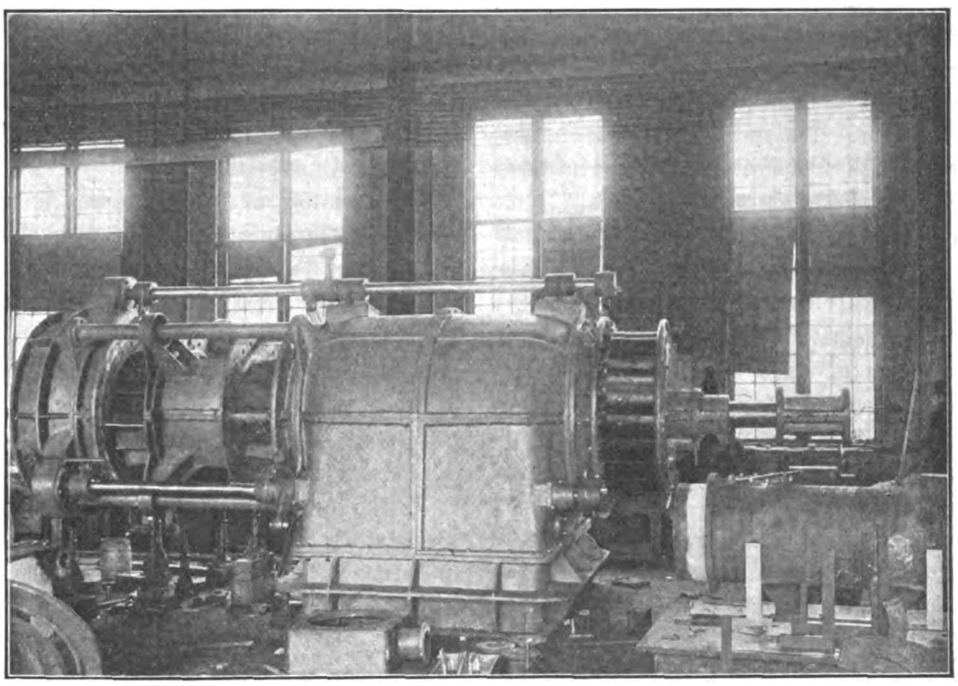
God grant our honored guest the peace
His life has fairly won.
And crown him with Thy blessings,
For the noble deeds he's done.
'Tis not a nation, but the world,
To him should grateful be.
Oh, may he live yet many years,
Sustained by "Seventy-three."

Hydraulic Turbines at Priest Rapids, Washington.

The photograph reproduced herewith shows as it appeared during construction one of the vertical triplex Allis-Chalmers hydraulic turbines for open flume which has been installed at Priest Rapids, east of North Yakima, Wash., for the Hanford Irrigation and Power Company. This company is a Seattle corporation and has lately completed the work of building and equipping a new power house on the Columbia River at the rapids mentioned. This development has a present capacity of 2,000 horsepower, which will eventually be increased many times over. The irrigation project in connection with it embraces 16,000 acres of land and has a capacity for watering another 16,000 acres with a small addition to the present equipment. The company has also completed a pumping station at Coyote Rapids on the Columbia River, fourteen miles below the Priest Rapids, and has already in service transmission lines for electric power from Priest Rapids to this station.

The entire equipment for the new plant was contracted for at one time and from one builder. The latter's engineers, in conference with H. K. Owen, consulting engineer, of Seattle, laid out the entire plant for a hydro-electric pumping station of the type best adapted to the local conditions. Vertical triplex hydraulic turbines are set in open flume, each direct-connected to a vertical Allis-Chalmers alternator, each set being designed to meet the following normal conditions: Fall fifteen to thirty-two feet, power 1,000 to 2,200 brake-horsepower, speed 150 revolutions per minute. At fifteen-foot head each turbine develops 1,000 horsepower, at full gate and with a speed of 150 revolutions per minute. The vertical alternators are rated at 900 kilowatts and wound for sixty-cycle, three-phase current at 2,300 volts. The governor used is of the Allis-Chalmers oil-pressure type.

An exciter turbine and direct-connected generator is installed, designed to operate under twenty-one-foot fall, with a discharge of fifty-two cubic feet per second, and rated at 100 horsepower. A motor-generator exciter set of small capacity has also been provided. The transmission line mentioned above carries the current from the main station fourteen miles at 22,000 volts. This line is supported by eucalyptus pins and the cross-arms used were boiled in oil. The wires are arranged in a triangle. The poles are thirty-five feet high.



VERTICAL TRIPLEX TURBINE FOR OPEN FLUME, EIGHTEEN TO THIRTY FOOT HEAD; CAPACITY, 1,000 TO 2,100 HORSEPOWER—HANFORD IRRIGATION AND POWER COMPANY, HANFORD, WASH.

The pumping equipment consists of four single vertical-shaft suction pumps with thrust bearing. Two units have a capacity of fifty-two-and-one-half cubic feet each per second, against a total head of thirty-four feet. Their speed is 175 revolutions per minute and the diameter of the suction and discharge nozzles is thirty inches. These pumps are direct-connected to 450-horsepower Allis-Chalmers induction motors. The water is admitted at the bottom of the pump and the discharge casing is of the snail-shell type. The complete casing rests on three feet securely bolted to the foundation and held rigid. The remaining two pumps are of the same general type for high-lift service; each has a capacity of thirty-six cubic feet per second, against a total head of eighty-one feet and operates at a speed of 514 revolutions per minute. These pumps are direct connected to 550-horsepower induction motors. The bilge pumps are of the vertical motor-driven centrifugal type. They have bottom suction and open impeller. Direct-current, 110-volt, fifty-one-horsepower compound motors are used to drive them at 850 revolutions per minute. These pumps have a capacity of 150 gallons per minute against a thirty-five-foot head.

Proposed German Tax on Electricity and Gas.

The *Elektrotechnische Zeitschrift* of November 12 is accompanied by a supplement, which contains a reprint in full of a bill just introduced in the German Reichstag and having for its purpose the establishment of a tax on electricity and gas. It is proposed to levy a tax of five per cent on the selling price of electric current, with a maximum of 0.4 pfennig per kilowatt-hour. Current generated for private use is to bear a tax of 0.4 pfennig per kilowatt-hour, with a reduction to five per cent of the cost of production, when it can be proven that the above rate is in excess of this percentage. Gas is to bear the same rate of taxation per cubic metre of gas sold as the kilowatt-hour of electricity. Electrical installations of not over one-and-one-half kilowatts capacity are to be exempt from taxation. If the product is imported from a foreign country, the receiver is to pay the tax; if it is exported, the exporter is to pay the tax. All electrical illuminants, as well as incandescent bodies for gas, alcohol and oil lamps, are also to bear their burden of taxation. On the basis of statistics appended to the bill it is estimated that the net revenue to the German Government from this source will be about fifty million marks annually. The statistics show the number of generating stations existing in Germany in 1907 to be 1,530, with a capacity of 858,841 kilowatts and connections of a value of 1,100,861 kilowatts. The average cost of generating a kilowatt-hour in 1906 was 12.91 pfennig, and the average receipts per kilowatt-hour were 28.29 pfennig. The available water-power in Germany is stated to be 1,931,000 horsepower, of which 490,100 horsepower, or about twenty-five per cent, is now being utilized.

SMOKELESS COMBUSTION.

BY CHARLES L. HUBBARD.

So much has been said of late in regard to smoke abatement that a review of the subject may be of some interest and of practical value to those in charge of power plants which are located in or near large villages and cities.

It is probably true that comparatively few firemen in charge of the average plant are familiar with the nature of the chemical actions which take place in the boiler furnace during the process of combustion. While such knowledge is not absolutely necessary in order to avoid the formation of smoke, an understanding of the elements of any process is always the first step in successfully carrying on the same, whether it be the manufacture of some article, the running of a machine, or the burning of coal under a boiler.

A careful investigation of the matter of smoke consumption as reported by various experts lays particular stress upon firing and furnace construction, and these will be taken up briefly along the lines especially affecting the formation or prevention of smoke.

First, let us consider the process of combustion without reference to where it takes place or to the nature of the fuel. Chemically speaking, combustion is the combination of oxygen with certain elements which produce heat and light. The substance with which it combines is called the combustible, or when combustion takes place in an ordinary furnace it is called fuel. The chief elements of a fuel are carbon and hydrogen, and the products of perfect combustion are water, which consists of two atoms of hydrogen and one of oxygen (H_2O), and carbon dioxide or carbonic acid, as it is usually called, which is a gas made up of one atom of carbon and two of oxygen (CO_2). In the process of combustion, as it takes place in a furnace, the oxygen is taken from the air which enters through the draft doors, and this unites with the carbon and hydrogen in the full, forming carbon dioxide and water.

In order to secure perfect combustion, oxygen must be present in just the right proportion to unite with the elements of the fuel, as stated above. If there is not a sufficient air supply, carbon monoxide (CO) will be formed instead of CO_2, and this greatly reduces the quantity of heat produced. For example, if a pound of carbon is converted into CO, it will generate 4,400 heat units, but if double the amount of air is supplied, CO_2 will be formed and 14,600 heat units will be given off, provided the temperature is maintained at the proper point. On the other hand, if too much air is supplied, it lowers the temperature below the point necessary for complete combustion, and so the results may be no better than when the air supply is too small.

When combustion is not complete, some of the hydrogen, together with the carbon with which it is usually combined (called hydrocarbon), may be distilled from the coal and not burned, or the hydrogen only in this volatile matter may be burned, leaving the carbon in the form of soot or smoke, to be carried off in the gases passing out of the furnace. Smoke is a sure evidence of improper combustion, but it does not follow that where there is no smoke combustion is perfect. The perfect combustion of coal in a furnace can only be effected by a sufficient supply of oxygen supplied under proper conditions. The most important of these are a high temperature and an intimate mixture of the air with the fuel.

Coal is a compound substance and may be decomposed by heat into several distinct constituents, but in combustion we deal principally with but two—carbon in the form of coke, and hydrogen, generally known as gas. These two elements practically contain the full heating properties of the coal. We say that when coal is thrown upon a fire it commences to burn, but before any burning takes place it is decomposed into its constituent elements. The gas, having been distilled by the heat of the fire, burns first by its chemical union with the oxygen of the air, forming water. The gas having been disposed of, the coke burns in a similar manner, forming carbonic acid.

In order to ignite a substance and keep it burning it must be heated to a certain kindling point and kept up to that temperature. While the gas is being expelled from the coal the latter remains at a relatively low temperature; no particle of solid coal can burn while gas is issuing from it. A lump of coal may, however, be giving out gas in one place while it has been expelled from another and the remaining coke has already ignited. Coke does not produce smoke in burning; this is only formed during the distillation of the gas. To support combustion it is necessary to maintain a temperature of at least 800 degrees Fahrenheit. At temperatures lower than this there can be no burning of the coal. It is common in furnaces to have a temperature of 3,000 degrees Fahrenheit and over, just above the bed of live coals on the grate.

The amount of air required by a pound of soft coal to completely burn it is approximately twelve pounds, or 150 cubic feet. The actual amount needed in practice depends upon the force of the draft and upon how thoroughly the air and the gases are mixed. Former practice with ordinary chimneys allowed twenty-four pounds of air per pound of coal. With improved draft and better grates this has been reduced to eighteen pounds, and where combustion tubes or steam jets are used above the fire fourteen pounds has sometimes been found sufficient. The disadvantage of using too much air is the cooling of the fire, which retards combustion and reduces the transmission of heat, and second, the reducing of the chimney draft by cooling the stack. Every extra pound of air has to be heated by the fire, and this heat passes up the chimney without being used.

The quantity of air, however, should vary with the condition of the fire. Just after firing, when the gases are being distilled rapidly from the coal, more air must be admitted; after the coal becomes incandescent a comparatively small supply is needed.

The object to be attained in smokeless combustion is to prevent the formation of smoke rather than to provide means for burning it after it has been allowed to form. That smoke can be burned if carried into a very hot chamber and brought in contact with a sufficient quantity of highly heated air may be shown by the following simple experiment: First, place a short piece of candle inside of a tall narrow cylinder. The deficient air supply which the candle receives under these conditions will cause it to give off a column of black smoke. If this is led into the central draft tube of a Rochester kerosene lamp and passed up into the flame it will be completely burned.

The action of combustion and the effect upon it of different conditions is well illustrated by a kerosene lamp, and although this example has often been made use of, it may well be repeated in the present case. If we take a lighted central draft lamp and adjust the wick to such a point that it gives a rather short and clear white flame without a trace of smoke, then gradually obstruct the opening at the bottom, the following result will be observed: First, the flame will grow longer and its color change from white to yellow, and then to red, and it will also begin to smoke. Finally, when the air supply is nearly shut off the flame will rise almost to the top of the chimney, at the same time giving off a column of dense black smoke and soot. In this example the wick represents the automatic stoker, supplying fuel automatically; the perforated gauze at the base of the burner is the grate which heats and regulates the air supply, while the chimney regulates the force of the draft. The smoky flame caused by turning up the wick is analogous to that caused by adding too much coal at one time to a furnace. If the supplies of air and fuel are properly adjusted to each other the flame will burn clearly and steadily without a trace of smoke. If on the other hand the wick remains the same and the chimney is raised from the base, smoke will again appear, because cool air rushing in above the gauze checks combustion by cooling the flame. If a cold metal rod or strap be passed down the chimney into the flame it will become coated with soot, due to the chilling effect upon the burning gases. In like manner, too close proximity of a crown sheet to the fire causes soot in a boiler furnace.

We see from the above that perfect combustion may take place rapidly with a short flame and slower with a long flame; also that imperfect combustion takes place with a very long flame of a low temperature with the same amount of fuel, but with different results as regards the production of light and heat. The principles learned from these simple experiments with the flame of a lamp are of great importance in connection with the study of the action of boiler furnaces. Having become somewhat familiar with the process of combustion from its theoretical side, let us now apply the various results noted to the actual burning of coal in the furnace of a steam boiler.

Bituminous coal contains usually from fifty-two to eighty-four per cent of free carbon and from twelve to forty-eight per cent of hydrocarbons. When this is burned in a common furnace the coal is first heated and the hydrocarbon gases are driven off in such quantities that not enough heated air can reach them to give perfect combustion, and dense clouds of black smoke will escape through the chimney. A large amount of heat is thus lost until all of the hydrocarbons have been driven off, when the chimney will stop smoking and combustion become more perfect until a fresh charge of fuel is dropped on the hot coke, when the same performance will be repeated. This result is more evident as the volatile matter in the coal increases, hence bituminous coal produces large volumes of smoke, while anthracite gives off but little. The waste caused by a smoking chimney is due to the escape of unburned gases rather than to the carbon which appears in the form of soot and smoke, the latter being usually less than one-half of one per cent of the coal burned on the grate.

Let us suppose we have an ordinary flat grate of the old-fashioned type without stoker or smoke-preventing device of any kind. Let there be a clear, even fire, with plenty of air coming up through the grate to complete the combustion of the coke. The fireman opens each door in turn and covers the whole surface of the fire with a layer of fresh coal. Additional air is needed to supply oxygen for this sudden increase of fuel, but the stopping of the air passages by the fresh coal prevents even the usual amount from passing through the grate. At the time when air is most needed least is supplied, and dense smoke is the result. A similar occurrence takes place at the time of starting up a fresh fire after cleaning.

Now let the fireman when he comes to replenish the fire put in one or two shovelfuls, and that on one side, leaving the other side red and bright. Let him also open wide the damper and get a free draft, and if the fire shows signs of smoking, leave the furnace door open an inch until the smoke has burned off. The next time let him fire the other side in the same manner. Likewise when he cleans the fire let him do but one side of the grate at a time and build his new fire with one or two shovelfuls at a time, keeping it bright and clean.

To be a good fireman, one should possess a rudimentary knowledge of the principles of combustion, although such knowledge may be more of a practical than a theoretical nature. The fireman should be able to demonstrate his ability to put such knowledge to good use by firing skillfully, placing each shovelful of coal where it will give the best results; promptly filling every hole in the firebed through which cold air may find an entrance; keeping the fuel bed level and the firebox temperature up to a desirable degree by skillful use of the furnace doors, ashpit doors and damper. He should avoid unnecessary slicing, but at the same time keep the fuel bed sufficiently open for the free and even passage of air. He should also be able to tell the condition of the fire closely by watching the ashpit.

On the other hand, with the best effort the fireman may be unable to produce satisfactory results as regards smoke because he is given too much to do; that is, in a large plant a man may be given too many furnaces to feed, and in a small one he may be given other duties that interfere with handling the fires in a proper manner. A case was reported some time ago where satisfactory conditions as to smoke production were brought about by reducing the grate area cared for per man from seventy-five to forty-seven square feet each in the case of hand-fired furnaces.

[To be continued.]

Westinghouse Directors Elected.

At the meeting of the Westinghouse Electric and Manufacturing Company held at East Pittsburg, November 30, the stockholders took final action prior to the termination of the receivership.

Resolutions were passed amending the by-laws of the company so as to allow the election of sixteen directors and to provide for the election of a proxy committee. The following board of directors was elected: For the class whose term expires July, 1909, Richard Delafield, E. C. Converse, Anthony N. Brady and J. D. Callery; terms expiring July, 1910, A. G. Becker, George M. Verity, William McConway and Charles A. Moore; terms expiring July, 1911, Charles F. Brooker, James S. Kuhn, Edward F. Atkins and E. M. Herr; terms expiring July, 1912, George Westinghouse, Neal Rantoul, Joseph W. Marsh and Albert H. Wiggin.

The election of a proxy committee resulted as follows: James N. Jarvie, Jacob H. Schiff, Charles Francis Adams, Robert S. Smith and F. W. Roebling.

Indiana Electric-Light Men Organize.

A large number of managers, superintendents and owners of electric-light plants in Indiana held a meeting at the Denison Hotel, Indianapolis, November 26, and formed the Indiana Electric Light Association. Thomas McReynolds, of Kokomo, was elected president, and Frederick Leslie, of Muncie, secretary and treasurer. The purposes of the association are defined to be educational, making for the discussion of scientific, experimental and electrical subjects. The members of the association are sanguine that sufficient interest will be taken in the associaton to make it a success, and believe the meetings for the exchange of ideas and methods of operation will prove helpful to electric lighting throughout the state.

QUESTIONS AND ANSWERS.

Ayrton Universal Shunt.—In the answer to the query of M. A. G., relative to the Ayrton Universal Shunt that was published in this column on November 14, a typographical error was made in the first equation. It should have been given thus:

$$\frac{I_g}{I_s} = \frac{s}{g + r - s}$$

The first member of the equation was unfortunately inverted. The equation is based on the principle that the currents in the two branches of a divided circuit are inversely proportional to the respective resistances. The subsequent equation, as previously correctly stated, is derived from this by the rules of proportion.

Use of Leather Belting.—Kindly advise me as to which is the proper side of a leather belt to be placed against the pulley face.—R. E. B., Carthage, Mo.

The two surfaces of a leather belt are called the flesh side and the grain or hair side. The latter is harder but not as strong in tensile strength as the former. For both these reasons the grain side should be placed against the face of the pulleys. Being a harder surface it is better adapted for the wear of attrition. At the same time the flesh side being much stronger, is better adapted to withstand the greater tensile stress to which the outside of the belt is subjected.

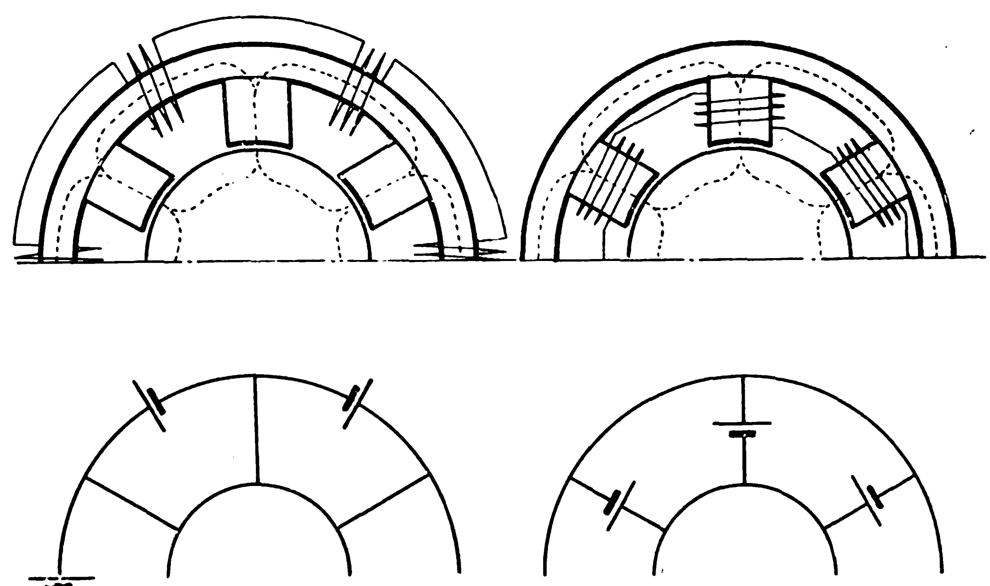
Induction Motors.—1. Can the stator of a three-phase induction motor be connected delta? 2. If some of the copper bars are grounded through faulty insulation, what effect will it have on the rotor? 3. If current lags or electromotive force lags on a three-phase induction motor, will it cause fuses to blow? The motor generally runs from no load to twenty-five per cent overload, the fuses being heavy enough to carry forty per cent overload.—T. J. S., Dixon, Ill.

1. The stator may be either delta or Y-connected. 2. In the rotor the difference of potential developed between the conductor bars and the laminated core is very small, since the entire rotor, both copper and iron, acts as the secondary of a transformer. In the squirrel-cage type, moreover, the copper bars are entirely short-circuited by the end rings, so that the grounding of a few of them would produce little, if any, effect. In a rotor having an auxiliary resistance the grounding of a few bars might short-circuit some or all of the resistance so as to lose the value of the latter in keeping down the starting current. 3. The current in an induction motor invariably lags, but this should not cause any fuses to blow in normal operation unless the angle of lag is excessive on a very heavy overload. In this case the current would become exceptionally large and might cause the opening of the fuses. In the case cited, if the power-factor is not immoderate, there will be no occasion for the blowing of fuse.

Wiring Rules.—1. The following formula has been used by the writer for a number of years in calculating the size of wire used in direct-current wiring:

$$A = \frac{I \times D \times K}{V},$$

where A = area of wire in circular mils, I = amperes on line, D = distance in feet, V = voltage, and K = 21.62, a constant for direct current. Recently an insurance inspector told me specifically "that it was at fault when applied to No. 14 or No. 12 B & S wire, claiming that in practice the actual drop was about three times the theoretical result. Is this formula incorrect, or can you suggest a better one?



ARRANGEMENT OF FIELD COILS AND ELECTRICAL ANALOGY THERETO.

2. A certain architect's specifications call for "100 candlepower and 250 candlepower at each outlet—i. e., the size of wire and number of circuits to be large enough for the above candlepower lamps to be used." What authority will govern the interpretation of these words? For instance, if tungsten lamps are used in place of carbon-filament lamps, there is a difference between one-and-one-fourth and three-and-one-half watts per candle, with a corresponding difference in the number of circuits and size of wire. If the circuits were filled up to the capacity of 660 watts with tungsten lamps, would this be necessarily hazardous or against the National Code?

3. Kindly calculate for me the voltage at the last lamp on a two-wire circuit 100 feet long having twelve sixteen-candlepower, three-and-one-half-watt lamps connected to it, when the voltage at the tablet board is 115 volts, direct current and No. 12 B & S wire being used. Also what would this voltage be, if No. 14 wire were used?—H. K., Harrisburg, Pa.

1. The formula is correct and applies to any copper wire carrying direct current, provided K has the value given and V is the voltage drop in the line. It is derived directly from the fundamental laws of resistance and is frequently given in different but substantially equivalent forms. Thus, in place of V in the denominator, PE is sometimes used, where E is the voltage at the receiving end and P the percentage of line drop; in this case K has a value 100 times that given.

2. Rule 21d of the National Electrical Code limits incandescent lamp circuits to 660 watts without specifying the type of incandescent lamps to be used. It is the general practice for inspectors to allow such circuits to be loaded up to 660 watts with tungsten as well as other such lamps. The only hazard there is in this practice is the danger of substituting carbon-filament lamps of nearly equal candlepower for the tungsten lamps; this would, of course, overload the circuit. This procedure would be very unlikely, however, since a person that has once used tungsten lamps would probably not go back to the use of carbon lamps.

3. Assuming the lamps to be uniformly distributed at a distance of eight-and-one-third feet from one another, and considering each lamp as taking one-half ampere, the voltage at the last lamp would be 113.97 when No. 12 wire is used and 113.36 volts when No. 14 wire is used.

Dynamo Field Design.—Which is the more effective position for the field coils of a multipolar dynamo, assuming they are to have in either case the same number of ampere-turns—placed on the poles, as appears to be the more general practice, or linking the yokes, as I have seen in the case of a few machines. The latter seems to me to be preferable, as I believe it makes possible a saving in the length of the turn, and, hence, the total field copper. The cross-section of the yoke is necessarily only one-half that of the poles; consequently, assuming the same number of ampere-turns per winding will produce equal flux values in either case (the total number of coils being the same in either arrangement), the length of the pole-turn must be $\sqrt{2}$ times the length of the yoke-turn. As the resulting difference in the respective windings would be $\sqrt{2} - 1$, or nearly forty per cent, it appears that this yoke arrangement of coils would effect a substantial saving.—V. R. L., Augusta, Me.

Given coils of the same number of turns and traversed by equal currents, that is, of the same ampere turns, and placed on either the poles or the yokes of the machine as contemplated in the query, the yoke arrangement of the coils will set up only half the flux which would be produced by the pole arrangement. It must be remembered that flux "flows" as a result of magnetomotive force after a fashion analogous to the electrical phenomena of Ohm's Law. With magnetic circuits of equal reluctance the greater the magnetomotive force the greater the flux. It will be noted that in each of the local magnetic circuits formed by the yoke, pole pieces and armature, there are two sources of magnetomotive force (coils) per circuit in the case of the pole arrangement, while there is only one magnetomotive coil in the yoke arrangement. Since in each circuit the coils are placed in series cumulatively, having the same magnetic direction in each local path, the total magnetomotive force per circuit will be twice that of the yoke arrangement, and if the reluctances of the paths are equal the resulting flux will be correspondingly doubled.

An electrical analogy forms a convincing demonstration of this fact. In the electrical circuits shown the reader will detect an analogous relation to the magnetic paths, the coils or seats of magnetomotive force being represented by ideal cells (having no internal resistance) as seats of electromotive force. Considering the local circuits to be of equal resistance, a little examination will show that the currents which flow in the radial paths are twice as great in the "pole" arrangement of cells as in the "yoke" arrangement. Carrying back the analogy of current to flux, it will appear that there would be no theoretical gain but a fifty per cent loss in the yoke arrangement, while the mechanical disadvantages of putting the coil in this position are very great. As the inquirer says, the field yoke need be only half the area of the pole from magnetic considerations if the same quality of iron is used, but this relation is seldom given for structural reasons, since to gain stiffness the yoke or frame, made of a cheaper material of lower permeability than the poles, is given a comparatively large cross-sectional area and perimeter. Moreover, the magnetic leakage with the tangential coil arrangement is nearly twice as great as that with the radial coil design. For all these reasons the latter is almost exclusively used.

Relation of Current and Potential.—In the article on "Alternating Currents and Their Applications" the diagram, Fig. 16, on page 687, shows the current curve, which is dotted, as leading the impressed electromotive-force curve 1TS. Kindly inform me whether this can be correct for the supposed inductive circuit?—A. J. S., Indian Head, Md.

In the diagram referred to the axis OX represents time as measured from the point O as origin. The curve 1TS is further to the right than the corresponding half of the dotted current curve, and therefore leads the latter as it should. The electromotive force in this case leads the current by about twenty-seven degrees.

To Honor Wright Brothers.

In recognition of the achievements of the Wright brothers in their record aeroplane flights in France and this country, the Aero Club of America is now obtaining designs for two gold medals, which will be presented to Wilbur and Orville Wright at a banquet to be given in their honor early next year. President J. C. McCoy has appointed a committee to raise subscriptions from the 300 club members. The medals will cost about $1,000 apiece.

DeWitt C. Morrell is chairman of the Medal Committee, and the other members are Prof. Alexander Graham Bell, Peter Cooper Hewitt, Gutzon Borglum, Major B. Hersey, Charles J. Glidden, Christopher J. Lake, Octave Chanute, James Means, Albert F. Zahm, Charles M. Manly and Alan R. Hawley.

Invitations will be extended to all of the affiliated aero clubs in the country to send representatives, and an effort will be made to obtain one or more foreign delegates for the dinner.

Wilbur Wright has already received medals in honor of his notable flight from the Aero Clubs of France and Great Britain.

Hydraulic and Electric Machinery.

In his presidential address, given before the Yorkshire students of the Institution of Civil Engineers at Leeds, A. Meysey-Thompson referred to the controversy as to the relative advantages of hydraulic and electric machinery for docks, and said that probably all light and fast-working machinery, with the exception of capstans which are only worked intermittently, was better operated by electricity. For all underground machinery, excepting capstans which are constantly employed, and all heavy appliances of a quick-working character, hydraulic power was more efficient. Until quite recently the hydraulic accumulator was operated by a steam engine working high-pressure pumps, but electrically-driven pumps are being substituted with advantage. On large docks the demands on the accumulator are constantly varying, and a few weeks ago he had timed an electrically-driven accumulator and ascertained that it started and stopped pumps of 130 horsepower thirteen times in ten minutes. As the service required that the pumps should not run more than ten seconds before delivering water after starting the motor, there must be considerable stress on the machinery in absorbing the momentum of a falling accumulator, and so frequently changing its direction. Several systems of electrical control gear to start against full load have been introduced, and most of these employ a small subsidiary motor of about one-half horsepower, controlled by the position of the accumulator, and so geared to the starter as gradually to cut out the resistances in the rotor circuit at starting. The author described a method which avoids the use of the subsidiary motor and electrical connections to the accumulator and has the advantage of enabling the main motor, of whatever power, to start under practically no load. The accumulator operates a small pilot hydraulic valve which controls both the electrical starter of the motor and a by-pass on the pump. At starting the operation is first to accelerate the motor gradually under no load by cutting out the resistances until full speed is attained, and afterward to bring on full load slowly by closing the by-pass on the pump. When stopping the by-pass is first opened, the load on the motor reduced, and then the electrical starter breaks the circuit. By this system both the electrical starter and the by-pass work in consonance, and in emergency the former can be cut out and the pump worked directly by the accumulator.—*Times Engineering Supplement (London), November 11.*

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER I. (PART IX).—CAPACITY AND INDUCTANCE.

ELECTROSTATIC INDUCTION.

Heretofore the electric current has been considered to the exclusion of the static charge. However, the latter is of considerable importance in alternating currents, especially where long transmission lines are used. As is well known, static charges of electricity, produced by rubbing glass with silk, or sealing wax with flannel, can be accumulated by means of electrical devices called condensers. A condenser consists essentially of two or more electrically conducting plates separated by an insulator, as shown in Fig. 29, where A and B represent two plates and X represents the insulator. If a positive charge, such as would be obtained by rubbing a glass rod with silk, be given to the conductor A, an equal quantity of negative electricity accumulates on B. This action is known as electrostatic induction as distinguished from electromagnetic induction, previously explained. It is the induction of electric charges and not currents. To be sure, these charges, being electricity at rest, become currents when suitably connected to conductors. For example, if the two sides A and B of the condenser illustrated in Fig. 29 be connected, the two charges neutralize each other.

THE CONDENSER.

A condenser usually consists of many layers of conducting and insulating material alternately arranged. Every other conducting plate is connected to one terminal and the intervening conductors to the other terminal.

The capacity of a condenser increases with increasing the area of the plates and with decreasing the distance between them. It also depends on the material of the insulator between the conductors; for example, being greater when glass is used than when only air intervenes, and still greater if mica is used to separate the plates. The unit of capacity is called the "farad," but this is so large that its one-millionth part, or the "microfarad," is the unit in common use.

A conventionalized condenser composed of a number of plates is illustrated in Fig. 30. This is made of many layers of mica and tinfoil.

EXAMPLES OF CAPACITY.

A telegraph, telephone or transmission line is a type of condenser, as is, indeed, every arrangement containing conductors separated by insulators. In the case of a conducting wire suspended on poles, the

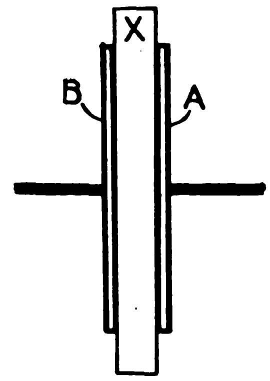


FIG. 29.—SIMPLE CONDENSER. A. B—CONDUCTING PLATES. X—INSULATOR OR DIELECTRIC.

wire itself forms one conductor and the earth the other plate of the condenser, the air between acting as the insulating medium. In the case of ocean cables the wire within acts as one conductor, the water as the other, and the insulation of the cable forms the insulating medium between. The capacity present in long ocean cables was one of the serious difficulties of their early operation, and its effects are by no means entirely eliminated at the present time.

CONDENSERS IN ALTERNATING-CURRENT CIRCUITS.

The electric charge produced by friction and electrostatic machines is of very high voltage, but is relatively small in amount. However, since the quantity of electricity accumulated by a condenser increases with the voltage, even with a

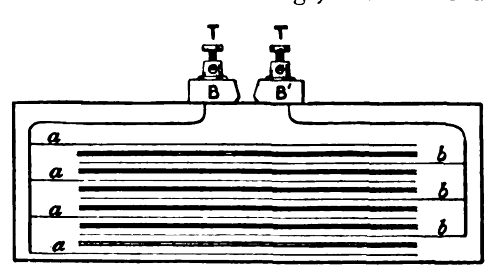


FIG. 30.—CONDENSER, ORDINARY TYPE (SECTION).

condenser of small capacity, considerable quantity may be stored up when a very high voltage is used. When a condenser is connected to an alternator each time the current changes direction the condenser charges and discharges. Thus an alternating current will flow in a circuit containing an alternator and a condenser, though with ordinary condensers the current is small. This is more clearly shown in Fig. 31.

Suppose at one instant of time the positive side of the generator is connected to A and the negative to D, a positive charge flows in AB in the direction of the arrow, producing the charges as shown in the condenser C. An equal positive charge is repelled along DE in the direction of the arrow. When the current changes direction the same phenomenon takes place except in the opposite direction. The negative charge could also be used to explain the above, as it may be assumed that a current of electricity consists of the flow of positive charge in one direction and a simultaneous negative charge in the other.

The effect of a condenser in an alternating-current circuit is such as to introduce another induced electromotive force, namely, that of the charge in the condenser and the characteristics of this are such that it tends to annul the induced electromotive force previously described, due to the changing magnetic field.

BALANCE OF INDUCTANCE BY CAPACITY.

In other words, the increased opposition to the flow of an electric current

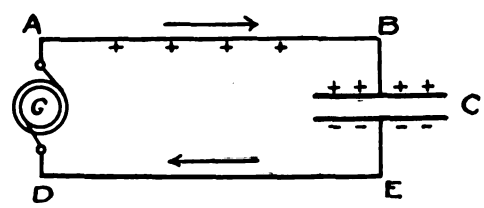


FIG. 31.—CONDENSER IN ALTERNATING-CURRENT CIRCUIT.

produced by the introduction of inductance in the circuit can be annulled by the introduction of suitable capacity in the same circuit. Suppose, for example, that a coil having a resistance of ten ohms and an inductance of 0.01042 henry be introduced into an alternating-current circuit having a frequency, f, of 127.5 cycles (these numbers are chosen so as to make the product $2\pi f = 800$, which is convenient to handle). In order to obtain a current of ten amperes in such a circuit an electromotive force of 130 volts will have to be applied, as shown in Fig. 32, where AC equals 100 volts, the product of the current by the resistance, and $BC = 2\pi fLI = 800 \times .01402 \times 10 = 83.3$ volts, the drop in potential over the coil. AB equals the resultant, or 130 volts, and is the voltage necessary to obtain a current of ten amperes. It may be obtained graphically. Thus, if AC = 100 units and BC = 83.3 units, then AB = 130 units, or $\overline{AB}^2 = \overline{AC}^2 + \overline{BC}^2$.

Suppose now that a capacity of 150

microfarads be introduced into the same circuit, as is shown in Fig. 33. Here G represents the alternating-current generator, L the coil and C the condenser. With the frequency, capacity and inductance as stated above, the last two balance each other exactly, and 100 volts applied at G gives just ten amperes. This is the same value that would be obtained if there were no inductance or capacity in the circuit. In other words, the potential drop over the condenser just balances that over the coil. Graphically this is represented by Fig. 34, where BC represents the potential drop over the coil and CD represents that over the condenser; the two differ 180 degrees in phase, or are exactly opposite in direction.

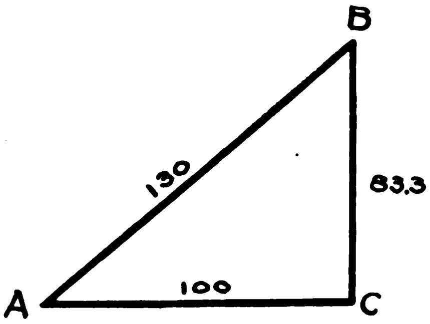


FIG. 32.—COMBINATION OF ELECTROMOTIVE FORCES.

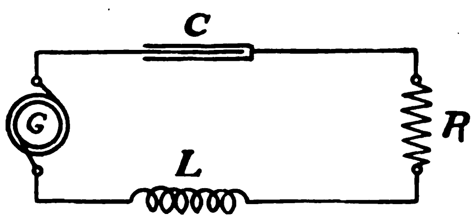


FIG. 33.—CAPACITY, RESISTANCE AND INDUCTANCE IN ALTERNATING-CURRENT CIRCUIT.

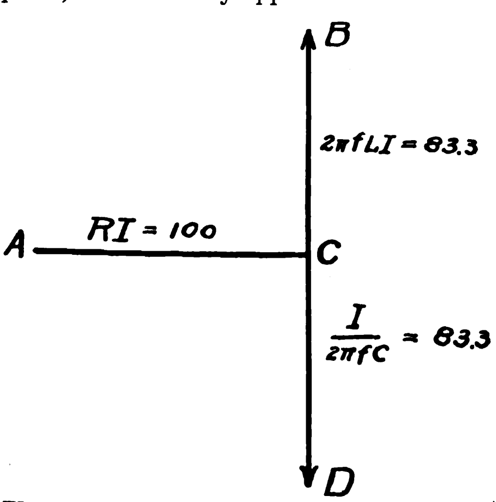


FIG. 34.—RELATION OF ELECTROMOTIVE FORCES FOR CONDITIONS OF RESONANCE.

The opposition offered by a condenser to the flow of an alternating current is inversely proportional to the capacity, for the greater the capacity the less the opposition; while with a coil, the greater the inductance, the greater the opposition. The capacity reactance of a circuit containing a condenser is therefore determined as $\frac{1}{2\pi fC}$, where C is calculated in farads. Thus 150 microfarads = .00015 farad.

$$\frac{1}{2\pi fC} = \frac{1}{800 \times .00015} = \frac{1}{.120} = 8.33$$

and the potential drop $10 \times 8.33 = 83.3$. This can be expressed algebraically as follows:

$$Z = \sqrt{R^2 + \left(2\pi f L - \frac{1}{2\pi f C}\right)^2}$$

where Z represents the impedance of a circuit containing both inductance and capacity.

ALTERNATING-CURRENT CURVES.

It has been assumed thus far in this discussion that the alternating-current curves are of the sine form first shown, but this is not always the case in actual practice. A very common wave form is that illustrated in Fig. 35, which was observed with an oscillograph, an instrument especially designed for this purpose, which will be described later. The fluctuations shown in this electromotive-force curve are due to the armature windings being placed in slots. The effect of inductance on this curve is to smooth it out, as shown in Fig. 36. Inductance in an electrical circuit acts like inertia in masses and tends to prevent sudden changes. Current through a condenser, on the other hand, magnifies the irregularities in the voltage curve, for any change in the electromotive force produces a rush of current into or out of the condenser. This is illustrated in Fig. 37, which represents the current produced by the voltage wave shown in Fig. 35 when applied to a circuit containing a condenser. A condenser resembles in some ways an elastic medium, in that slight vibrations may cause large disturbances. This is particularly true when the vibrations are accurately timed. For example, the trotting of a horse across a bridge has been known to set the bridge to vibrating to such an extent as to cause serious damage.

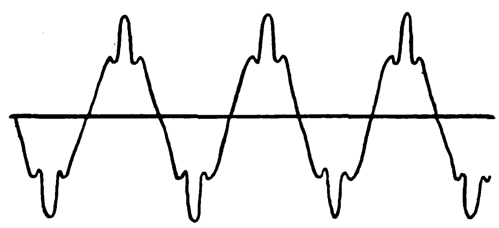


FIG. 35. — OSCILLOGRAM OF VOLTAGE WAVE FROM ALTERNATOR HAVING ARMATURE CONDUCTORS ASSEMBLED IN SLOTS.

The application of the phenomenon of balancing capacity by inductance is now being worked out to remedy the defects of long-distance telephones, telegraph and submarine cables. The capacity of the last particularly is very great, and inductances, called "loading coils," are being introduced at certain distances to annul the condenser action.

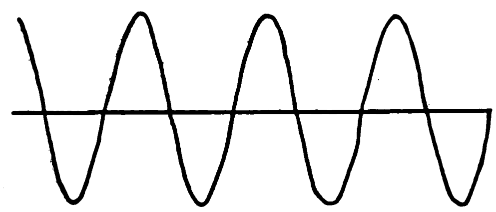


FIG. 36. — OSCILLOGRAM OF CURRENT CURVE PRODUCED BY SAME VOLTAGE WAVE IN CIRCUIT CONTAINING INDUCTANCE.

TUNING ELECTRICAL CIRCUITS.

The proper adjustment of capacity and inductance for a given frequency finds many applications where currents of very high frequency are used, such as in wireless telegraphy and other forms of high-tension discharge. The proper regulation of the value of condensers and the inductances is often called tuning from its resemblance to the tone adjustment of musical instruments. The phenomena observed in electrical tuned circuits are of very great interest, but rather too complicated to be considered here.

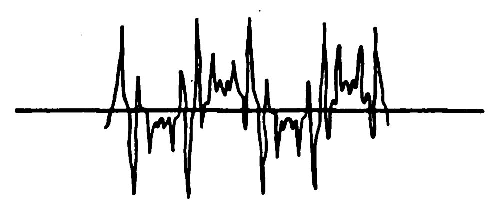


FIG. 37. — OSCILLOGRAM OF CURRENT CURVE PRODUCED BY SAME VOLTAGE WAVE IN CIRCUIT CONTAINING CAPACITY.

Northwestern Elevated.

John B. Dennis, of Blair & Company, has completed a plan for readjusting the Northwestern Elevated finances, including the issue of first-mortgage bonds at four and one-half or five per cent to take up the entire four per cent issue and possibly the new issue of preferred stock. The floating debt will be liquidated and provision made for development.

The first installment of electrical machinery for the Gatun handling plant for the Panama Canal has arrived on the Isthmus. It is expected that the plant will be in operation by July 1, 1909.

Cincinnati to Have an Electrical Show.

To show that it is wide-awake to the progress and rapid strides of the electrical industry, Cincinnati has planned an electrical show for next spring. The city has marked advantages of an industrial and commercial character, owing to its nearness to the sources of supply of the principal raw materials, its good transportation facilites and central location. These factors have created a demand for an exposition which will familiarize the general public with the practical applications of electricity. With this object in view the Western-Southern Electrical Show has been announced for the two weeks, March 13 to 27, 1909. About thirty per cent of the space has already been subscribed for and the success of the show is assured.

The representative character of this exposition is indicated by the personnel and standing of its directorate, among whom are: John L. Shuff; A. F. Chamberlain and J. A. Brett, Westinghouse Electric and Manufacturing Company; F. D. Lawrence, F. D. Lawrence Electric Company; J. D. Lyon; A. J. Conroy; M. E. Moch; Samuel Glover, Post-Glover Electric Company; J. E. Devere, Devere Electric Company; L. J. Van Lahr, Provident Savings Bank and Trust Company; L. J. Lowenberg, Reliance Engineering Company, and General Michael Ryan.

Alton Road Begins Motor-Car Experiments.

Officials of the Chicago & Alton Railroad have started on a demonstrating trip of the new Strang motor car. The experiments will continue for a period of three weeks. The method of propulsion of the car is electricity generated by a gasoline engine. The system consists of a gas engine with direct-connected generator, electric transmission and control between the generator and truck motors and a storage battery. By means of a starting rheostat the current is taken from the battery to the generator, which is converted temporarily into a motor for starting the engine. The fuel and ignition then being turned in, the engine and generator increase in speed to a point where the generator, acting as such, produces an electric current. When the car is standing still the current will go into the storage battery and be kept in reserve until such time as the motors require more current than is produced by the generator. The engine occupies the forward end of the car and the balance of interior space is devoted to a passenger compartment. The railroad is experimenting with the car both from the standpoint of economy and improvement in service between stations on branch lines.

The London Electric-Power Problem—Bulk-Supply Scheme Rejected.

After a hearing lasting fifteen days a committee of the House of Commons has rejected the bill which proposed the erection of a generating station having a capacity of 120,000 kilowatts to supply electrical energy in bulk to London and a large surrounding area. This decision is of much greater moment than may actually appear on the surface, for it is the application of a policy which if prosecuted to the fullest extent means the stifling of private enterprises in London, at any rate while the present Government is in power. The rejection of this electric supply scheme is undoubtedly a political decision, and one cannot help recalling the fact that for no less than thirty days a most influential committee of the House of Lords considered the same scheme in much greater detail than did the House of Commons and finally passed it in a somewhat modified form. The House of Lords committee included Lord Cromer, who was in charge of the administration of Egypt for so many years, and Lord Welby of financial fame, for many years chairman of the finance committee of the London County Council. But the House of Commons committee, presided over by a coroner, by the way, and consisting of members with no experience in large commercial undertakings or problems, has the final word in this particular instance, and so the scheme is dead. It is interesting to note the conflict of opinions between the political party which has undoubtedly wrecked the scheme and the actual opponents before the committee. On the one hand it is argued that such a scheme is wanted, but that it should be in the hands of the London County Council, and on the other hand it was urged that the present supply is ample for all purposes and that no bulk scheme is required.

This brings us back to the present position. Broadly, London has been parcelled out, for electric supply purposes, to a number of local authorities and companies. The latter hold their powers in perpetuity, while the latter are purchasable in 1931 by the local authorities of their respective districts. No local authority, however, may purchase anything outside its area, and knowing this limitation the companies have in many cases carefully set to work and erected generating stations outside the boundary, with the result that many a local authority is in the position of being able to purchase only the distributing mains. At the commencement of the present session of Parliament the companies brought in a bill giving them powers to link up the various generating stations so as to be able to use them with greater economy. A wise legislature in 1882 had put upon the companies the provision that they should not "associate," an absurd position of affairs which has remained in force ever since. As a *quid pro quo* for granting these powers the Government expressed its intention of inserting a clause in the bill substituting the London County Council the purchasing authority in respect of all the companies instead of the individual local authorities, and this would to a large extent get over most of the difficulties applying to the local authorities purchasing. For instance, practically one undertaking would then be in existence on the one hand. When the matter came before the same committee which rejected the bulk scheme, it was quickly realized that difficulties lay in the way. While on the one hand the London County Council had been constituted the purchasing authority for all the companies in 1931, it was suddenly discovered that certain local authorities had special powers of purchase at dates preceding this, and as the committee refused to take away these special powers the companies threatened to withdraw the bill. Having gone so far, however, the committee refused to allow this to be done, and what Parliament is pleased to call a comprehensive scheme is one over which some local authorities have purchasing powers before 1931, as to a portion, and the London County Council purchasing powers over the remainder after 1931. Furthermore, no provision is made for merging the undertakings of the local authorities into the larger undertaking when the County Council comes into possession, and unless some such arrangements are made the year 1931 will witness the London County Council in several portions of London competing with a small local authority electricity undertaking, and both the County Council and the local Borough Council will be representing the same ratepayers! Confusion is certainly becoming worse confounded the further the matter goes. A. W.

AN ENGLISH VIEW OF SOME TRACTION PROBLEMS.[1]

BY H. E. YERBURY.

Ordinary street traction has during the past ten years become standardized and improvements which have been made in electrical and mechanical details are of a minor character.

Series-parallel control with series motors appears to have fulfilled all reasonable requirements, and although the all-around efficiency may be improved in many cases, yet as long as the motors run without vigorous sparking and the cars maintain schedule speed, and the temperature of motors and bearings is not abnormal, and the cost of maintenance is fairly low, the average tramway manager is satisfied.

In respect to the economical generation of electricity, we can hardly expect—with the present price of fuel—that costs will be materially reduced, for about fifty-two per cent of the total generating costs are now expended in coal. Engineers of combined lighting and power stations should consider themselves fortunate in being able to obtain such a high price for current supplied to tramway undertakings, for the average price charged in Great Britain is 2.82 cents per unit, whereas in tramway power stations current can be generated and distributed at about 0.78 cent per unit, and including interest on capital, sinking fund, rates, taxes, insurance, etc., at a total cost of about 1.32 cents per unit. We may therefore reasonably expect in the near future to see a reduction in price to large consumers, such as tramway departments.

As what might be called commercial rather than technical knowledge often governs tramway administration and management, such considerations as the determination of the characteristic properties of tramway motors for the work they are often called upon to perform, and the plotting of efficiency curves of motors in order to get the greatest commercial advantage in working cars, are often ignored, and if drivers could be educated to work controllers and brakes in an efficient manner and utilize the kinetic energy, the resultant saving would, in the author's opinion, be at least equal to the results obtained by regenerative control, which, by the way, does not appear to have made the progress that was expected at the time of its inception, for it is evident, after comparing the relative efficiencies and advantages of series and shunt motors for traction work, that there is nothing to be gained by using shunt motors.

It speaks well for the stability of series motors when one finds that notwithstanding the diameter of carwheels has been increased two to three inches, canopy tops have been fitted, making cars some two tons heavier, and motors are now often used for ordinary service braking; yet the same motors which were designed for lighter work are well able to stand these onerous conditions. But we must expect that maintenance costs will increase, and in the author's opinion it will doubtless be necessary in the near future to install ventilated motors, possibly of the interpole type, to effectively meet the requirements of modern practice.

The trackless trolley system, which has for several years been in operation on the Continent with a fair measure of success, appears to offer advantages in the way of low capital and running costs, and the system generally compares very favorably with motor cars carrying their own power equipment. In the author's opinion there is a useful and remunerative field for a trackless trolley system in many districts, as the same overhead equipment could be retained if the population or requirements of a particular district justified the laying down of rails with a frequent service of cars after, say, a few years' running under above conditions.

In the early days of railway electrification three-phase motors were used, presumably for want of a better system, for it was then necessary to run two overhead wires for each track, yet this was proved to be more economical than laying heavy insulated steel rails on the permanent way as required for locomotives working with continuous current.

Now that single-phase motors are built that have the characteristics and large starting torque necessary for railway work, we may expect to see rapid progress in that direction. It has been demonstrated in many instances that, as a single-phase motor is nothing more than a direct-current motor with laminated fields so as to reduce the iron losses with alternating-current excitation, and fitted with a compensating winding for neutralizing armature action, these motors may be used for either system, and in the author's opinion should prove very useful for tramway and railway work in this country, for when run on a direct-current system, say for town or suburban service, the motors would have an efficiency of about eighty-eight per cent, and for linking up towns or cities the same cars and motors may be used with, say, a twenty-five-cycle single-phase current and give an efficiency of about eighty-three per cent. In such cases the single-phase system is economical, as energy can be transmitted at high voltage, and the capital and maintenance costs are low.

A problem which is engaging the minds of designers at the present time is that of building satisfactory direct-current turbo-generators of, say, 1,000 to 1,500-kilowatt capacity. With alternators no difficulties present themselves, for they can be readily designed suitable for the high speed required by turbine manufacturers, whereas for the comparatively low speed required up to the present for direct-current generators, steam consumption is invariably higher, and is brought down to a point practically equal to the steam consumption of reciprocating engines of equal power. Important developments and improvements have been effected within the past few years, and we now find that compensating windings and interpoles have been adopted for neutralizing reactance voltage and armature reaction, and radial commutators appear to have given good results, so that we may reasonably expect that brush and commutator troubles, with their high maintenance costs, will be minimized, and that carbon brushes will be universally adopted in the future. I think we may also expect to see great improvements in the general design and mechanical construction of turbines. It is well known that clearances in the past have been so fine and so closely calculated for a predetermined temperature of steam that either serious trouble or loss in efficiency has taken place when the temperature of steam has been raised or lowered, and to overcome this trouble combination turbines of impulse and ordinary blading design have been evolved. The true value of the latent heat of steam is now being fully understood and appreciated, and we may reasonably expect that turbines will be so designed in future that their efficiency will not be impaired by eliminating the very fine clearances which have been the primary cause of considerable trouble in the past.

[1]Abstracts from an inaugural address by the chairman of the Leeds local section of the Institution of Electrical Engineers, delivered at the University of Leeds, England, on October 28.

PRACTICAL CONSIDERATIONS IN THE SELECTION OF TURBO-ALTERNATORS.[1]

BY M. KLOSS.

Whenever a new invention is brought out, its development is to a certain extent retarded by the fact that people base their judgment of the new thing on their experience with old things, or, in other words, they measure it with the same scale they are accustomed to use without first considering whether this attitude is fair toward the new thing. It seems to me, therefore, the duty of all who take an active part in its development, to show that the supposed discrepancies are chiefly due to using the wrong scale, to provide the right scale instead, and to show the proper point of view from which the new thing ought to be looked at.

These considerations have often occurred to me when designing turbo-alternators, especially when reading specifications for such machines. Very often one finds conditions laid down in a specification which are simply copied from slow-speed alternators, where they are quite within the limits of commercial or physical possibilities, whereas, in the case of turbo-alternators, they may be impossible of fulfillment, owing either to mechanical reasons or to commercial considerations.

I, therefore, regard it advisable to investigate some of these points from a designer's point of view for the guidance of those who have to get out specifications for a turbo plant. This is the more important at the present juncture, as the various makers have now gained a more or less costly experience in manufacturing this new class of machinery, while, on the other hand, the demand for larger high-speed units is constantly increasing.

The three points with which I propose to deal in this paper are: Ventilation, voltage regulation, power-factor and its influence on the size of machine.

VENTILATION.

In old times (relatively to the electrical industry), nobody troubled themselves about the heat produced by a dynamo in the form of losses. However, when competition became keener and the theory of the design was better understood, the makers were driven to squeeze as much output out of their machines as they possibly could. The limit was then given by the heating of the machine. Now designers are not satisfied even when they have found out how to predetermine the heating under given conditions, but they are carefully studying the laws of ventilation with a view to improving this through proper design, or even by providing special means for insuring the most efficient method of cooling a machine.

It is well known that under otherwise equal conditions the output of an electrical apparatus increases approximately

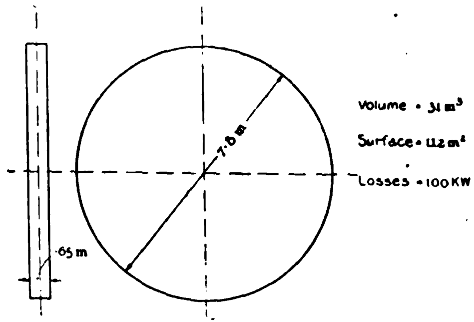


FIG. 1.—OVER-ALL DIMENSION OF LOW-SPEED MACHINE.

in proportion to its volume, or as the cube of its linear, while the radiating surface only increases as the square of dimensions. Hence there must be a limit of size where the surface is no longer sufficient to radiate the heat produced in the apparatus. This is the reason, for instance, why transformers above a certain output can only be built with artificial ventilation. As regards machines with moving parts we are much better off, because they produce, through their own motion, a natural ventilation, which helps to keep the machine cool.

The time is not far distant when we shall have to regard a scheme of ventilation for a turbo-alternator of large ca-

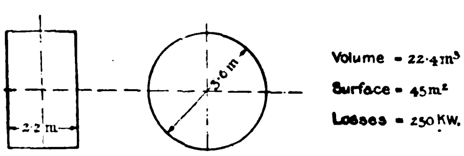


FIG. 2.—OVER-ALL DIMENSION OF HIGH-SPEED MACHINE.

pacity as a natural and essential part of the plant, just as one does the condensing plant for the steam portion. In order to make this quite clear, I give in Figs. 1 and 2 the overall dimensions of a slow-speed alternator for 2,000 kilowatts and for a turbo-alternator for 6,000 kilowatts. The total losses in the low-speed machine are about 100 kilowatts. However, the losses in the higher-speed machine are about 250 kilowatts, or two and one-half times as great as in the other machine. For every 100 kilowatt losses, therefore, there is only a volume of nine cubic meters available against thirty-one cubic meters in the large machine (that is, less than one-third), and the available surface is only eighteen square meters per 100 kilowatts against 112 square meters in the first machine (that is, less than one-sixth). I think these figures show clearly that it is quite necessary for the designer to provide special means for dissipating the heat which is generated in a relatively very small space. This is the more important, as the high peripheral speed at which modern turbo-alternators run is liable to produce noise, and in order to reduce this as much as possible one is bound to enclose the whole machine. The result is that the conditions of cooling by simple radiation and conduction to the surrounding air are made still worse.

The consequence of this is that makers must design the rotors so that, either by their own shape or by additional fans at their ends, they produce a strong draft through the machine. This seems to be now quite common practice, at all events with machines, say, up to about 3,000 kilowatts.

If, however, sets of larger capacity are to be installed, the user has to face the fact that rather large quantities of heat will be produced in a comparatively small space, and it is quite a serious problem to consider beforehand what he is going to do with this energy. For instance, in a power station where it is intended to install six turbo sets of 6,000 kilowatts each, the amount of heat produced by these six sets running at the same time will be something like 1,500 kilowatts, without allowing for the heat radiated by the steam turbines. If this great amount of energy were allowed to go into the engine room without special provision for dispersing it, it would not be surprising to find the temperature in the engine room rising rather rapidly to a point which would make it impossible for men to stay in the room.

The heat created in the room can escape only in two different ways: A portion will be conducted and radiated by the walls, the roof, and the floor; and another portion will disappear by the natural renewal of the air through windows and doors. If these two means are not sufficient, special arrangements must be made for ventilating the room.

Now, if the amount of heat passing through the walls is calculated, it will be found that this is comparatively small.

[1] Abstract of a paper read before the Manchester Local Section of the (British) Institution of Electrical Engineers.

For instance, I have assumed that a house of very ample size would be provided for the 6,000-kilowatt alternator mentioned before, and I have calculated how much heat would be conducted and radiated by walls, roof and floor. Assuming an outside temperature of 25° C. (= 77° F.) and a room temperature of 34° C. (= 93° F.) corresponding to conditions of a hot summer day in England, I find that this quantity of radiated heat only amounts to about 15 kilowatts, which is practically nothing compared with the total loss of 250 kilowatts.

Now, when it is admitted that special ventilation must be provided for the power house if large units are to be installed, it seems to me to be somewhat unreasonable, first, to let this quantity of heat enter the engine room (making it very uncomfortable to stay there), and afterward to adopt means to drive it out again and replace it continuously by air taken from outside. I rather think the idea must offer itself to the user that the best and easiest way would be not to let the hot air issuing from the machine enter the engine room at all, but to take it straight away from the machine to the outside through special ducts. A further consideration leads to the conclusion that it is also very advantageous for the cooling of the machine not to use the engine-room air as a cooling medium (as it is already warm to begin with), but to take the necessary cooling air direct from the outside atmosphere. This arrangement also enables the cooling air to be cleaned by passing it through a filter, thus avoiding dirt and moisture from getting into the machine.

But it is not only for the sake of convenience that, instead of ventilating the engine room, the machines should be ventilated directly. It is also very advisable to do this from the point of view of saving capital and running costs. This may best be explained by carrying out a comparative calculation of the amount of air required for cooling by the two different methods. If we provide a special ventilation scheme for the machine itself, we can, of course, allow the air to rise to a higher temperature, because it does not pass into the engine room. Calculations show clearly that by providing a ventilation scheme as part of the machine plant instead of part of the building plant, a saving in capital outlay and running cost might be effected.

In conclusion, I should like to enumerate again the chief advantages of this system:

1. The machine is cooled with fresh, clean air, free from dirt and moisture, and therefore has a lower temperature rise than if the ventilating air was taken from inside the power house.

2. The machine is fully enclosed, and by this means the noise is reduced to a minimum.

3. The appearance of the machine is greatly improved.

4. The hot air issuing from the machine does not enter the engine room, so that it is quite easy to keep this at a moderate temperature.

5. The capital outlay for the necessary ventilating plant is smaller if the machines themselves are ventilated than if the engine room is specially ventilated.

6. In addition to this, it is quite possible to utilize the energy contained in the hot air. It could be used either for heating buildings, or heating feed water for boilers, or by blowing it into the boiler fires, or for all kinds of other useful purposes, so that one may regain part of the energy which would otherwise be lost entirely.

I am quite aware that there are at present different ideas as to whether or not such a ventilation scheme is to be recommended. But I am convinced that the final decision cannot be influenced by ideas, but only by facts.

The object of my statements is not so much to advocate one particular scheme of ventilation as the best. What I am aiming at is to impress upon people connected with the laying out of power stations for large high-speed units the great importance of not neglecting the ventilation problem. Careful calculations should always be made in this respect. The amount of heat produced is to be calculated, and then the architect of the building has to state how much heat will, under certain given conditions of outside and inside temperature, be radiated by the walls and the roof, and how much can be got rid of by the natural ventilation through windows and doors. The calculations will show that these two quantities represent only a very small percentage of the total amount of heat produced, and that therefore by far the greatest amount of that heat must be dealt with by special ventilating arrangements.

VOLTAGE REGULATION.

In order to build a machine which can give the greatest possible output at a minimum cost of manufacturing, we must get as much flux through the machine as possible, and provide the highest possible number of ampere-turns on the armature or stator, because at a certain given speed the output is proportional to these two quantities. Now, the number of ampere-turns determines the armature reaction, and in order to balance this under normal running conditions, and to keep the voltage regulation within reasonable limits, we have to provide a sufficiently high number of ampere-turns on the field, or, in other well-known terms, we must design the machine with a short-circuit current which is sufficiently high, compared with the normal current. With the ordinary slow-speed alternators, it has become quite a usual practice to design the machines such that with no-load excitation the short-circuit current is equal to about two and one-half to three times the normal current. This means that the number of excitation ampere-turns even for no load must be two and one-half to three times as great as the full-load ampere-turns on the armature. The amount of copper therefore to be provided on the field must be correspondingly greater than the copper in the stator.

In large multipolar alternators there is no difficulty in doing this, because there is plenty of space left between the poles for the field winding, on account of the very small angle formed by two adjacent poles. For our investigation we are only interested in the number of ampere-turns per centimetre pole-pitch. In order to arrive at an idea of the comparative amount of ampere-turns per centimetre pole-pitch, we have only to compare the useful winding space available in, say, a six-pole and a sixty-pole alternator. The ratio of the two available areas is, of course, not equal to the ratio of possible ampere-turns per centimetre pole-pitch, because the current density may be different in the two machines. Still, with due allowance for this difference, we can get an approximate idea of the actual conditions by simply comparing the useful winding space. Figures show that in the case of the six-pole turbo there is only about one-quarter of that winding space available which can be made use of in the sixty-pole slow-speed alternator.

It is therefore evident that we shall not find the slightest difficulty in the latter case to provide for a large number of ampere-turns and still keep the field quite cool. Or, in other words, we can easily design a slow-sped alternator with a high short-circuit current, and consequently with a good voltage regulation, without being restricted by the heat limit of the field. The output of the generator will be more limited by the magnetic densities than by the armature strength (number of ampere-bars per centimetre circumference).

In the six-pole turbo it is clear that we must come up against the heat limit of the field, on account of the rather restricted winding space, and I think every designer of turbo-alternators will agree that the output of such a machine is never limited by the stator, but always by the rotor, whether this may be of the salient pole or of the cylindrical type.

In designing a machine which should be salable as regards price, one is bound to go to the heat limit of the rotor. But even then, for the simple geometrical reasons given, it will not be possible to obtain the same number of ampere-bars per centimetre as in a multipolar machine. Consequently the armature strength must also be reduced, which means a reduction in the output per centimetre circumference, with a corresponding increase in price per unit of output. Now, in order to prevent this increase in unit price from becoming prohibitive, we are driven to design the machine with a comparatively lower short-circuit current, because then we need not reduce the armature ampere-turns per centimetre in the same ratio as we are bound to do with the field ampere-turns. This, of course, results in sacrificing something of the regulation of the machine, and it is this point which I want to make quite clear to those who have to draft specifications for turbo-alternators. One should always bear in mind that it is not possible to obtain the same regulation figures with a turbo as with an ordinary multipolar slow-speed machine. When I say "it is not possible," I do not mean, of course, "physically impossible," but impossible from a "commercial" point of view, because the regulation of any given machine is only a question of rating, and therefore a low regulation can only be obtained by an increase of price per unit of output. However, it seems rather doubtful whether any station engineer or any corporation would be willing to pay a considerable excess of money in order to get a machine with the same voltage regulation as can without difficulty be obtained with a multipolar alternator.

Now, having outlined the reasons for the difference in the conditions of voltage regulation in the two classes of machines, I will go more into details and show some curves, which will give an idea of the quantitative difference in the two machines.

Fig. 3 represents a typical open-circuit characteristic which I have used as a basis for all further investigations. For the sake of comparison, I have chosen the scale so that I call the normal voltage 100 per cent, and also the corresponding no-load excitation 100 per cent. At this excitation the machine will have a certain definite value of short-circuit current I_k, while the normal current of the machine is I_n at a certain power-factor $= \cos \phi$, and we will measure the current, not in amperes, but simply by the ratio of its value to the short-circuit current, that is to say, $\frac{I_n}{I_k}$. This factor will therefore give the rating of the machine corresponding to its kilovolt-ampere output, on which the size of it will depend. For

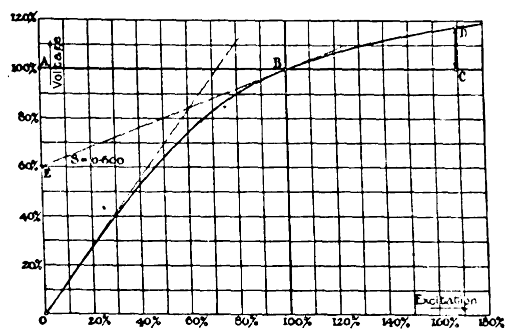


FIG. 3.—TYPICAL OPEN-CIRCUIT CHARACTERISTIC.

the station engineer, however, the kilowatt output of his machine is the more important quantity, and in order to introduce this into the comparative investigation we will call the watt component of the current I_w, which will, of course, be $= I_n \cos \phi$, and therefore the kilowatt output of the generator can be expressed by the ratio $\frac{I_w}{I_k}$.

If we now want to find the full-load excitation, we have to allow an increase in excitation due to three different factors: First, the increase in flux through the gap due to the armature leakage; secondly, the necessary ampere-turns to counterbalance the armature reaction; and thirdly, the increased pole leakage. Thus, we obtain a full-load excitation, represented by point C in Fig. 3. If the load is taken off at constant excitation and constant speed, the open-circuit voltage will then be given by point D, and therefore the distance CD represents the rise in voltage for inductive full load, and this is the quantity which the designer has to keep within a certain limit, in accordance with the specification he has to work to. The value of CD, however, does not solely depend on the distance BC, and therefore on the three factors mentioned above; but it is to a large extent also determined by a fourth factor, namely, by the shape of the open-circuit curve. It is evident that with the same excitation AC, a machine with a flat characteristic will have a smaller voltage rise than a machine with a steep open-circuit curve. As the shape of this curve depends on the saturation of the magnetic circuit, we must find a way to signify the degree of saturation prevailing in a machine. The simplest way to do this is to introduce the slope of the curve at the point of normal voltage. For this purpose we will draw a tangent to the curve at the point B, which will cut the ordinate axis at a point E. It is clear that this point E will be higher the greater the saturation is. We will therefore call the factor $S = \frac{OE}{OA}$ the "saturation factor" of the machine. In the case of Fig. 6 we find $S = 0.600$.

We now can say that the voltage rise depends on the following four factors:

1. Armature leakage.
2. Armature reaction.

} Proportional to load current.

3. Increase of pole leakage.
4. Saturation factor.

} Partly influenced by saturation factor.

If a special machine is designed to meet a certain specification, then the designer can choose to a certain extent the value of factor No. 3, by so fixing the dimensions of the magnetic path that he obtains the most suitable initial pole leakage at no load to meet the conditions of specification. In most cases, however, the designer will, from a manufacturing point of view, avoid special designs, and will want to put forward standard machines. In such cases he is more or less tied down to a certain initial pole leakage, and if he has to fulfill certain conditions of voltage regulation, he can only do this by choosing suitable values for the quantities given under Nos. 1, 2 and 4.

This is the reason why I have restricted myself in the following to an investigation of the influence on voltage rise, of the rated load current, and the saturation factor. The two variable quantities for this investigation will therefore be the ratio $\frac{I_n}{I_k}$ or $\frac{I_w}{I_k}$, and the factor S. The calculations have been carried out for various power-factors, namely, $\cos\phi = 1$, 0.95, 0.90, 0.80, 0.70 and zero, and have in most cases been extended over a range of $\frac{I_n}{I_k} = 0$ to $\frac{I_n}{I_k} = 1$, and a large number of curves have been plotted for the different conditions.

These curves show clearly that it is advisable to work at relatively high saturation, especially in the case of machines which are to be designed for a relatively low short-circuit current, that is to say, for a high ratio of $\frac{I_w}{I_k}$, whereas in machines with a high short-circuit current the saturation factor has not so great an influence on the regulation. However, as the high increase of exciting current at high saturation is not desirable, one is obliged to work at lower saturations than one would do if only the voltage regulation had to be looked out for. We must therefore make a compromise, and from my experience I find that for a modern machine the saturation factor should be between 0.50 and 0.60. The values of rise corresponding to these two values of saturation factor have been plotted against the power-factor in Fig. 4.

We find that for geometrical and physical reasons one is bound to work a turbo at a higher value of $\frac{I_w}{I_k}$ than is possible with a multipolar. As fair average figures we can assume $\frac{I_w}{I_k} = 0.50$ for a turbo, and $\frac{I_w}{I_k} = 0.30$ for a slow-speed machine. The two pairs of curves given in Fig. 4 can therefore be taken as representing relative conditions in the two classes of machines.

From what I have said before it is evident that the price will be affected by the specified figure for voltage regulation. A machine with small regulation is bound to be more expensive than one with a larger regulation figure. In order to make a comparison, I have not worked out a new design for every different condition, but have simply modified the rating of a standard size, so as to fulfill various conditions of regulation, the price remaining constant for that machine.

Let us assume that a standard three-phase machine gives 1,000 kilowatts at $\cos\phi = 0.80$, 100 amperes normal current, $I_w = 80$ amperes watt current (or current at unity power-factor), the no-load excitation will be 100 amperes, $\frac{I_w}{I_k} = 0.50$, that is to say, the short-circuit current will be $I_k = 160$ amperes. The full-load excitation (in accordance with curves) will be 169 amperes, the saturation coefficient of the open-circuit curve S = 0.60. The rise in voltage will then be 17 per cent for $\cos\phi = 0.80$, while the corresponding figure for unity power-factor will be 6.2 per cent. For the sake of argument we will assume that the price for this machine will be £1 per kilowatt.

Now we will take the case of a specification which calls for rather a low voltage-regulation figure, as can be obtained without great difficulty on slow-speed alternators. We will take, for instance, 14 per cent for $\cos\phi = 0.80$, and 4.5 per cent for unity power-factor. As it would not be advisable to work the machine at a higher flux density in order to flatten the open-circuit curve, the only means left for obtaining the lower regulation figures

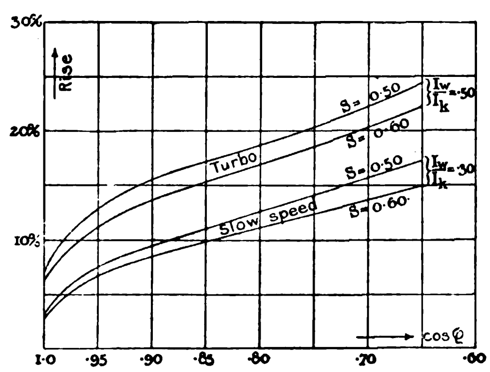


FIG. 4.—RELATIVE CHARACTERISTICS OF HIGH AND LOW-SPEED MACHINES.

would be to work it with a lower ratio of $\frac{I_w}{I_k}$, or, in other words, with a higher ratio of short-circuit current to normal current. Now, again, it is not possible simply to increase the excitation ampere-turns by increasing the gap, as the rotor field winding is already designed to the thermal limit. So, if no higher temperature rise is permissible, the desired result can only be obtained by a reduction in the rating of the machine. We will now find out how much that will be.

From curves we find that a ratio of $\frac{I_w}{I_k} = 0.40$ will give the figures specified. The rated current would therefore have to be reduced in the ratio $\frac{0.40}{0.50} = 0.80$. However, we can now make a correction, because for this lower output the exciting current will also be lower—namely, only 153 amperes, while our machine is designed to stand 169 amperes excitation. We can therefore increase the excitation ampere-turns in the ratio of $\frac{169}{153} = 1.104$ either by increasing the air-gap or by working the machine at a slightly higher density. This, however, enables us to put up our rated current to such a value that it still fulfills the relation $\frac{I_w}{I_k} = 0.40$. As I_k is proportional to the no-load excitation, it follows that we can increase I_w proportionally to the permissible increase in excitation. We therefore find that the rating of our machine is to be $0.80 \times 1.104 = 0.884$ of the standard rating. The price per kilowatt would therefore now be $\frac{1}{0.880}$ = £1.132 per kilowatt.

A small reduction is perhaps possible, because the stator copper can be reduced by 11.6 per cent, corresponding to the reduction of normal current output. So we can say the reduction in voltage rise from 6.2 per cent to 4.5 per cent at unity power-factor, and from 17 per cent to 14 per cent at $\cos\phi = 0.80$ is to be paid for by an increase in cost of 13 per cent.

It must, however, be kept in mind that this figure only holds good in case the modified output of the machine happens to coincide with the output called for in the specification. In reality specifications are accustomed to call for outputs in round figures, and the manufacturers also design their standard machines to give an output in round figures. If, therefore, a voltage regulation is specified which falls outside the figures of a properly designed standard line, it will, in most cases, be necessary to put in the next larger size of machine, so that the price per kilowatt will still be increased.

POWER-FACTOR.

I will now deal with the rated power-factor and its influence on the rating and the price of the machine.

It seems to suggest itself to the buyer of an alternator that he will be on the safe side if he orders the machine for a lower power-factor than is actually prevailing in his power station. As a matter of fact, this is very often done in practice. We will now see what he is to gain by this method.

We take again, for the sake of comparison, the same standard machine as before, with a price of £1 per kilowatt. Now, we will assume that, for the sake of getting a "bigger machine," the power-factor be specified as 0.70, while the actual power-factor in the station be 0.80. For

1,000 kilowatts the current at $\cos\phi = 0.70$ would then be $I_n = \frac{80}{0.70} = 114.2$, and $\frac{I_n}{I_k} = \frac{114.2}{160} = 0.715$. The curve for $\cos\phi = 0.70$ shows that for this load an exciting current of 192 amperes would be required, while the permissible current for the standard machine is only 169 amperes. This would mean about 35 per cent more heat in the field, with a correspondingly higher rise, which, of course, is not permissible. We have, therefore, to reduce the current output of our machine to such a value that at a power-factor of 0.70 the full-load excitation is equal to the normal figure of 169 amperes. From the same curve we find this armature current to be $= 0.556\ I_k = 90.5$ amperes; this gives a watt current $I_w = 0.70 \times 90.5 = 63.4$ amperes against 80 amperes of the standard machine. In other words, the output of the standard machine is reduced to $\frac{63.4}{80} \times 100 = 79.2$ per cent, or 792 kilowatts, and therefore the unit price increased by 26.5 per cent. This, of course, refers to the output stated on the nameplate to specification. The fact, however, that the actual power-factor is 0.80 instead of 0.70, as specified, will enable the station engineer to take more output out of the machine than is stated on the nameplate. The latter gives him as normal stator current the figure 90.5 amperes. With this current at his actual power-factor of 0.80 he can get a watt current of $0.80 \times 90.5 = 72.5$ amperes against 63.4 amperes, at $\cos\phi = 0.70$. He will therefore be very happy that, by specifying a lower power-factor, he gets an increase of output of 14.2 per cent "for nothing," or that the price per kilowatt which he actually gets out of his machine is only 87.5 per cent of the "nominal" price per kilowatt "rated" output. However, if he were aware of the fact, explained before, that the price per "rated" kilowatt of this machine is 26.5 per cent higher than it would be if designed for the correct power-factor, he would come to the conclusion that his unit price is actually $1.265 \times 0.875 = £1.107$ per kilowatt, while it would have been £1.00 per kilowatt if the machine had been built to suit the actual requirements.

In other words, he does not get 14.2 per cent more output "for nothing," but he pays 10.7 per cent more money "for nothing." Or probably still more, because it will, in most cases, happen that on account of the low power-factor the next larger standard will be put forward.

In order to make these facts still more evident, we can make the following comparison: The standard machine would be designed for 100-ampere stator current and 169-ampere rotor current, both windings being so dimensioned as to give the permissible temperature rise. The machine, which is actually put forward "to meet the requirements of the specification," will be designed for 90.5-ampere stator current, and 169-ampere rotor current—that is to say, with less stator copper, these two currents referring to $\cos\phi = 0.70$. The machine, however, will be run under actual load conditions with its rated stator current of 90.5 amperes (but with increased kilowatt output corresponding to $\cos\phi = 0.80$). From the curve for $\cos\phi = 0.80$ it is found that the necessary exciting current for $\frac{I_n}{I_k} = \frac{90.5}{160} = 0.566$ will be 161 amperes, or eight amperes less than the permissible current of 169 amperes. From this it is evident that although the engineer takes 14.2 per cent more output out of the machine above its rated capacity, he does not get the full benefit out of the capacity of the rotor, and if he would try to do this he would exceed the thermal limit of the stator.

It is therefore only to the interest of the customer to specify the actual conditions of power-factor under which the machine is to work, and not to include a margin where it is only detrimental to himself to do so.

SUMMARY.

The following are the conclusions to be drawn from my investigations:

1. If large turbo units are to be installed the problem of ventilation is not to be neglected, as one has to deal with large quantities of energy produced in a relatively small space. The best scheme seems to be to provide ducts for getting fresh air from outside the building to cool the machine and for taking the hot air away without allowing it to enter the engine room.

2. When specifying the voltage rise of a turbo-alternator due allowance should be made for the fact that the figures obtainable are not so low as those which can easily be obtained with multipolar machines. As fair figures for turbo-alternators can be regarded—

5 to 7 per cent for unity power-factor;
13 to 15.5 per cent for $\cos\phi = 0.90$; and
15 to 18 per cent for $\cos\phi = 0.80$.

3. When specifying the power-factor at which a turbo-alternator has to work, it is of no use to put in a lower figure than is actually prevailing in the station, as nothing can be gained by this, and it would, if anything, decrease the possible output of the machine.

Receivers Appointed for the Rockingham Power Company.

Receivers were appointed on November 23, by Judge J. C. Pritchard, of the United States Court, at Rockingham, N. C., for the Rockingham Power Company. William H. Browne and W. A. Leland were named.

The application for the appointment of receivers was made by the S. Morgan Smith Company, of York, Pa., manufacturer of hydraulic apparatus and waterwheels, who had the contract to supply and install the waterwheels and adjunct parts for the plant. The petition was made by this company, both as contract creditor and as a large owner of the bonds and stock of the Rockingham Power Company. The bill of complaint alleges that dissension among the members of the board of directors, and the action of the firm of Hugh McRae & Company, of Wilmington, N. C., who had undertaken to seize certain property essential to the development of the plant, and of which the company is said to be the equitable owner, and out of which seizure conflicts have taken place, impaired the credit and militated against the efforts of the majority of the holders of the bonds and of the board of directors and management in the procurement of additional funds required for the completion of the plant.

Mr. Leland has been in charge of the construction work, and Mr. Browne has been general manager of the company.

At the beginning of the year the bondholders of the Rockingham Power Company appointed from among their members a reorganization committee, which formulated a plan of procuring the additional money needed for the completion of the plant.

Under the order of the court, the receivers are continuing the work of construction, carrying it on in the same manner as it had been proceeding prior to their appointment.

New Independent Telephone Company.

The Valley Home Telephone Company, a corporation which is to take over practically all the so-called independent telephone interests in northeastern Michigan, including the exchanges at Saginaw, Bay City and Flint, has been organized. The authorized capital of the new company is $2,500,000, divided into 25,000 shares.

Chicago Traction Consolidation Under Consideration.

From time to time during the past year tentative negotiations have been made looking to the consolidation of the four elevated railway companies in Chicago. These have never met with success, owing to inability to agree on the financial readjustments that would be required. During the past week or so such negotiations have been resumed on what was said to be a larger and more promising scale. It was proposed now to merge not only the elevated railways but the surface lines as well into a huge unified corporation controlling practically all the traction facilities of Chicago and its suburbs. There would seem to be greater difficulty in harmonizing so many interests in view of the previous partial attempts. However, the task has been asserted to be less formidable because of a number of features that are aiding the consolidation idea. These are a general sentiment in its favor on the part of the municipal authorities and the public as a whole.

The present negotiations, unlike many of the previous ones, are being pushed by local financiers and capitalists that are directly concerned in the several properties. A number of conferences have been held under the direction of John J. Mitchell, president of the Illinois Trust and Savings Bank, and Samuel Insull, president of the Commonwealth Edison Company. At one of the meetings these two gentlemen with Chauncey Keep, John A. Spoor, Henry A. Blair, W. U. Eisendrath and Wallace Heckman were appointed a committee to consider the subject in all its aspects. These gentlemen represent the New York financiers as well as the Chicago interests, and practically assure the careful consideration of any consolidation project on the part of all financially concerned. If the merger is carried out to take in all the traction interests of the city, i. e., the four elevated and two surface companies, the total capital in stocks and bonds that will be involved will be close to $200,000,000.

Later accounts, however, seem to indicate that the present move will be confined to the Chicago City Railway Company and the Chicago Railways Company, which control practically all the surface lines in the city and have a combined capitalization of about $100,000,000. These two companies are now operating under the similar traction ordinances passed by the City Council in February, 1907, and approved by popular vote in April of that year. Under the supervision of the Board of Supervising Engineers, Chicago Traction, they are rehabilitating their systems on a plan contemplating ultimate unified control.

The Commonwealth Edison Company has been mentioned in the present negotiations as being one of the parties to the enlarged consolidation scheme. This statement is denied by the officials of the company. Its interest in the plan is indirect and arises from the fact that it is under contract to supply all the electric power for the Chicago City Railway and the Chicago & Oak Park Elevated Railroad as well as a large percentage of the power required by the Chicago Railways Company and the Metropolitan and Northwestern Elevated railways.

Harlem River Line to Be Electrified.

Application has been made by the New York, New Haven & Hartford Railroad Company and the Harlem River & Port Chester Railroad Company to the New York State Public Service Commission for permission to change the motive power of the latter road from steam to a high-potential alternating electric system similar to the system in use on the New Haven's main line between New York city and Stamford. It is believed that the intention is to make the smaller line the main line eventually and to establish connections through it with the New York Connecting Railroad in Queens and with the proposed Lexington Avenue subway which President Mellen of the New Haven has said his company may offer to build.

The petition sets forth that the New Haven is the lessee of the Harlem River & Port Chester Railroad, and that as it is now operating its main line by electricity, it desires to extend the same system to the operation of the leased lines.

The company states that it intends to finance the project from the proceeds of an issue of $15,000,000 of bonds known as the New York, New Haven & Hartford-Harlem River & Port Chester first mortgage four-per-cent fifty-year gold bonds. This issue was secured by a first mortgage dated May 16, 1904, made to the United States Trust Company as trustee. The issue was consented to by the then Board of Railroad Commissioners on September 6, 1904.

Should the applicaton be granted and the improvement installed the New Haven will have an outlet for its passenger traffic over the Connecting Railroad, and thence through the Pennsylvania's East River tunnels to Manhattan. If eventually the company should build and operate the Lexington Avenue tunnel, as Mr. Mellen once stated he hoped would be the case, the local passenger traffic will doubtless be diverted from the main line at the Mott Haven yards and sent into Manhattan through the new subway.

Successful Starting Up of the 6,000-Horsepower Motor at Gary, Ind.

The 6,000-horsepower, three-phase, twenty-five-cycle induction motor installed in the rolling mill of the Indiana Steel Company at Gary, Ind., by the General Electric Company, was started for the first time on Sunday, November 29. This is the largest individual motor unit in the world, and was assembled and erected on its own foundation ready for actual service before any tests of the machine were possible.

Two 2,000-kilowatt Curtis turbines were put in operation to supply the current for the motor, but at first the question of applying the 6,600 volts direct gave the engineers some concern. It was confidently determined, however, by the erecting engineers that the General Electric system of step-by-step control, using a master controller, would take care of the high voltage. This master controller gradually inserts resistance in a number of steps, starting at 1,350 volts, to full voltage.

To the satisfaction of everyone present, the motor started in the right direction—counter clockwise—and attained full speed in forty-five seconds. The starting or magnetizing current at the first jump was indeterminable, and for the following thirty seconds stood at 540 amperes, gradually dropping down to eighty-five amperes. Owing to outside conditions—the turbines feeding South Chicago at the same time—the voltage was about 5,600 during the first part of the test.

The operators in charge of the turbines reported a very satisfactory operation of these prime movers, and the meter readings were satisfactory at the meter board.

One can imagine the size of this equipment when it is known that it requires 300 gallons of lubricating oil in each of the bearings.

Telephone Injunction.

United States Judge Tayler, at Cleveland, Ohio, has issued an injunction restraining the American Telephone and Telegraph Company and the Central Union Telephone Company, both of them allied with the Bell system, from alleged interference with the business of the independent companies operating in Ohio, Indiana, Illinois and adjoining states.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

THE INFLUENCE OF ROENTGEN RAYS ON THE STARTING OF THE BRUSH DISCHARGE.

A paper on this subject was read by E. Marx at the annual meeting of the Association of German Physicists and Physicians. In order to measure the velocity of the Roentgen-rays, the author made use of their property of facilitating the starting of the brush discharge when they strike the negative pole of a spark gap. As there existed no record of an experimental investigation of this pole-releasing effect of the Roentgen-rays, the author examined their influence on a spark gap in a direct-current circuit, consisting of a platinum electrode and an aluminum window. This arrangement was chosen for the reason that it had previously served for determining the velocity of the rays. The aluminum window was grounded, and the platinum electrode, upon which the Roentgen-rays impinged, was alternately used as anode and cathode. It was demonstrated that in the first case the discharge was not only facilitated by forty per cent, but that—and this was so far unknown—in the second case the discharge took place with considerably greater difficulty than when no Roentgen-rays fell on the spark gap.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), November 1.*

WIRELESS TELEPHONY.

In the course of a description of wireless telephone systems, with which notable results have lately been achieved, it is stated that the Danish engineer, Valdemar Poulsen, has established perfect wireless telephone communication at a distance of 270 kilometres between two stations in Denmark. The primary energy was 900 watts, the radiated energy 300 watts; the masts were about sixty metres high and the wave-length was 1,100 to 1,200 metres. Communication was also established between Linkby and a station near Berlin, a distance of 500 kilometres. The German Gesellschaft für Drahtlose Telegraphie has developed the Telefunken system and has established satisfactory communication between Rheinsberg and Berlin, a distance of seventy-five kilometres. The masts used were twenty-six metres high, the primary energy 440 volts and five amperes. De Forest has reached distances of twenty-five miles by means of the arrangement devised by him.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), October 29.*

EFFECT OF ELECTRIC STREET RAILWAYS ON MAGNETIC OBSERVATORIES.

The opening of an extension of the Potsdam electric street railway had to be delayed on account of objections raised by the Magnetic Observatory there until the cause of disturbances noted had been removed. The authorities had originally made the condition that the magnetic disturbances caused by the operation of the railway should not exceed 0.00001 centimetre-gramme-second at the Observatory. The old railway fulfilled this requirement by adopting a method devised by its manager of feeding and insulating the rails, so completely, that the allowed limit of disturbance was approached only within fifty per cent. Similar conditions were made for the new extension from Potsdam to Nowawes, which approaches the observatory within 1.1 kilometre. The same method of feeding and insulating the rails was adopted, and during the final test the installation did not cause greater disturbances than were expected from calculations, amounting to 0.000003 centimetre-gramme-second. But during a preliminary trial an erroneous connection was made and two separate rail nets were charged with current under a difference of potential of sixteen volts, which gave rise to earth currents and distant magnetic effects of about tenfold strength. Against this disturbance resulting from the preliminary test the authorities raised objections.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), November 5.*

EXPLOSION GAS TURBINE OR COMBUSTION GAS TURBINE.

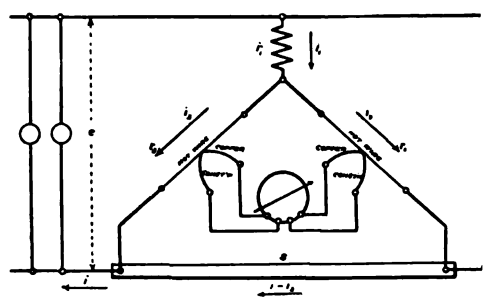
The present installment is a continuation of an article previously noted in these columns, the explosion turbine being dealt with. Such a machine might be constructed by sending explosive mixtures of gas and air into a series of explosion chambers by means of a compressor in such a way that one chamber will explode after the other in regular succession, and leading the exploded gases into a turbine. An arrangement of this kind with ten explosion chambers has actually been constructed, but the combination of so many different turbine elements intended to work in common is a source of great loss. Besides this, the apparently simple problem of supplying the explosion chambers with gas by means of special compressors, which are in turn dependent on the turbine, is difficult to carry out in practice and causes unreliability of operation. Drawings are shown of an arrangement which appears to the author more practicable. The compressor, explosion chamber and partly, also, the turbine, form one and the same part of the gas turbine and successively perform the various functions. Calculations of the theoretical efficiency of this arrangement are given in detail. The conclusion arrived at is that the thermo-dynamic prospects of the explosion gas turbine are not brilliant; however, an absolute thermal efficiency of fifteen to twenty per cent can be attained, and competition with the steam turbine will therefore be possible. A factor in favor of the gas turbine is its simplicity, due to the absence of the steam boiler. The explosion turbine seems to be the only possible solution of a gas turbine, and its success will depend in a large measure on its perfect construction, which can be developed only by practical experience.—*Translated and abstracted from Die Turbine (Berlin), October 20 and November 5.*

THE STERILIZATION OF WATER BY OZONE.

The Siemens & Halske Company has been manufacturing for some time three standard sizes of sterilizers—a laboratory apparatus, an apparatus for small communities or factories, and a portable apparatus for army purposes. In each type the essential elements comprising the sterilizer are an ozonizer, an electrically-driven compressor with the necessary accessories, a high-tension transformer, a sterilizing column, and a measuring arrangement. The construction of the ozonizer differs in the various models, but in principle it consists of discharge tubes, each element being composed of two concentric tubes, the outer one of glass being immersed in cooling water; the inner one is of aluminum or glass, and in the latter case it is filled with water for conducting the current. The compressor draws the air through drying tubes, blows it through the ozonizer, where it is electrified, and then into the sterilizing tower. This is a simple scrubber, a column of glass or sheet metal filled with glass balls or pebbles, through which the water percolates from the top and is brought in contact with the purifying gas during its passage. The measuring arrangement consists of a glass vial with a mercury seal filled with a solution of iodide of potassium, a gas meter for measuring the ozonized air, and an aspirating vial, which, when once graduated, may take the place of the gas meter. This vial is not necessary when the pressure is sufficient to drive the gas through the solution. The laboratory model can be attached to incandescent-lamp sockets. It is capable of treating 500 to 1,000 litres of dry atmospheric air an hour (ozone contents five to six grammes) and consumes one-fourth to one-half horsepower; if oxygen is used, the ozone is doubled or tripled. The portable outfit intended for army use has been adopted by some governments, especially Russia. It is carried on two wagons, weighing about 900 kilogrammes each, and is guaranteed to sterilize from two to three thousand litres of water an hour, utilizing, under ordinary conditions, not more than one-half or one-third of the ozone produced. The output of the ozonizers is illustrated by curves, which show that the production of ozone per horsepower-hour increases with the velocity of the flow of air through the ozonizer. However, the concentration of the ozone—that is, the number of grammes per cubic metre of air treated—diminishes under the same conditions. This is explained by the fact that, when the air circulation is slow, the ozonizing effect is immediately followed by decomposition. In practice, it is impossible to go below certain limits with the concentration.—*Translated and abstracted from L'Electricien (Paris), November 7.*

THERMO-WATTMETERS.

For the purpose of measuring high-frequency currents, R. Van Cauwenberghe has devised an arrangement consisting of two Voege thermo-elements and a differential galvanometer, thus constituting what he terms a thermo-wattmeter. The principal quality of the arrangement is that it possesses no appreciable self-induction or capacity and offers no skin-effect, even with frequencies as high as 10,000 periods per second. The thermo-element of Dr. Voege consists of a straight hot wire soldered in the middle to the place where the elements, copper and constantan, unite, the entire element being enclosed in a rarefied atmosphere. This thermo-element is much more sensitive than that with a spiral, but requires the use of a differential galvanometer in order to prevent the current intended for the galvanometer from being partially shunted



CONNECTIONS FOR THERMO-WATT-METERS.

by the hot wires connected in series. Galvanometers with permanent magnets and two-wire movable coils are recommended. The author expresses the fear, however, that long use may cause a modification of the elements and be detrimental to the accuracy of the measurements. The circuit arrangement is shown in the accompanying diagram.—*Translated and abstracted from La Lumiere Electrique (Paris), October 31.*

AN ELECTRICALLY-DRIVEN ROLLING MILL.

The electrical equipment of Dorman, Long & Company's wire mills, at Middlesbrough, in the northeastern district of England, has recently been completed by the Electrical Company, Limited. The operation of the reversing rolling mill is on the Ilgner system, in connection with Ward Leonard control. The Ilgner set consists of a flywheel, motor-generator, the generator of the direct-current type, coupled in series with the mill motor. The generator field is controlled by an exciter, and the variation or reversal of the small exciting current provides for the entire control of the rolling-mill motor. The stored-up energy in the flywheel is made to neutralize the otherwise heavy current demands at periods of peak load on the mill, this being achieved by compulsorily decreasing the speed of the Ilgner set during such periods by means of a liquid resistance automatically governed by a regulating motor, which introduces resistance into the rotor circuit of the driving motor as required. The torque exercised by the regulating motor varies with the main current. An increase of the latter to maximum value enables the regulating motor to lift the electrodes, and thus introduce the necessary resistance; while, on the other hand, a decrease in the main current to a predetermined value, such as occurs when the mill runs empty at the end of a pass, decreases the motor torque, allowing the electrodes to fall, and ultimately short-circuit the rotor of the driving motor of the Ilgner set, which consequently speeds up, enabling the flywheel to store energy for the next peak load on the mill. The plant at the Dorman works operates a rolling mill containing two housings with sixteen-inch-diameter rolls, intended for rolling angles and small girders. The mill is coupled to a compound-wound, 600-volt motor of 1,200 horsepower capacity, with a maximum output of 3,600 horsepower, and a varying speed of from zero to 110 and 160 revolutions per minute. The maximum torque of the motor is 232,000 foot-pounds. The Ilgner set consists of a 950-horsepower motor, operating on three-phase current at 2,750 volts pressure, forty cycles, coupled direct to a 1,250-3,600-horsepower dynamo, giving 600 volts, and attached by a coupling to two twenty-ton flywheels mounted on a separate shaft. If the maximum demand of the rolling-mill motor on certain work does not exceed 950 horsepower, it is possible to disconnect the flywheels. The Ilgner generator is provided with compensating coils on the Deri system for the purpose of reducing the armatutre reaction, securing sparkless commutation at all loads, with a fixed brush position. To start the Ilgner set, a special barring gear is provided, consisting of a fifteen-horsepower motor, with the necessary gear, this being cut off automatically when the set reaches a speed of three revolutions per minute. The flywheels, which are each fourteen feet in diameter, are equipped with powerful water-cooled brakes for quick stopping. The exciting set consists of one three-phase motor of eighty horsepower capacity, running at 2,750 volts, forty cycles, coupled direct to two continuous-current dynamos, one of which serves to excite the fields of the Ilgner generator and the mill motor, and the other excites a special compound winding on the mill motor. This is with the object of strengthening the field, and thus decreasing the speed at sudden heavy overloads.—*Abstracted from the Electrical Review (London), November 13.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Ridgway Side-Crank Engine.

Well-informed engineers recognize that for some purposes the side-crank type of engine construction is most satisfactory, although to produce a machine of this type certain valuable features of the center-crank engine must be sacrificed. Constructed with a view toward the high quality which characterizes its well-known center-crank line, the Ridgway Dynamo and Engine Company, Ridgway, Pa., has brought out the Ridgway side-crank engine. Like the older line, this engine has been designed for simplicity, strength and quality.

In the construction of these engines the best materials are used by skilled workmen, and all parts are made to standard gauge and are interchangeable wherever possible. After passing numerous inspections the completed engine is erected on the testing floor, connected to a dynamo loaded with a water rheostat, and subjected to a test lasting from ten to twenty-four hours, under full and overload conditions.

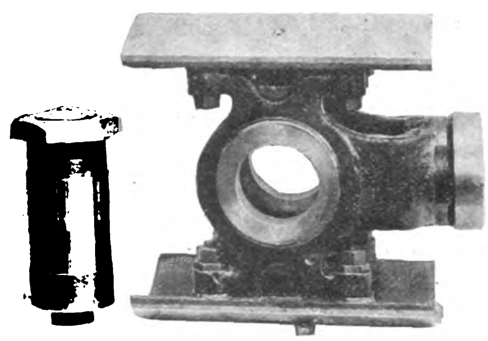
The engine bed is of heavy design throughout, with the metal so distributed as to bring the heaviest sections in line with the greatest strains. Careful consideration for small details, as well as for pleasing outlines, has been observed. The main part of the bed is of a box section having bored guides of large diameter. The guides and end for the cylinder are bored and turned at one setting, insuring the perfect alignment of bed and cylinder.

At the cylinder end of the bed is a removable partition which prevents oil from being thrown against the end of the cylinder. Between the cylinder and the partition is a well in which the drip from the stuffing-box is caught. The water is removed by an efficient separator, and the oil flows back to the crank pit. The crank disc is covered with an oil-tight guard of light sheet steel, hinged at the top so that it may be turned back over the bed, giving access to the connecting rod and crank-pin.

The main bearing on all sizes is of the quarter-box type. The shells are lined with babbitt metal peened in place and bored out in accurate jigs, and are, therefore, interchangeable in engines of the same size. Horizontal adjustment is secured by a wedge, and vertical adjustment by drawing down the cap.

The connecting rod is forged from open-hearth steel and is designed with a minimum factor of safety of fifteen. The straps at both ends are slotted out of the solid forging. The wrist-pin box is of phosphor-bronze, while the crank-pin box is lined with babbitt peened and bored. Both ends are adjusted by the wedge and bolt method.

The cross-head body is of cast-steel of a substantial design. The lower shoe is adjustable, and, besides bolts, means have been provided for adjusting both top and bottom shoes by the use of shims, if desired. The wrist-pin is provided with keys so that it may be turned ninety degrees as it wears.



CROSS-HEAD AND PIN, RIDGWAY SIDE-CRANK ENGINE.

The cylinder and valve on this engine are of the same design which the manufacturer has used for over fifteen years on the center-crank engines. The cylinder is cast of a hard, close-grained iron, and the barrel is covered by heavy polished cast-iron lagging. The valve is of the flat balanced type and moves between the seat and a heavy pressure plate. Cored ports in the pressure plate corresponding to those in the valve seat and connecting through side openings with the main ports, make this a double-ported valve. This construction gives an indicator card in which the steam line holds up well and cut-off is very sharp. In case of water being carried into the cylinder, the holding spring allows both valve and pressure plate to lift from the seat, permitting the water to pass into the exhaust. Relief valves are, therefore, not necessary.

The piston is a single hollow casting, strongly braced by ribs and made as light as is consistent with strength. The rod and piston are joined by a force-taper fit, supplemented by a jamb nut held by a set screw.

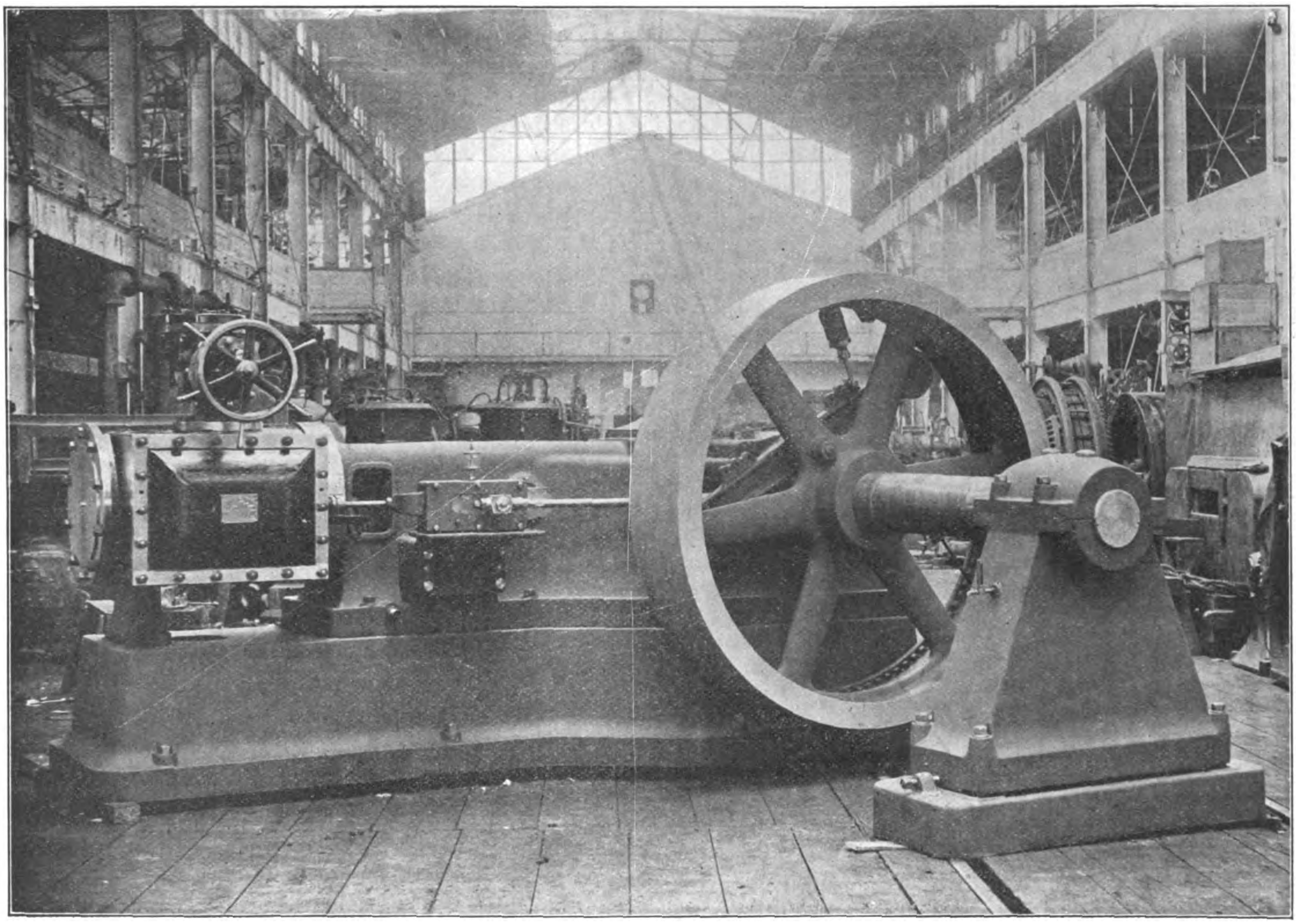
The main shaft is a single forging of the best open-hearth steel. It is extra large in the bearings and proportionately increased in the governor wheel hub. The crank disc is made of a mixture of cast-iron and steel designated as semi-steel, the result being a tough, close-grained, hard iron. The crank-pin is cast solid with the disc. The shape of the disc forms the counterbalance, a feature not secured on side-crank engines by using a circular disc. The fitted crank is forged to place on the shaft under hydraulic pressure and is secured by a heavy key.

The Ridgway governor, formerly known as the "Begtrup," was the pioneer inertia governor, and is described as follows: A long bar, called the inertia bar, having weights at each end, is pivoted at the center on a roller bearing. The inertia bar is lined with hardened steel bushings and the space between the main pin is filled with hardened steel rollers. This insures a minimum of friction and a bearing subject to very little wear. This is the only bearing requiring lubrication, although it will go without attention for several weeks. To the hub of this bearing is clamped the eccentric, which being split, is removable without disturbing the governor or the setting of the valve. A heavy coil spring is secured to the middle of one end of the bar. Opposite the spring is an oil dashpot, having its connecting rod bolted to the inertia bar. A by-pass with an adjustable opening allows the oil to circulate from one side of the piston to the other. The governor is reversible without the use of any extra parts.

The action of the governor is as follows: Rotating from right to left, the weight in the spring end of the bar being the greater, centrifugal force tends to swing it outward and backward toward the lower stop. This tendency to move backward is balanced by the spring, whose tension is such as to hold the inertia bar in equilibrium when the engine is at its desired speed. When starting up the eccentric travels in its greatest path, giving the valve its widest opening and latest cut-off. As the speed increases, centrifugal force acting on the weighted end of the inertia bar moves it backward to the lower stop, reducing the travel of the valve and cutting off steam earlier. This backward movement of the bar is continued until the travel of the valve reduces cut-off to the amount necessary to keep the engine rotating at its proper speed to give an even balance between centrifugal force acting on the inertia bar and the opposing tension of the spring. If a load is now applied to the engine, there is a check to the speed of the governor wheel, while the inertia bar, by reason of its momentum, rotates forward sufficiently to increase valve travel and give late enough cut-off to carry the load. Should the load be thrown off, this wheel tends to increase its speed, causing the inertia bar to swing backward and reduce valve travel and cut-off until equilibrium is re-established.

In harmony with the proportions of the bed and sub-base, the outboard bearing pedestal is built on liberal lines and made broad at the base to insure stiffness. The bearing is of the self-oiling, self-aligning type; the shells being lined with babbitt peened and bored. Vertical adjustment is accomplished by means of special devices used on the cross-head and applied to the four bolts at the base of the pedestal.

Two standard methods of lubricating the engine are provided. In the first, known as the "splash" system, the crank pit is filled with oil, which the disc throws in an almost steady stream over the cross-head and guides. Oil from the upper guide is wiped off by the top cross-head shoe and flows through passages and pipes to the cross-head pin. Pockets on the inside of the crank guard collect great quantities of oil which are led through ample passages to the main bearings and to the crank-pin. All bearings are, therefore, practically flooded at all times. This is the usual lubrication system furnished by the manufacturers. The other system uses a small but efficient filter placed in one side of a tank, which is mounted on the sub-base below the slide bracket. In the other side of the tank is a valveless pump driven by a cam on the valve-gear ram. This cam is designed to give a full stroke regardless of the travel of the ram. All oil from the bearings flows to the crank pit, from which it is piped to the filter, then passes to the pump chamber, where it is pumped to a large tank on top of the bed. From this tank the oil flows through nickeled piping to each bearing. Sight-feed valves are placed in each pipe near the tank so that the supply may be shut off or regulated. As the engine is fully enclosed, no oil can be thrown on to the floor or into the governor wheel. With either system the valve gear is supplied with grease cups.



ASSEMBLED VIEW OF RIDGWAY SIDE-CRANK ENGINE.

Ridgway side-crank engines are built in the simple, tandem and cross-compound types. In the compound types the low-pressure valve is of the balanced type, though slightly modified from the one previously described. On tandem engines both valves are driven by the governor, the low-pressure directly and the high-pressure by means of a tail-rod on the low-pressure valve. On cross-compound engines the high-pressure valve is driven by the governor and the low-pressure by a fixed eccentric on the main shaft. Simple and tandem compound engines are made from fifty to 800 horsepower, and cross-compound engines up to 1,500 horsepower.

The New Westinghouse Distributing Transformers.

The Westinghouse Electric and Manufacturing Company has just developed and placed on the market a new shell-type distributing transformer, known as the Type "S" which has ben worked out from theoretical consideration a well as from the practical results of many tests. In these transformers the most economical disposition of all the material used has been made, and the result is a line of transformers of small dimensions, liberal overload, high efficiency, great reliability and good regulation. Use has been made of a new alloy of steel, and the design so proportioned that remarkably low magnetizing or no-load currents are secured.

Distributing transformers must at all times be ready to furnish electrical power up to their maximum overload capacity.

VIEW OF TYPE S DISTRIBUTING TRANSFORMER.

Interruptions of the service not only cause pecuniary losses to the power company but, worse still, are a source of friction between the consumer and the central-station manager. In cases where the central station is under contract to furnish continuous service to its customers an interruption of the service is a very serious matter.

The reliability of a transformer depends largely upon the disposition, quality and amount of insulating materials used in its construction. The insulation must not only separate the different turns of the individual conductors, but must also act as a barrier between the high and low tension coils and between either circuit and the core. A failure to fulfill these duties will result in a partial or complete destruction of the transformer, interruption of the service and very often danger to life and property. The presence of a very small amount of moisture in the insulation of a transformer will greatly reduce its dielectric strength. This is one of the most frequent causes of breakdowns, and often very disastrous results occur when only the slightest trace of moisture is present. To avoid troubles of this nature the insulation should be treated in such a manner as to make it impervious to moisture.

In Westinghouse Type S transformers the insulation is non-hygroscopic, that is, it will not absorb moisture, and will not deteriorate under ordinary operating temperatures. It undergoes a rigid inspection before being used in the transformer, and the assembled core and coils are further subjected to high breakdown voltages for the purpose of discovering any defects in the insulation.

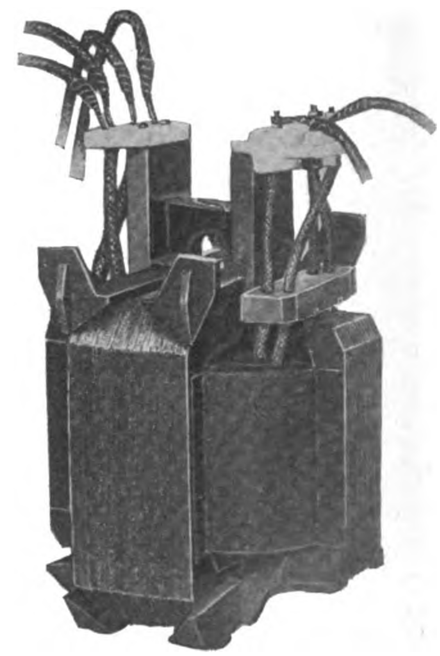
A vacuum impregnating process is used to remove the last traces of moisture and to form the winding and insulation into a solid, moisture-repelling unit.

Insulation deteriorates under high temperatures, due to the carbonizing action which takes place in fibrous materials. A low operating temperature is therefore necessary for the satisfactory service of the transformer. By low operating temperature is meant not only low average temperature, such as would be indicated by a thermometer in the oil, but also a low maximum temperature, that is, at no point within the coils should the temperature rise much beyond the average temperature of the transformer. A transformer with hot spots is as much to be avoided as one having a high operating temperature.

The construction of shell type transformers such as the Type S permits of large ventilating ducts between the coils. Through these ducts the oil circulates freely and is thus enabled to reach the innermost parts of the apparatus. This oil circulation effectually prevents hot spots and maintains a uniformly low temperature throughout the transformer.

Good ventilation also enables a transformer to carry large overloads without a dangerous rise in temperature. If a distributing transformer has a large overload capacity, it may be installed to supply power considerably in excess of its normal rating, providing this power is only required at intervals and for a limited time. This not only saves the increased cost of a large transformer, but also gives a higher average all-day efficiency, due to the lower fixed losses of the smaller unit.

The electrical performance of distributing transformers should be carefully considered. Those having high losses are unsuitable for central-station work, and this is especially true in cases where the cost of the production of the power is high. The efficiency of a transformer depends upon the iron or core loss and the copper loss. These losses represent energy delivered to the transformer for which no return is received. The iron loss is of particular importance, since it is a continuous loss as long as the transformer is connected to the mains. This fact is well recognized and nearly all transformers show a reasonably low core loss when new. In many transformers, if the core loss is measured after having been in service about twelve months, it will be found



TYPE S DISTRIBUTING TRANSFORMER, SHOWING COILS, TAPS AND CORE.

that this loss has greatly increased, due to what is known as the "aging" of the iron. The magnetic circuit of the type S transformer is built of a special grade of alloy sheet steel, which has been selected only after an extensive series of tests proving it to have practically non-aging qualities.

The regulation of a distributing transformer is a matter of prime importance both to the consumer and to the operating engineer. It depends principally upon the copper loss, and the per cent regulation is generally very little more than the per cent copper loss. If a transformer of zero regulation could be constructed and connected to the line the potential on the low-tension circuit would not change in passing from full load to no load. Distributing transformers should have as good regulation as possible. In type S transformers the arrangement and size of the conductors provide for an especially good regulation.

All these transformers under twenty kilowatts are mounted in smooth cast-iron cases which have a cooling surface sufficient to keep the transformers at normal temperature. The cases for transformers of larger sizes are made of cast-iron with corrugated sides, which greatly increase the area of the cooling surface. The leads are brought out through porcelain bushings which are babbitted into the case. The lead insulation is moisture-proof, and a sealing compound is poured around the leads where they issue from the case.

The core is built up of laminated sheet-steel punchings, each layer of laminæ being reversed with reference to the preceding layer. This gives a continuous magnetic circuit of low reluctance. The full benefit of laminating the iron is thus obtained with a resulting low core loss. All iron used in the cores of these transformers is subjected to rigid tests and inspection at the factory. Samples taken from the iron used are tested for loss and aging, and only those giving satisfactory results are accepted. The assembled transformer is also tested to make sure that no inferior iron has passed the previous tests. The assembled core consists of four magnetic circuits encircling the winding and protecting it from mechanical injury.

Type S transformers have the high-tension winding mounted concentrically between two low-tension coils. All coils are form wound and individually insulated, the insulation consisting of those materials which long experience has shown to be the best suited to this work. The low-tension coils of transformers above five kilowatts are wound from cotton-covered strap copper having a rectangular cross-section; transformers of a smaller capacity have wire-wound low-tension coils. The high-tension coil is form wound of cotton-covered wire. The conductors are of circular cross-section in the smaller sizes but are of strap copper in the larger transformers.

Between the high and low-tension coils are layers of paper and mica. After the core and coils are assembled they are baked in a vacuum tank which removes every trace of moisture. A hot liquid insulating compound under high pressure is then introduced into the tank. This compound is oilproof at all temperatures. It does not dissolve in the oil, fill the ventilating ducts and cause the transformer to run hot.

The high-tension winding has four leads brought to the studs in the terminal block. Adjustable brass connectors or links between the studs provide for series or multiple connections between two points of the high-tension winding. The position of the studs and the length of the links are so proportioned that wrong connections on the block are impossible. Barriers on the porcelain block separate the studs and prevent danger of arcing.

The fuses furnished with these transformers are mounted in a weatherproof porcelain fusebox. The stationary contacts are deeply recessed in the porcelain and are well separated from each other. The contacts are so constructed that the plug is held securely in place by giving it a partial turn after inserting it. When the plug is in position the fuse is in sight and its condition can be noted; this eliminates all danger of pulling the fuse while intact and the transformer under load.

Connectors are supplied with all Westinghouse Type S transformers for connecting the low-tension leads to the feeder wires. These connectors for the larger sizes of transformers are of the interleaved type and form a mechanically strong joint of high current-carrying capacity. By means of these a change can be made in the low-tension connections of a transformer, or one transformer removed and another of the same or a different capacity substituted usually without unsoldering or soldering a joint.

Type S transformers are made in sixteen sizes, from one-half to fifty kilowatts, and are designed for normally supplying 110, 220, and, in the larger sizes, 440-volt service from primary circuits of 1,100 and 2,200-volt and sixty-cycle frequency, although they are suitable, without change in the rating, for any frequency from fifty to 140 cycles.

Union Switch and Signal Contract.

The Union Switch and Signal Company has received the contract for the protection by signaling and interlocking of the McAdoo tunnels.

At the terminal stations of these tunnels, at Church and Cortlandt streets, New York city, the signaling work will be the most important. The Switch and Signal company will install at this station at once four electro-pneumatic interlocking equipments, and also the intermediate block signals and train stops. The latter will be actuated by compressed air; the signals will be electrically operated.

RECENT IMPROVEMENTS IN LIFTING MAGNETS.

BY ARTHUR C. EASTWOOD.

The first commercial lifting magnet was placed in service in this country about thirteen years ago. This magnet was designed by S. T. Wellman for handling plates and slabs, and proved fairly satisfactory for such service. The design was later refined and improved upon by E. B. Clark, then electrical engineer for the South Works of the Illinois Steel Company.

The manufacture of lifting magnets of both the Wellman and Clark types was taken up by the Electric Controller and Manufacturing Company (then the Electric Controller and Supply Company) more than ten years ago. A special magnet-testing machine was designed and installed, and much valuable data bearing on the design of lifting magnets were secured.

Many magnets of the Clark type have been manufactured and sold, and have given excellent results in the handling of smooth, homogeneous material, such as plates, blooms and slabs. These magnets, however, were useless for handling rough and detached material, such as pig iron, crop ends and scrap. A magnet which would readily lift a steel ingot weighing 10,000 pounds would not lift a single pig of iron weighing 100 pounds.

Many attempts were made to perfect a magnet for handling pig iron and scrap, since, obviously, the large amounts of such raw material handled by tedious hand methods at all steel and iron works and foundries offered a tremendous field for the saving of labor, providing a practical lifting magnet could be developed for the purpose.

Perhaps the first experiments in this direction which gave promise of commercial results were made at the West Seneca plant of the Lackawanna Steel Company, under the direction of E. D. Edmondson and L. R. Palmer, a lifting magnet being constructed which actually lifted pig iron, though in rather small quantity, taking into consideration the weight of the magnet and its current consumption.

The first commercially successful lifting magnet for handling pig iron, scrap and miscellaneous magnetic material was placed on the market by the Electric Controller and Manufacturing Company in March, 1905. This magnet was built in two sizes, commercially known as No. 1 and No. 2 Type S magnets. Over 150 of these magnets have since been placed in service, and, at a conservative estimate, have saved to the iron and steel trade of this country at least half a million dollars in the cost of handling material within the past year. This type of magnet has also been introduced in Germany and England.

In view of these facts, there can be no doubt that Type S magnets, as manufactured by the Electric Controller and Manufacturing Company, have become satisfactory and reliable tools—more dependable, in fact, than the cranes which carry them. This company, however, has not been content to rest upon the satisfactory results thus far obtained with its Type S magnets, but has been constantly at work on improvements, both in the direction of dependability and in increased efficiency in the handling of material.

Unquestionably, a successful lifting magnet must withstand in service more severe abuse and rough handling than any other type of electrical apparatus. In operation it is suspended from the hook of a crane (frequently not equipped with a lowering brake), and may be dropped at high speed upon the material to be lifted, which may be comparable almost to dropping the magnet from a second-story window. In service it will be swung against cars, charging boxes, piles of pig iron, etc., and must be capable of withstanding the blows and shocks which result. It must operate under all weather conditions, day or night, irrespective of rain or snow, and its insulation must withstand a voltage much higher than line voltage, due to the inductive kick which occurs when the circuit of the magnet is opened. Its winding must not be injured by the large amount of heat which is necessarily generated within it, and, preferably, also, should not be damaged by external heat when the magnet is called upon to handle hot material.

Fig. 1 is a typical cross-section of a Type SA magnet, and shows the arrangement of parts which by experience has been found to meet the severe and exacting requirements of service.

In Fig. 1, A is the body or framework of the magnet, which is an annular casting of special electrical steel heavily ribbed on both its upper and outer surfaces. The ribs serve to add largely to the surface available for dissipating heat, and are so disposed as to stiffen the magnet case mechanically and at the same time to add to the cross-section of the magnetic circuit.

B is the core of the magnet, which is surrounded by the winding C. This winding is composed of a series of coils, each wound with a conductor in the form of a copper ribbon or strap, the turns of which are insulated with asbestos ribbon. Neighboring coils are mechanically separated and electrically insulated by noncombustible insulating discs D. The coils are wound upon a heavy brass form E, which resembles a spool with one head re-

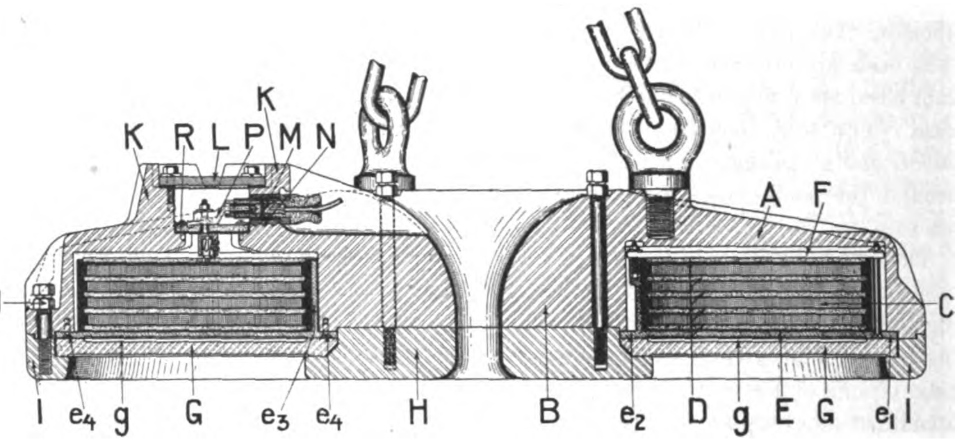
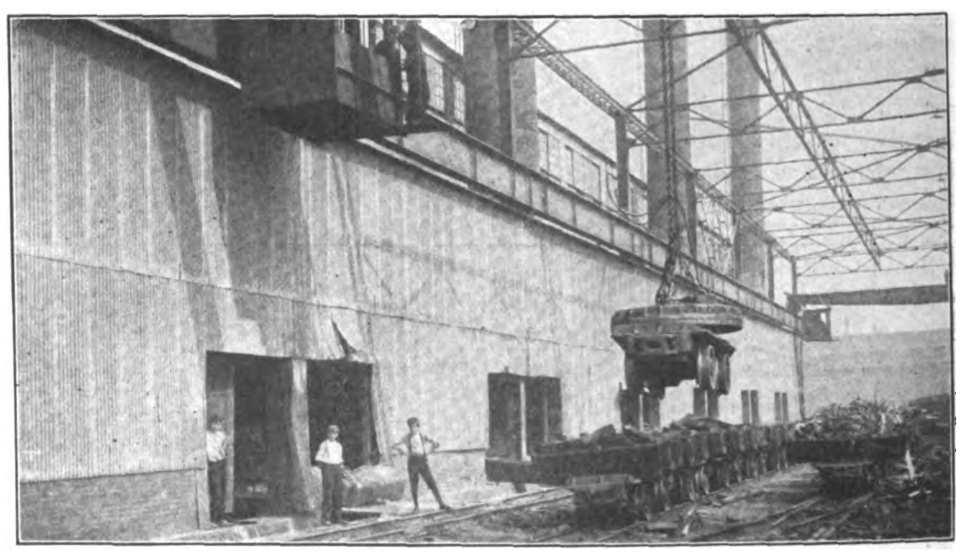


FIG. 1.—SECTIONAL VIEW OF ELECTRIC CONTROLLER AND MANUFACTURING COMPANY'S TYPE SA LIFTING MAGNET.

moved. This form serves to support the coils during the process of winding and insures coils of uniform and perfect shape, since there is no danger of springing or otherwise distorting the winding. After the last or uppermost coil is wound and the outer disc of insulation is in place, the entire winding is rigidly clamped to



NO. 6 TYPE SA MAGNET LIFTING BUGGY WEIGHING 70,000 POUNDS BY LINE CONTACT WITH SPACING RIBS—CARNEGIE STEEL COMPANY, HOMESTEAD, PA.

the form by means of radial straps F, which are bolted and locked in place, thus making the winding and the brass form which carries it a rigid unit. The completed winding is then dried in a steam-heated chamber under a vacuum, and when the initial drying process is completed the winding is impregnated with a plastic insulating compound, first, under the influence of a vacuum and then under air pressure and finally is again dried under a vacuum. This results in a winding not only fireproof—not a particle of combustible material being used in its make-up—but, what is of still greater importance, the winding is thoroughly waterproofed. The completed winding is then placed in the magnet case.

It will be noted that the form E is provided with an outer flange $e1$, and an inner flange $e2$, in addition to the central upwardly-extending flange $e3$, which centrally supports the winding. The inner and outer flanges are carefully finished and engage with finished surfaces on the inner and outer pole faces of the magnet case, thus completely sealing the lower face of the winding chamber, a water-tight joint being insured by clamping the flanges in place with screws $e4$, $e4$, spaced four inches apart, entirely around the flanges $e1$ and $e2$. Since the winding is clamped to the form E by the radial clamps F, and the form E is clamped in the magnet case by screws placed four inches apart entirely around its inner and outer edges, it will be readily seen that the winding is rigidly held against displacement.

With the winding thus assembled in the magnet case, the lower face of the coil form E is covered by a heavy annular plate of non-magnetic manganese steel G, which in turn is held in place by pole shoes H and I, bolted, respectively, to the inner and outer poles of the magnet case. Both of the pole shoes are provided with shoulders which protect the clamping bolts from shearing strains. The heads of the outer clamping bolts J are located between adjacent ribs on the outer surface of the magnet case, where they are protected from abrasion.

In the cross-sectional view it will be noted that the manganese steel plate G carries raised shoulders around its inner and outer peripheries, by means of which the plate is made to seat against the magnet poles, and an air space or cushion is left under the winding at g. This results in the shocks taken by the outer plate G being transmitted directly to the magnet frame instead of being taken by the winding, as would necessarily be the case if only a single-bottom plate were used.

The pole shoes are so disposed with respect to the outer plate G that none of the clamping surfaces can become battered over, and, therefore, the plate G may always be readily renewed.

It will be seen that the entire lower or wearing face of the magnet is renewable, and that these renewals can be readily effected in the field, there being no necessity of in any way exposing or disturbing the winding or breaking the water-tight joint between the coil form E and the frame of the magnet.

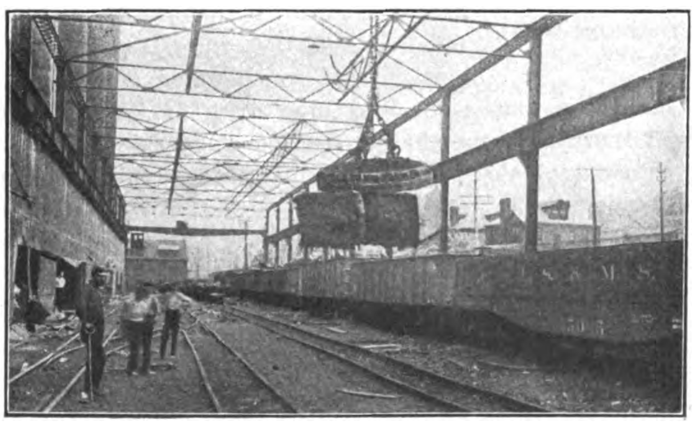
The arrangement of terminals also deserves attention, since, no matter how good the design in other respects, if the terminal construction be weak, trouble is certain to result from this cause.

In Type SA magnets the terminal cavity is surrounded by raised walls K, K, cast integral with the magnet case and of such thickness as to be as strong as the magnet case itself. The terminal cavity is closed at the top with a heavy steel cover L, which seats against a gasket to form a water-tight joint, and is firmly bolted in place, the heads of the bolts being protected from abrasion by the walls of the terminal cavity. All of the terminal parts are thus enclosed in a water-proof box of steel. The terminals themselves, as in the earlier Type S magnets, are of the plug type, which permits of quick attachment and detachment of the service wires. Numerous improvements, however, have been made in the details of construction. The female members M of the terminal are enclosed in an insulating tube, so that a ground or short-circuit cannot result, even if the service wires are left hanging from the crane with current on. The insulating tubes are each encased in a steel tube to prevent abrasion of the insulation, and these steel tubes fit closely in babbitted openings N in the side of the terminal chamber. The male members P of the plug connectors are mounted upon a heavy plate R of fire-proof insulating material, which closes the entrance to the winding chamber and is seated upon a gasket to effect a water-tight joint. The plugs proper are separable from the terminals by removing the nuts which hold them in place. The plugs and also the plate R may therefore be removed without throwing any strain on the connections to the winding, the connections consisting of loops of very flexible copper ribbon, these loops being stowed away in the box-like ends of the terminal studs. This construction permits of great flexibility and at the same time makes it impossible for the flexible leads which connect to the two ends of the magnet winding to come into accidental contact. These features of construction indicate how carefully the design of Type SA magnets has been thought out and worked out from a mechanical and electrical standpoint.

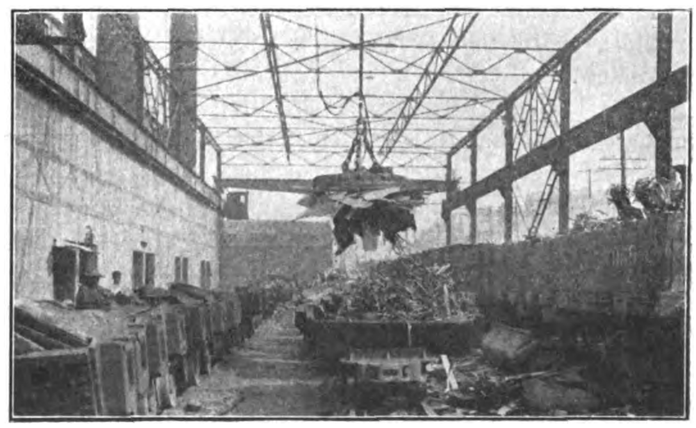
In additon to these structural features the Electric Controller and Manufacturing Company has incorporated in the design of Type SA magnets the results of long experience and careful study.

By maximum efficiency is meant the ability to handle the largest amount of material in a given time with minimum total consumption of current. In this respect the results obtained with Type SA magnets far surpass any results which have been obtained in the past. As an instance, the No. 4 Type SA magnet, forty inches in diameter, lifts substantially as much as older forms of magnets of fifty inches in diameter with substantially the same current consumption, but weighs 2,000 pounds less. Comparing the performance of the two magnets on a five-ton crane having a twenty-five-horsepower hoist motor, with equal lifts, the No. 4 SA magnet has the advantage of 2,000 pounds in total load to be lifted, or twenty per cent of the total hoisting capacity of the crane. This will mean a saving in current consumption of twenty amperes on the part of the hoist motor, and by virtue of this lower current consumption and lighter load, the hoisting speed will be higher and the amount of material handled in a given time will be materially increased.

Proportionate increases in efficiency are shown by the No. 5 and No. 6 Type SA magnets, the No. 6 magnet being without question the most powerful commercial lifting magnet which has ever been constructed.



NO. 6 TYPE SA MAGNET HANDLING TWO INGOT BUTTS, NOT WEIGHED—CARNEGIE STEEL COMPANY, HOMESTEAD, PA.



NO. 6 TYPE SA MAGNET HANDLING SHEET SCRAP, WEIGHT 1,200 POUNDS—CARNEGIE STEEL COMPANY, HOMESTEAD, PA.

Advertising with Flame Arc Lamps.

The first flame arc lamps used in this country were of foreign manufacture. It was, however, only a comparatively short time after their introduction that American manufacturers awoke to the realization that the lamp was destined to play an important part in decorative lighting. The result was that at the present time there are several American-made lamps on the market, all of which are widely advertised.

Although in foreign countries the flame arc lamps has been widely adopted for street illumination, its use in this country is confined principally to the illumination of store fronts and amusement places such as theatres, parks, etc. While its use in connection with mercantile establishments is principally to attract attention, it can at the same time be used to advantage for the illumination of the store windows, thus serving a double purpose. For this service the lamps are suspended from suitable supports just above the top of the window.

To the brilliant light emitted by the flame arc lamp when in operation is due its advertising or attention-attracting quality. The entire globe seems filled with a luminous gas, and, although the light has the property of penetrating the thickest fogs or smoke, it is soft and not blinding to the eye like the enclosed arc. Carbons giving a yellow or orange colored light are generally used, but carbons may be obtained that will give a light of a red or white color.

Fig. 1 shows the front of a department store in Schenectady, N. Y., lighted with four flame arc lamps of a type manufactured by the General Electric Company, Schenectady, N. Y. This illustration was reproduced from a photograph taken solely by the light of the lamps, and although it fails to show the true beauty of the illumination, gives an idea of how the store appears at night. This is only one of many similar installations in this city, and it is interesting to note that the merchants have clubbed together and made arrangements to have the entire business section lighted with G-I flame arc lamps. The lamps will be spaced at equal intervals along both sides of the street and at the same height from the sidewalk.

In Fig. 2 is shown an exterior view of the lamp. In this type of lamp several good points of construction may be noted. All clock mechanism is eliminated, thus producing a lamp of simplicity and one free from the troubles common to more complicated lamps. Instead of the carbons being placed one above the other, as in the ordinary arc lamps, they are placed at such an angle that they form a V, the arc forming at the lower end. All of the light is directed downward, and

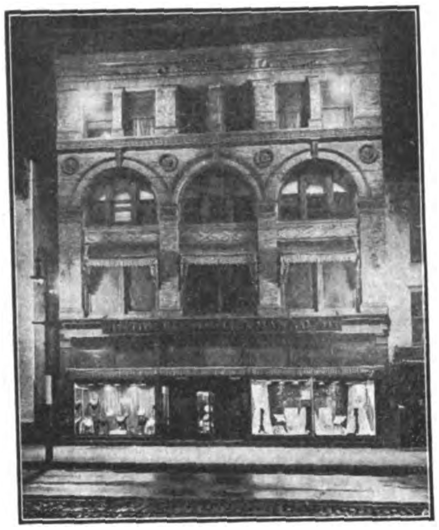


FIG. 1.—BUILDING ILLUMINATION WITH G.-I. FLAME ARC LAMPS.

the absence of any obstruction below the arc prevents shadows being formed. The carbons are fed in such a manner that flickering is prevented and it is impossible for one of them to slide past the other and cause the lamp to go out. Every part of the mechanism is accessible when the

FIG. 2.—G.-I. FLAME ARC LAMP.

casing is lowered. As regards efficiency, the company states that this type of lamp takes less power per unit of illumination than any other illuminant in commercial use.

In designing the lamp special attention has been paid to its external appearance. The shell is made of copper or steel and finished in antique copper or bright japan. The globe is not held by the wire network, but is securely fastened by a flange and ring at the top, the net being retained to prevent the glass from falling should the globe be broken. The entire length of the lamp is only thirty-one inches.

These lamps operate satisfactorily either in series or in multiple on alternating or direct-current circuit and will burn any approved make of flame carbons now on the market.

Proposed Car-Lighting Combination.

An effort is being made, it is stated, to consolidate the United States Light and Heating Company, which was formed to manufacture electric-lighting apparatus for passenger trains, with other concerns doing a similar business. The New York Stock Exchange house of Hooley, Learnard & Company is interested in the proposed consolidation, and is reported to be now engaged in obtaining options on a controlling interest in the United States Light and Heating Company.

About two years ago this company passed under the control of interests identified with the New York Air Brake Company, Charles A. Starbuck, president of that company, becoming president of the United States Light and Heating Company. About the time that Mr. Starbuck was elected president of the United States Light and Heating Company, C. H. Chaffee, now assistant treasurer of the New York Air Brake Company, was made the lighting company's general manager. At the same time Edwin Hawley was named as vice-president. Besides these, the list of officers and directors of the company included A. S. Adler, Charles G. Smith, Charles S. Furst, John J. Moore and W. S. Crandell.

The system of lighting in which the United States Light and Heating Company is interested is known as the Moskowitz system, which employs power generated directly from the axle of passenger cars.

In 1903, the year after the company's organization, William J. Arkell was president of the company, and among the directors were Chauncey M. Depew, Joseph Leiter and Leroy W. Baldwin. The capital of the company from $3,000,000, the figure at which it stood in 1903, was increased to $6,000,000, divided into shares of the par value of $10.

Current Electrical News

GREAT BRITAIN.

London, November 20.—It is interesting to note that in the midst of a prolonged controversy over the efficiencies of surface-contact systems in Great Britain, the Lorain system, which is of American origin, stands quite alone in having demonstrated its reliability above all others. The experiment in London with the "GB" surface-contact system has developed a further stage this week in that the London County Council, acting upon the advice of the president of the Institution of Electrical Engineers, has decided to spend $2,500 more in certain amendments to the car equipments. Although Mr. Mordey's report is not to be made public, from what is known there is a strong suspicion that it criticizes the car equipments. It was this portion of the work, which was in the hands of the Council's officers, about which the "GB" surface-contact company complained when it was decided last July temporarily to cease working the line in the Mile End Road. In this same connection, a lively discussion has been going on at Oxford, where the municipal corporation arranged, a few years ago, with another company to install the Dolter surface-contact system. This system is still in operation in Torquay and Hastings, having been supplanted by the overhead-trolley system at Mexborough in Yorkshire, but after having seen the operation at the first two places, the Oxford corporation was not satisfied as to the suitability of the system and has refused to allow it to be installed.

In connection with a proposal for new capital, the London Electrobus Company has issued a statement showing that during the fifteen months of its existence it has created a record in 'bus receipts, its average having been twenty-eight cents per bus-mile, compared with about twenty-four cents on the London tramways and sixteen cents on the petrol buses. The buses are now said to be earning a profit of $2,250 per month, which leaves a considerable margin for dividend after meeting establishment and overhead charges, debenture interest and depreciation. The new capital is to take the form of six per cent debenture stock.

Following the rejection by Parliament of the bulk electricity-supply scheme for London, the committee is now wrestling with the many conflicting interests arising out of the proposal by the Board of Trade that the London County Council shall be constituted the purchasing authority in 1931, in the place of the various borough councils. Today feeling ran so high that the companies threatened to withdraw the bill and so upset all the plans of the Government, but after consultation with the government authorities, the committee chairman said that such a course of procedure would not be allowed.

It is a popular saying that the best way to shelve a matter is to relegate it to a royal commission. The royal commission on London traffic reported several years ago, but so far no action has been taken to put into effect its recommendation that a special traffic board for London should be elected. This week, however, the prime minister has agreed to receive a deputation from the London County Council on the question. It is of interest to note that since the royal commission on London traffic concluded its sittings, twenty-six and one-half miles of new tube railways have been opened, eighty miles of new electric tramways have been constructed in the outer area and twenty-eight and one-half miles in the county of London; electric traction has been substituted for steam traction on sixty-eight miles of railway, and the northern and southern tramway systems have been linked; and all without a guiding authority to see that there is no waste in the duplication of means of transit, etc.

Systems of charging for electric supply are exercising the minds of engineers in this country to a considerable extent, especially since it has become to be regarded as part of an electric-supply engineers' training that he should have the commercial instinct developed to an even greater degree than his engineering capabilities. The reverse was the case until comparatively recently. So important is this matter regarded, that the Institution of Electrical Engineers, although it devoted a large portion of its time last session to the subject, is opening its new session next week with a paper on a similar subject. G.

EASTERN CANADA.

Ottawa, November 28.—The town of Pembroke, Ont., has passed a by-law providing for the installation of electric pumps for the waterworks system of the town.

The gross earnings of the Shawinigan Water and Power Company for the ten months of the current fiscal year have increased about seventeen per cent, the total for that period being $563,679, as compared with $476,844 for the corresponding period of last year.

The English interests which contemplate putting through the Mexican Power Company's lease to the Mexico Tramway Company over the heads of the directors of the former company, are overwhelmingly in control of the power company and have English proxies, it is said, for no less than 100,000 shares out of 160,000 shares.

Announcement has been definitely made that a merger of electrical interests has been consummated in London, England, whereby Mr. William MacKenzie secures control of the Toronto Electric Light Company, which will consolidate that company with the Electrical Development Company and the Toronto & Niagara Power Company.

The Canadian Postmaster-General, Hon. Rudolph Lemieux, is in London, England, continuing his inquiries regarding a state-owned Atlantic cable. Mr. Lemieux does not admit or deny that he possesses cabinet authority to complete a bargain with the British and Australian Governments, but he says the idea of a state-owned cable is much approved on both sides of politics and among the press, and there is no question that it would also prove a financial success. The minister is also inquiring about government ownership of inland telegraph service in England.

During the first part of December work will be commenced on the building of the proposed bridge across the Niagara River, of the Trans-Niagara Bridge Company. With the completion of this bridge, the International Railway, the Niagara, St. Catherines & Toronto Railway, and the Hamilton, Grimsby & Beamsville Railway companies will be consolidated and the broken links in the trolley system between Niagara Falls and Toronto completed. The new bridge will be exclusively for electric-railway traffic.

A couple of years ago tests were made of electric smelting of iron at Sault Ste. Marie by the Dominion government. As soon as the results of these experiments appeared, a Swedish firm of ironmasters began constructing furnaces, and after two years seems to have achieved success. The furnace at Dumnarfvet was to be started on December 1. Dr. Haanel, the Canadian Government's expert, had been invited to be present and recently left for Sweden to report upon the matter. It is learned that the new furnace is a great advance upon previous efforts. It will use 800 horsepower instead of 250 horsepower employed at the "Soo" tests. The cost of the product under the Swedish process will be only $12 a ton. With the electric process ore with the admixture of two-and-one-half per cent of sulphur can be handled. W.

WESTERN CANADA.

WINNIPEG, NOVEMBER 28.—Although the civic electric street-car system in Edmonton, Alb., has been in operation for less than a month the people are already drawing up a petition for cars to be run on Sundays. At the last session of the Alberta Legislature an act was passed prohibiting the operation of street-railway systems on the Sabbath, despite the fact there was not then a street-railway system in the whole province. An effort will be made to have this law repealed.

Troubles are not coming singly at Port Arthur, Ont., as far as the civic electrical interests are concerned. Last week the street-car controversy was brought to a climax when the system was seized by the sheriff and handed over to a joint commission for operation while the matter is being thrashed out in the courts. The feature for this week is the announcement that the Kaministiquia Power Company, a corporation from the sister city of Fort William, will compel Port Arthur to live up to the contract for the supplying by the company of electrical power, which contract has been canceled by the city on the grounds that the company was using the contract as a leverage with the Ontario Government to obtain power privileges at Dog Lake Falls, where the city is also seeking power privileges.

The ratepayers of the municipality of Saskatchewan, Man., will shortly vote on the question of installing a municipal telephone system. The two adjoining municipalities have systems and it is practically certain that the Saskatchewan municipality will also build a system. Address Councilor John Hunter, Rapid City, Man.

J. L. Nelson, of Winnipeg, has received the contract to supply the Manitoba Telephone Commission with 25,000 telephone poles, which will be delivered during the present winter.

The British Columbia Electric Street Railroad Company will build twenty-four cars at its New Westminster shops, having large platforms that can be fitted up as pay-as-you-enter cars if the system proves successful locally. R. H. Sperling, Vancouver, B. C., is general superintendent of the company.

Tenders are being called by the city of Winnipeg, Man., until December 28 for various work in connection with the civic power plant at Lac du Bonnet. Tenders are being asked for the general work at the power site; the erection of the transmission line from the power site to Winnipeg, a distance of approximately 66.5 miles; the necessary steel towers, and electric transmission cables. Plans and specifications of these works, also forms of tender, may be obtained at the office of the Power Engineer, Carnegie Library Building, Winnipeg, Man., and also at the office of Smith, Kerry & Chace, consulting engineers, Confederation Life Building, Toronto. In discussing the proposed work C. B. Smith, the expert retained by Winnipeg, has announced the plant will be in operation during 1910 if progress is made as proposed.

At a recent meeting of the City Council of Fernie, B. C., it was decided to call for tenders for a 260-horsepower gas-producer plant providing satisfactory arrangements can be made with the Crow's Nest Pass Electric Light and Power Company. Tenders are now being called under these conditions until noon, December 15, and are receivable by A. A. Sharley, acting city clerk, who can also show plans and specifications.

Tenders will be received by Magnus Peterson, secretary of the civic board of control, until February 22, for the supply and erection of a turbine pump and motor for the city water works. Plans and specifications may be seen at the office of H. N. Ruttan, city engineer, Winnipeg, Man.

At Saskatoon a committee has been appointed consisting of R. Smith, M. Mansell and several others, to petition the government to construct telephone lines along the railways both east and west from that city. R.

At Hedley, B. C., the Hedley Power and Development Company has been organized to furnish electricity to a number of the mines in the neighborhood. L. H. Patton has been elected secretary of the concern and 2,000 inches on the Similkameen River has been applied for and a power site selected. Active construction will be commenced as soon as the water rights are granted.

The City Council of Victoria, B. C., is seeking rights from the Provincial Government to develop and distribute electric power, and if these rights are granted will enter into competition with the British Columbia Electric Company.

The ratepayers of McLeod, Alb., will shortly vote on a by-law to raise $35,000 by the sale of debentures for enlarging the civic electric-light and power plant. To date this plant has met all demands, but owing to the rapid growth of the city enlargement is necessary. These debentures will be repayable during a period of forty years. Address E. F. Brown, secretary-treasurer.

IMPORTANT DEVELOPMENTS.

TWENTY-FIVE-YEAR CONTRACT FOR 25,000 HORSEPOWER CLOSED BY ST. PAUL RAILROAD—The Chicago, Milwaukee & St. Paul Railway Company has closed a contract with the Great Falls Water Power Company, of Helena, Mont., for the supply of 25,000 horsepower for twenty-five years. C.

CHICAGO AND MILWAUKEE ELECTRIC RAILROAD MORTGAGE TO BE FORECLOSED—On November 27 the attorney representing the bondholders' committee of the Chicago and Milwaukee Electric Railroad filed a bill in the United States Circuit Court at Chicago asking for the foreclosure of the mortgage on the Illinois section of the road. A similar suit relating to the Wisconsin corporation was filed a week previously. It is believed that the system will be bought up by the bondholders at the foreclosure sale and a reorganization effected that will terminate the financial entanglements of the properties.

CHICAGO CITY RAILWAY COMPLETES ITS BOND ISSUE—The Chicago City Railway Company has sold $6,000,000 of its first mortgage five per cent bonds to the Illinois Trust and Savings Bank. With the previous issues of $12,000,000 this completes the $18,000,000 of bonds authorized for rehabilitation purposes by the new traction settlement ordinance. The expenditures permitted from the proceeds of the bond issue are all carefully checked by the Board of Supervising Engineers. Considerably over half of the rehabilitation work assigned to the company has been completed in less than half the specified time.

SULTAN OF TURKEY REMOVES BAN ON TELEPHONES IN EMPIRE—The Turkish government is looking for someone who will undertake the installation of a complete telephone system throughout the empire, according to a communication sent to the Department of Commerce and Labor by Vice-Consul General Heizeer, from Constantinople. Soon after the establishment of a constitutional government in the Ottoman empire, an order was issued abolishing the former regulations prohibiting the telephone. Now the Turkish government announces that it will receive bids on a complete telephone concession for the entire country during the month of December.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY SELLS $50,000,000 BONDS—The American Telephone and Telegraph Company has sold $50,000,000 of its four per cent convertible gold bonds to a syndicate consisting of J. P. Morgan & Company; Kuhn, Loeb & Company; Kidder, Peabody & Company, and Baring Bros. & Company, Limited, of London. These bonds are identical with the $100,000,000 issue sold to the same bankers in 1906. This sale completes the authorized issue of $150,000,000 of these bonds and fully finances the company for the years 1909 and 1910, including provision for the $6,000,000 Western Telephone and Telegraph notes, due in May, 1909, and $25,000,000 American Telephone and Telegraph notes, due in January, 1910.

BEGIN SURVEYS FOR PHILADELPHIA-CAMDEN TUNNELS UNDER DELAWARE RIVER—Actual work on the tunnels under the Delaware River to connect Camden, N. J., with Philadelphia has been begun, a corps of civil engineers having commenced the surveys on both shores. This was announced by W. A. Stern, of Stern & Silverman, the railroad contractors, who will have charge of the work, the cost of which is conservatively estimated at $7,500,000, but which may aggregate nearly twice that amount before the task is completed. The method of construction will follow very closely that used by the Pennsylvania Railroad in building its tunnels under the North and East rivers in New York. They will be excavated by the "shield" method, which involves the forcing of an immense steel section ahead of the big force of men that will be required in removing the earth.

BOSTON'S NEW MILE OF SUBWAY COSTING $10,000,000 TO BE OPENED—Excellent progress is being made on the new subway under Washington Street, and the Boston Elevated Company expected to be running cars in the tunnel before December 1. The length of the new subway is 5,676 feet, and the construction and equipment have cost over $10,000,000. The platforms are 350 feet long, and the addition to the road is expected to increase the carrying capacity 175 per cent. The new tunnel has been made absolutely fireproof. The lighting is by incandescent lamps, arranged behind beams of the arched ceilings. To insure a perfect supply of fresh air in the tunnel there are four fan chambers, each fan being capable of exhausting 25,000 cubic feet of air per minute. The foul air is drawn out in the tunnel between stations, through ducts constructed in the concrete ceilings. The fresh air enters at the several stations, the entrances of which are open save for an ornamental grille work.

TELEPHONE AND TELEGRAPH.

McCALLSBURG, IOWA—A new switchboard will be installed in the telephone building at McCallsburg. C.

OAKWOOD, OKLA.—The Oakwood Telephone Company has been incorporated with a capital stock of $750. P.

MERCEDES, TEX.—The Mercedes Telephone Company has been incorporated with a capital stock of $1,000. P.

IOWA CITY, IOWA—The Johnson County Telephone Company contemplates spending $35,000 on improvements. P.

BARTLETT, TEX.—The Bartlett & Donahoe Telephone Company has been incorporated with a capital stock of $300. P.

KINGSLEY, IOWA—The directors of the Kingsley Telephone Company have decided to install a new switchboard in the exchange at Kingsley. C.

FRANKLIN, PA.—The Bell Telephone exchange at Franklin was destroyed by fire, entailing a loss of $35,000, part of which is covered by insurance.

OLYMPIA, WASH.—The United Wireless Company is arranging equipment for a receiving station, using the dome of the state capitol as a mast.

OLYMPIA, WASH.—The Uniontown Telephone Company, of Uniontown, has been incorporated with a capital stock of $5,000 by Lambert Taufen, W. W. Miller and George A. Dressel.

PORTLAND, ME.—All the property rights, franchises, privileges and appurtenances of the Northeastern Telephone Company will be sold at public auction, December 16, by Frank E. Ebersole, as special master, by a decree of foreclosure.

OMAHA, NEB.—The Independent Telephone Company is contemplating putting in $1,000,000 worth of extensions and improvements. It is the intention to develop exchanges simultaneously at Benson, Florence, Dundee and South Omaha.

FOND DU LAC, WIS.—Articles of incorporation have been taken out for the organization of the Eldorado & Friendship Telephone Company, the capital stock being $5,000. The incorporators are: John Reilly, W. H. Keyes, W. C. Pay, L. G. Barnes and W. T. Reilly.

VALLEJO, CAL.—The new switchboard recently installed by the Western Electric Company, of Chicago, in the exchange of the Pacific Telephone and Telegraph Company, at Vallejo, was successfully cut over recently, and the town has now one of the most modern exchanges in the country.

ROCHESTER, N. Y.—Reorganization and merging of all seven Bell telephone companies operating in New York state is under way by the American Telegraph and Telephone Company, and on or about January 1 the merger will become a fact. A holding company will be the vehicle for carrying the control of the companies. The total capitalization of the seven companies is now $89,585,200.

PERSONAL MENTION.

MR. JOHN T. MORRIS, of Columbus, Ohio, has been engaged by the Canal Dover Board of Public Service as designing engineer and superintendent of construction for the municipal electric light plant which will be erected in that city.

MR. GRANT W. SPEAR, who for many years has been vice-president of the Dearborn Drug and Chemical Works at Chicago, has taken charge of the general eastern offices of the company at 299 Broadway, New York city, as vice-president and eastern manager.

MR. JOHN MUSTARD, of the Wagner Electric Manufacturing Company, has been appointed assistant manager of sales for the territory inclusive and east of Pittsburg, with headquarters in Philadelphia. Mr. Mustard has been with the company as district manager at Philadelphia for the past fifteen years.

MR. MELDON H. MERRILL, who, as salesman for the Westinghouse Electric and Manufacturing Company, has been active for some years past in promoting the introduction of electric drive among the textile mills in New England, has recently resigned his position with that company, taking up similar work in connection with the Boston office of the Allis-Chalmers Company.

MR. THOMAS GRAHAM GRIER, of Chicago, president of the Grier Company, manufacturers' agent, and author of the book "On the Canal Zone," recently favorably reviewed in this paper, delivered an illustrated lecture on "The Panama Canal and Life on the Canal Zone," before an audience at the auditorium of the Hyde Park Young Men's Christian Association, Chicago, Thanksgiving night.

MR. GEORGE A. POWELL, of Winnipeg, who has been associated with the Packard Electric Company, Limited, of St. Catharines, Ont., for the last fifteen years, has severed his connections with that company. He has started business for himself in the electrical line as commission broker, with offices in the Union Bank Building, Winnipeg, Man. He will continue to represent, among other agencies, the Eugene F. Phillips Electrical Works, Limited, of Montreal, well-known makers of bare and insulated copper wires and cables.

MR. J. R. GORDON has accepted the position of manager of power apparatus sales for the Western Electric Company for its southern territory. He will continue to make his home in Atlanta, Ga. He resigned a month ago from his position of manager in the Southern States for the Westinghouse Electric and Manufacturing Company. Mr. Gordon is known throughout the country as a pioneer in the electrical field, having been associated with those who organized and operated the first of the Edison plants. For many years he has been a prominent member of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers.

MR. KARL LAURELL, a draftsman at the Lynn, Mass., works of the General Electric Company, has sailed for Sweden, where he will soon begin duties as general superintendent of the Stockholm Electric Supply Company. Mr. Laurell has been in this country for less than two years, and during that time has been connected with the General Electric Company, where he has been studying American systems in the production of electrical supplies. He is twenty-six years of age and was born in Upsala, Sweden. Laurell attended the Royal College in Stockholm, where he took a thorough electrical course, and after finishing came to this country for practical experience.

MR. W. B. McVICKER, resigning as vice-president and eastern manager of the Dearborn Drug and Chemical Works, with which he has been connected for many years, has incorporated the W. B. McVicker Company, with offices in the United States Realty Building, 115 Broadway, New York. A new and complete laboratory and factory is being built to have exceptional facilities for general analytical work and the manufacture of high-class products, and a specialty will be made of high-grade lubricants and scientific preparations for treating boiler feed-waters and hydraulic systems. The personnel of the company includes Charles M. Eddy, Albert E. Carpenter, Joseph F. Hammill, William J. Schatz, G. Frank Duemler and Frank J. Zink.

ELECTRIC LIGHTING.

WOMBLE, ARK.—The Bear State Lumber Company will install an electric-light plant at Womble. P.

ALVIN, TEX.—E. B. Hill has been granted a twenty-five-year franchise for an electric-light plant.

SEATTLE, WASH.—The Coast Lighting Company has been incorporated with a capital stock of $25,000.

HINCKLEY, MINN.—The dam of the Hinckley Electric Company has gone out entailing a loss of $1,000. C.

ROCHESTER, MINN.—Rochester contemplates issuing bonds for from $50,000 to $75,000 for a lighting plant. P.

RUTHERFORD, N. J.—The Borough Council has passed a resolution to advertise for bids for street lighting.

MERCEDES, TEX.—The Mercedes Electric Light Company has been incorporated with a capital stock of $2,000.

MONTEREY, TENN.—Monterey is to have an electric-light plant and bids are now being taken for the contract.

VAN BUREN, ARK.—W. R. Petty, of Pine Bluff, Ark., contemplates establishing an electric-light plant in Van Buren. P.

YORK, PA.—The Peach Bottom Electric Transmission Company, of York, has been incorporated with a capital of $5,000.

SABINAL, TEX.—The Sabinal Water and Ice Company has increased its capital stock and will build an electric-light plant. P.

WEATHERFORD, OKLA.—Twenty-five thousand dollars in bonds has been voted for the construction of an electric-light plant.

BROWNS VALLEY, MINN.—It is proposed to dam the Little Minnesota River near Browns Valley, securing power to operate an electric-light plant. C.

FAIRVIEW, OKLA.—Fairview will install an electric-light plant which will cost $10,000. The plant may be finally owned by the city on an option.

JOLIET, MONT.—Work is about to commence on an electric-light and gravity water system, which Norman S. Poole, engineer, has been promoting, at Joliet. C.

ESCANABA, MICH.—A second power dam, capable of furnishing 25,000 horsepower, will shortly be constructed across the Escanaba River near Groos, Mich. C.

NEW CASTLE, IND.—The Maxwell-Briscoe Motor Company will erect and install a combined water and electric-light plant for its large factory at New Castle. S.

KANSAS CITY, MO.—The main power plant of Swift & Co.'s packing house was destroyed by fire shortly before midnight, November 27. The loss was $40,000.

MONDOVI, WIS.—The Mondovi Light and Power Company has been incorporated with a capital of $35,000 to own and manage two mills and an electric-light plant.

MOUNT AYR, IOWA—The Mount Ayr Light and Power Company, of which W. Jackson Bell is secretary and general manager, has been incorporated with a capital of $20,000. C.

ST. CLOUD, MINN.—The Union Power Company expects to have its power station at the east end of the mill canal at St. Cloud completed and the water turned on December 15. C.

LOUISVILLE, KY.—The Kern Electric Company has been incorporated in Daviess County with a capital of $6,000. W. J. Kern, E. L. Holbrook and C. G. Kern are the incorporators.

DANVILLE, IND.—The Danville Light, Heat and Power Company has increased its capital stock from $36,000 to $100,000. It is proposed to improve and enlarge the plant and install new machinery. S.

LAPORTE, IND.—The managers of the electric plant of the Laporte Public Utility Company, which was recently destroyed by fire, have given out that the plant will be rebuilt and new machinery installed at once. Otto Wettstein is secretary and manager.

REDWOOD FALLS, MINN.—R. F. Wherland is working on a scheme to develop the waterpower of Redwood Falls, Minn. A stock company with a capital of $100,000 is being organized for the purpose. C.

JEFFERSON CITY, MO.—The American Light and Power Company, of Union, has been incorporated with a capital stock of $10,000, by W. W. McCurdy, C. P. Reinhard, L. W. McCurdy and others.

TONOPAH, NEV.—The Rhyolite Electric Company has filed letters of incorporation, with W. D. Hatton, C. A. Stoible and M. J. Hill, all of Goldfield, as directors. The capital stock is placed at $100,000.

BELLE FOURCHE, S. D.—The Belle Fourche Electric Light, Heat and Power Company will string a line from the Redwater plant of the Black Hills Traction Company to furnish electric light for the town.

ALVIN, TEX.—At a meeting of the City Council a twenty-five year franchise was granted to E. B. Hill for establishing an electric-light plant for the city. The conditions are that he complete it in twelve months.

JOPLIN, MO.—Henry L. Doherty & Co. have purchased the Consolidated Light, Power and Ice Company, of Joplin, and the Galena Light and Power Company, of Galena, Kan., and will erect a central power station. P.

WINNIPEG, MAN.—The City Council of Winnipeg will go ahead with the construction of the power plant on the rapids of the Winnipeg River. The contract will be let at once calling for an expenditure of $1,500,000. C.

VILLA GROVE, ILL.—The Villa Grove Electric Company has been incorporated with a capital stock of $15,000, for the purpose of operating electric-light and power plants. The incorporators are V. M. Elmore, C. W. Hagerman and C. B. Kennington.

COLUMBUS, OHIO—Articles of agreement for the consolidation of the Warren Gas Light and the Hyde Electric Companies, both of Warren, have been filed. The new concern will be known as the Hyde Electric and Gas Company, and the capital stock is fixed at $350,000.

SEATTLE, WASH.—An increase from $500,000 to $800,000 in electric-light bonds for the city of Seattle has been recommended by the City Council's finance committee. It will be submitted to popular vote on December 29. The smaller amount had been previously voted.

BOISE, IDAHO—Articles of incorporation of the Slate Creek Electric Light and Power Company have been filed. The company is capitalized at $3,000,000, and will do a general electric-light and power business in Wallace, Idaho, building a plant to operate a big water right in the Slate Creek district.

LINTON, IND.—The City Council of Linton is in the market for the purchase of $15,000 worth of new equipment for the electric-light plant. The proposition to improve the plant was opposed by many citizens who claim that after eight years of municipal electric-light service the plan has proved a failure. S.

GENEVA, N. Y.—The Geneva-Seneca Electric Company has begun the erection of a new power station. The company intends to expend approximately $150,000 in betterments, of which $75,000 will be utilized in the construction and equipment of a new power plant and the balance upon transmission improvements.

LUDINGTON, MICH.—A. P. Carr and E. J. Quirk are promoters of a company to build an immense concrete and pile dam across the Pere Marquette River in Custer township, to use the waterpower for the production of electricity. A power house will be built and three hydraulic turbines, each capable of generating 500 horsepower, installed.

HAGERSTOWN, MD.—Clarence E. Easterday, Orville E. Shifler and H. L. Moser, composing the Antietam Electric Light and Power Company, are constructing a $13,000 electric plant. The company has contracted to furnish light to the municipality of Boonsboro and is now negotiating to light the towns of Sharpsburg and Keedysville.

OGDEN, UTAH—The Chamber of Commerce of Ogden has gone on record as favoring a municipal electric-lighting plant, and urged the immediate action of the Council in utilizing water owned by the city for that purpose. A resolution was adopted requesting the Council to exercise its rights and perform its duty in establishing electric-light rates in Ogden.

FINDLAY, OHIO—Meter rates have been dispensed with for all commercial lighting at Findlay. Prices have also been reduced from ten to eight cents per kilowatt-hour. While the City Council is advertising for bids for lighting the city after the expiration of present contracts, it is thought that under the concessions named a new contract will be made with the present concern. H.

LYNCHBURG, VA.—A modern electric plant for lighting the country residence, barn, and other buildings on the Nelson County estate of Thomas F. Ryan has been put into commission. "Oak Ridge" is one of the finest estates in Virginia, and is one of the few rural homes in the state to be lighted by electricity developed in a private plant. The power plant cost Mr. Ryan $25,000, it is reported.

SANTA FE, N. M.—Incorporation papers have been filed by the El Paso Power and Light Company, with headquarters at Alamogordo, Otero County. The capitalization is $5,000. The incorporators and directors are J. L. Lawson, A. F. Menger and H. J. Stacey of Alamogordo. The company is to use the power from the Penasco River to generate electricity to be carried to El Paso.

LIMA, OHIO—The latest development in the municipal lighting-plant fight at Lima is the filing of an injunction suit by City Solicitor Rogers, who asks that the legislation under which the work is proceeding be declared illegal and the work be stopped until the matter can be determined by the courts. In the meantime the board of public service is going on with the erection of the new plant. H.

BUCYRUS, OHIO—On the first of March the present city-lighting contract expires and an injunction has been granted against the city restraining it from issuing $80,000 bonds, recently authorized by vote of the people, for the purpose of erecting a municipal lighting plant. Eight bids were tendered and as they were about to be opened the injunction was made on the application of T. M. Droleabaugh, a taxpayer. H.

AUGUSTA, GA.—The contract for the construction of a dam which will also serve as a bridge across the Savannah River at Price's Island, twenty miles above Augusta, has been awarded. The work will be commenced in December and will require about one year to complete. The dam, which will cost about $3,500,000, will be thirty feet high and will furnish 15,000 horsepower, which will be transmitted to Augusta to a substation.

SALISBURY, N. C.—It is reported that work will be resumed on the big $10,000,000 water and electric plant at Whitney, on the Yadkin River, thirty miles from Salisbury. Plans are being formulated for raising $2,000,000 for the completion of the plant, which will furnish electric power to a vast area in North Carolina. More than $5,000,000 has already been spent on the plant. Operations ceased on account of a receivership several months ago.

CHARLOTTE, N. C.—The Westinghouse Electric and Manufacturing Company has secured the largest contract for transformers ever made with an electric manufacturing company. This contract, awarded by the Southern Power Company of Charlotte, N. C., calls for transformers aggregating a capacity of 93,000 kilowatts. The apparatus will be used on the transmission line between Charlotte, Greensboro and Greenville, covering an area of 240 miles.

SAN FRANCISCO, CAL.—Another large hydroelectric power project is now in prospect for central California. It has been announced that the extensive water right properties on the American and Cosumnes rivers, owned by W. H. Tevis and recently offered to the city for a municipal water supply, are to be developed for the production of electric power. C. N. Beal, who is associated with Mr. Tevis in the project, says engineers are still at work on the matter. The properties have been released from the contract with the Bay Cities Company, and will be developed for power. Mr. Beal also states that a market for the power has been secured in advance.

ALBERTVILLE, ALA.—The Sand Mountain Electric Company, composed of Albertville business men, has been organized and active operations will begin toward the erection and installation of a plant to light the town of Albertville. E. O. McCord is president and general manager of the company, which owns the Short Creek Falls (four miles from town), valuable real estate in Albertville and has a twenty-five-year franchise and contract for lighting Albertville.

BRIDGEWATER, MASS.—The Edison Electric Illuminating Company has purchased the plant of the Bridgewater Electric Company and will soon begin extensive improvements, planning to give the town of Bridgewater twenty-four-hour service. A transmission line will be built from East Bridgewater to Bridgewater. The Edison company plans to install arc and incandescent lights along the streets and to increase the electric-power business in the town.

WINDSOR, ONT.—At the approaching municipal elections in Windsor, ratepayers will probably be asked to vote on a by-law to authorize the expenditure of about $25,000 or $30,000 in order to provide a practically new lighting plant for the city. As an alternative proposition, it is likely that they will be given an opportunity to express themselves on the project of purchasing Niagara power from the Hydroelectric Commission of the Ontario Government under the government scheme.

ANACONDA, MONT.—The Great Falls Water Power and Townsite Company announces it is developing approximately 30,000 horsepower now, and will probably add about 50,000 horsepower in other developments later on. The waterpowers at Great Falls were purchased, it is said, in the firm belief that the time is very near when the railroads operating over the mountains must avail themselves of the cheap power furnished by the waterpowers of the state in moving their trains over the mountain grades.

WALLACE, IDAHO.—The Slate Creek Electric Light and Power Company, which is endeavoring to secure a charter from the city for a period of fifty years, has filed articles of incorporation and is capitalized at $3,000,000. The company is to do a general electric-light and power business, the intention being to build a power house in the Slate Creek district, sixteen miles from Wallace. The incorporators are D. L. Hopkins, Thomas McGowan George W. Baldwin, Jesse Freeman and William Sites. The City Council is said to be favorably inclined toward the new company.

SAGINAW, MICH.—The Eastern Michigan Power Company is seeking to supply Saginaw and Bay City and adjacent territory with electric current for light and power. This company is developing the Au Sable River from Au Sable to Milo, a distance of about 100 miles. The total amount of power that can be developed is declared to be approximately 50,000 horsepower, and this is to be obtained by the erection of ten or twelve dams, ranging in height from twenty-five to forty feet, located at different points along the river, according to the fall and local conditions. The total outlay for the completion of the work will be several millions of dollars. If the franchises are granted the company expects to deliver current in these markets within a year to eighteen months.

TACOMA, WASH.—A report of a civil engineer, H. A. Whitney, on his investigation of the power site offered by Henry Bucey on the west side of Hood canal, shows the inadvisability of utilizing the water from the Dosewallips and Dickabuch rivers for power purposes by means of a dam placed at the foot of a canyon. "The minimum head which the dam will give, if placed where proposed, is 200 feet," says the report. "The flow of the Dosewallips River is 214 cubic feet per second, and of the Dickabuch 114 feet per second. If the city could utilize the rivers to their capacity, it would require an available head of 320 feet in each stream to get sufficient power at this time of the year. It is not possible at the present stage of the water to develop 10,000 horsepower, as proposed by the city council. About 4,000 horsepower is all that could be secured."

ELECTRIC RAILWAYS.

EAU CLAIRE, WIS.—There is a project on foot for connecting Eau Claire and Osseo by an electric railway twenty miles long.

WEBSTER CITY, IOWA—An interurban road between Webster City and Clarion, Iowa, is projected. It is expected that the $300,000 necessary to construct the road can be raised without resorting to bonding the property. C.

DES MOINES, IOWA—The company bonding the Des Moines & Sioux City Electric Railway Company insists that the road be an air line between Des Moines and Sioux City, and it be built to carry 100-ton electric freight locomotives. C.

NASHVILLE, IND.—Joseph Irwin, of the Indianapolis, Columbus & Southern, is making plans to build an electric line from Columbus to Bloomington, via Nashville. Inquiries have been made in regard to franchises and right-of-way. S.

BALTIMORE, MD.—Construction work is nearly completed on the new Baltimore, Halethorpe & Elkridge Electric Railway. The road, which is three and a half miles long, runs from the terminus of the Wilkens Avenue line of the United Railways to Halethorpe.

WARSAW, IND.—Representatives of the Murdock traction system have entered into an arrangement with officials of the Winona Interurban Railway and the Northern Indiana Railway, providing for running cars from Indianapolis to South Bend. The service will be put into effect as soon as the gap between Warsaw and Peru is closed. S.

CRAWFORDSVILLE, IND.—Citizens of Crawfordsville who are interested, announce that the Kokomo, Frankfort & Terre Haute Traction line will be built during the next year, and work will begin on the road at two or more places along the route. The company has placed the bonds on sale and there is every indication that these will find a ready sale. S.

RALEIGH, N. C.—The Burgrahaw Interurban Company, organized with a capital stock of $500,000, proposes building and operating an electric railway between Burlington, Graham, Haw River and other points near Burlington. The incorporators are: C. E. W. Tenney, of New York; F. S. Jones, of Nashville, Tenn., and E. S. W. Dameron, of Burlington.

OTTUMWA, IOWA—The leading business men of Ottumwa and representatives from nearby towns, which are anxious to get interurban roads, attended a meeting of the Ottumwa Commercial Association when the matter was discussed with H. W. Garner, manager of the Oskaloosa Traction and Light Company and the Oskaloosa & Buxton Interurban Company. C.

CAIRO, ILL.—The Cairo City Council has granted a fifty-year interurban franchise and a twenty-year street railway franchise to the McKinley syndicate. The syndicate has already bought the local electric street railway, electric-light plant and the Cairo City Gas Company. An interurban line will be built to connect Cairo with Mounds, Mound City and Villa Ridge, and will later go on to St. Louis.

BELLINGHAM, WASH.—To supply power for the proposed Skagit Interurban Railway, the Stone & Webster interests will double the capacity of the Nooksack power plant. The improvement will cost $250,000, a sum equal to the cost of the plant, which was completed two years ago. When the survey for the interurban right-of-way was made, all streams in Skagit County were carefully examined, but suitable waterpower was not found.

BELOIT, WIS.—Following the "tag-day" movement the City Federation of Women's Clubs of Beloit, Wis., ran the city street cars Saturday, November 21, and the fares collected were added to the fund from the tags to swell the total for the school children of Beloit. The Traction Company made the women the offer, which was promptly accepted, and everyone who patronized the cars—and everyone did—paid fares to the women of the federation, while the regular conductor stood by, attending to stopping and starting the cars. The traction company received no returns from the day's operation except the grateful appreciation of the citizens.

LAFAYETTE, IND.—It is announced that the Fort Wayne & Wabash Valley Traction Company will, during the next year, extend its line from Lafayette to Danville, Ill., where it will make connection with the McKinley Traction System, reaching many towns and cities in Illinois and including St. Louis, Mo. The new extension when built will touch West Point, Attica, Covington, Williamsport and other small towns in a territory thickly settled. S.

BOSTON, MASS.—The Railroad Commission has approved the terms of consolidation of the Middlesex & Boston, the Westboro & Hopkinton and the Natick & Cochituate Street Railway Companies, as the Middlesex & Boston Street Railway Company. The commission also approved an increase in stock of the Middlesex & Boston company to not exceeding $140,000 for carrying out the consolidation and in exchange share for share of the companies above named.

JOLIET, ILL.—The Secretary of State has issued a license to incorporate to the Chicago, Joliet & Western Interurban Railway Company. The principal office is Chicago and the capital stock is nominally $10,000. It is proposed to construct a railroad from the city of Chicago southwest through the counties of Cook, Dupage and Will to Joliet, and west to the counties of Kendall, Grundy and La Salle. The incorporators and first board of directors are headed by G. Fox, of Chicago.

STOCKTON, CAL.—A large meeting of land owners and business men from both Stanislaus and San Joaquin counties has been held at Escalon to further the immediate construction of an electric railway to run adjacent to the French Camp road to Escalon, thence to Modesto, with a main line to Oakdale. J. L. Craig, chairman of the meeting, delivered a convincing address covering the desirability, as well as the necessity to the future welfare of the district, of the construction of the railway.

DENVER, COLO.—Articles of incorporation for the Crags and Canon Railway Company have been filed by George F. Keller, recently of Fort Wayne, Ind., representing capitalists of that city; L. B. Bradley, recently of Chicago; G. A. Brink, D. C. Nevin and N. S. Williams, of this city. The company is capitalized at $300,000 and is incorporated to build a standard-gauge railway from the town of Crags on the Moffat Road to Eldorado Springs, thence to Boulder. Mr. Bradley, who is an electrical engineer, has been in Colorado for the past year, devoting most of his time to surveys of the proposed railway. The final survey from Crags to Eldorado Springs, with a maximum grade of four per cent, has been established and the line from Eldorado Springs to Boulder will not exceed a maximum of one per cent. The plan of the incorporators is to build to Eldorado Springs, if possible, in time for the tourist travel of next season, and when the line is completed to Boulder, it will connect all northern Colorado with the Moffat Road, making a cut-off that will save about sixty miles of travel by way of Denver to reach western points on the Denver & Northwestern Pacific.

OBITUARY.

MR. JAMES E. MURDOCK, head of what is known as the Murdock syndicate of interurban lines in northern Indiana, and one of the wealthiest men in the state, dropped dead in his home in Lafayette, Ind., November 27, at the age of seventy-one years. Mr. Murdock had been a prominent figure in the construction of the lines of the South Bend & Chicago and of the Fort Wayne & Wabash Valley Traction companies, and was president of the Merchants' National Bank of Lafayette at the time of his death, besides retaining his earlier connections with the natural-gas industry in Ohio and Indiana. Mr. Murdock was born in Ireland in 1837, coming to Lafayette when a lad. He started the career which led to his great fortune, by working in a brick yard. Mr. Murdock was not only enterprising in the building up of the great systems of which he was the nominal head, but was also known to be benevolent, never refusing, it is said, to contribute to a worthy cause. S.

ENGINEERING SOCIETIES.

INDIANA ACADEMY OF SCIENCE—The Indiana Academy of Science held its annual session at Purdue University, Lafayette, Ind., beginning November 27. "Deforestation and Its Effects" was the subject of the official address of Prof. Glen Culbertson of Hanover College, president of the body. Following a general inspection of the departments of Purdue University, the evening session was held in the lecture room of the electrical building, where a large audience heard an illustrated lecture and demonstration by Prof. H. T. Plumb, associate professor of electrical engineering at Purdue, on "High-Frequency Currents."
S.

ITHACA SECTION, A. I. E. E.—The second regular meeting of the Ithaca Section, American Institute of Electrical Engineers was held November 19, with 130 members and visitors present. Prof. H. H. Norris gave an experimental demonstration of "Atmospheric Insulator Losses in Transmission Lines." Various corona effects were shown, and by means of wattmeter measurements the corresponding power losses were determined. The sixty-thousand-volt transformer used in these experiments was the one designed and constructed by Prof. H. J. Ryan, and used in his famous experiments. This demonstration was appropriate in view of the recent discussion of Mr. Mershon's Atlantic City paper before the local section. Where such experiments are practicable in the section meetings they go far to arouse interest in the Institute papers.

FORT WAYNE SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The Fort Wayne Section of the American Institute of Electrical Engineers held a well-attended meeting on November 12, which was preceded by the usual informal dinner. The paper for the evening, "Paralleling of Alternators," presented by J. J. Kline, of the Fort Wayne Electric Works, was followed by a very active discussion, in which many interesting things were brought up. A. L. Hadley spoke at some length on the cross currents which occur in alternators direct-connected to slow-speed gas engines and the difficulty of adjusting the prime movers so as to reduce the cross currents to a minimum. M. J. Kehoe described his experience with some steam turbines direct-connected to alternators, citing a case which had occurred in his plant on frequent occasions, when with two machines running in parallel without apparent cause the machines would suddenly drop their load and the voltage would fall to zero. There seemed to all intents and purposes to be no cause for this on the part of the alternators, but it had occurred on numerous occasions and the makers failed to furnish a suitable explanation of the difficulty. It was suggested that the cross currents and armature reaction might succeed in demagnetizing the poles due to an excessive overload. Mr. Kehoe was asked to furnish further information on this point at the next meeting, although, as he explained, the trouble had been entirely obviated by the adoption of a Tirrill regulator. Owing to the lateness of the hour further discussion was postponed until next meeting. At the next regular meeting E. A. Barnes, superintendent of the Fort Wayne Electric Works, will present a paper, "Choice of Power for Industrial Purposes."

ELECTRICAL SECURITIES.

The general undertone of last week's stock market was firm, although there was considerable irregularity. Some smart rallies were shown, as compared with a week ago, and while trading was less active than previously and largely professional, there was some gain in this direction. The increased buying, however, did little to attract further public participation, and there has been quite a slump in commission business. It is understood that the larger interests are favoring higher prices. There has been no change in the bank situation, except that money rates have worked lower, especially for time funds, with liberal offerings. The indications are that if there is any turn, it will be for an easier market.

Dividends have been declared upon the following electrical securities: Regular semi-annual dividend of $4 per share on the capital stock of the Electric Light and Power Company, of Abington and Rockland, payable January 1 to stock of record December 21. Massachusetts Electric Companies' trustees have voted to resume the dividends on the $20,557,400 preferred stock by a declaration of a dividend of one per cent. The last regular semi-annual dividend on the preferred was paid January 1, 1905. Puget Sound Electric Railway; semi-annual dividend of $3 on the preferred stock, payable January 1 to stock of record December 15. Consolidated Gas Company, of New York; quarterly dividend of one per cent, payable December 15. Chicago Telephone Company; quarterly dividend of two per cent, payable December 31 to holders of record December 23. Mackay Companies; quarterly dividends of one cent on the common and preferred stocks, payable January 2 to holders of record December 12. Michigan State Telephone Company; quarterly dividends of one per cent on the common, payable December 1, and one-and-one-half per cent on the preferred stock, payable February 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED NOVEMBER 28.

New York:	*Closing.*
Allis-Chalmers common	14⅝
Allis-Chalmers preferred	48½
Brooklyn Rapid Transit	55¼
Consolidated Gas	162½
General Electric	158¾
Interborough-Metropolitan common	14½
Interborough-Metropolitan preferred	35⅛
Kings County Electric	128
Mackay Companies (Postal Telegraph and Cables) common	75¾
Mackay Companies (Postal Telegraph and Cables) preferred	71
Manhattan Elevated	146¼
Metropolitan Street Railway	30
New York & New Jersey Telephone	121
Western Union	71½
Westinghouse Manufacturing Company	91¼

Application has been made to the New York Stock Exchange by the Interborough Rapid Transit Company to list $25,000,000 three-year convertible six per cent notes.

The Consolidated Gas Company announces that more than $13,000,000 of the $20,000,000 outstanding six per cent convertible bonds have been turned in and exchanged for stock.

Current earnings of the Western Union Telegraph Company are reported by official sources as steadily improving, and the figures for the quarter ending December 30 are expected to considerably exceed the last two quarters and the normal earnings of the same period prior to the year 1907. The increase in gross revenue has been seconded by economies in operation and maintenance and has produced a large increase in net.

The New York & New Jersey Telephone Company will offer to stockholders $5,047,000 new stock in the ratio of one share of new for each five of old. The right to subscribe expires January 16, 1909, on which date a payment of fifty per cent must be made. The other fifty per cent is divided into two equal payments on April 6 and July 16, 1909. Right to subscribe accrues to stock of record December 1.

Boston:	*Closing.*
American Telephone and Telegraph	130¾
Edison Electric Illuminating	250
Massachusetts Electric	60
New England Telephone	124½
Western Telephone and Telegraph pref.	75
Philadelphia:	*Closing.*
Electric Company of America	10½
Electric Storage Battery common	43
Electric Storage Battery preferred	43
Philadelphia Electric	11½
Philadelphia Rapid Transit	22⅞
United Gas Improvement	93⅞

November earnings of the Philadelphia Rapid Transit Company, while not as good as those of October, which showed $85,000 increase in gross over last October, are very satisfactory, and will show a large increase over November, 1907. No action has been taken in regard to a new director to succeed George H. Earle.

Chicago:	*Closing.*
Chicago Telephone	129
Commonwealth Edison	104¾
Metropolitan Elevated preferred	42
National Carbon common	80
National Carbon preferred	112

It is announced that Chicago Telephone bonds to the amount of $1,000,000 will be offered to the public.

INDUSTRIAL ITEMS.

THE CAMPBELL-STAGG COMPANY, New York, calls attention by a useful blotter to its "Star" bushings for conduit, which are obtainable at all supply houses.

THE WARNER ARC LAMP COMPANY is erecting a factory at Wilton, Iowa, which when completed will provide employment for more than one hundred men. The plant will have a capacity of 125 finished lamps per day.

WICKES BROTHERS, Saginaw, Mich., machinery manufacturers and dealers, have issued their monthly stock list, dated November 15, listing boilers, engines, dynamos, motors and machinery in stock at their sales warehouses at Saginaw, Pittsburg, New York and Jersey City.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, manufacturer of automatic telephone apparatus, directed the attention of visitors to the Independent Telephone Convention, held at the Auditorium Hotel, Chicago, this week, to its exhibit in Rooms 614 and 616, where some of its latest automatic products were shown.

L'ARGUS DE LA PRESSE, Paris, whose offices were destroyed by fire January 15, announces that it has been completely reorganized and that its documents, collections and special services have been re-established and improved. The new address of the publication is Faubourg Montmartre, 37 Rue Bergere, Paris.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, 184 Lake Street, Chicago, is making a specialty of the "Wizard" massage vibrator. The vibrator weighs one and one-fourth pounds, and operates on both alternating and direct current. It is supplied with an aluminum case, maple handle, green silk conductor cord, scalp, face and body applicators and a small leatherette-covered case.

THE DURANT ELECTRIC SUPPLIES COMPANY, 60 Fifth Avenue, Chicago, will send prices and samples of Ironite duplex drop wire upon application. Ironite is declared to be flexible and as easily handled as soft-drawn copper. It will not sag or stretch, and linemen can pull all the slack out of the line without fear of breaking the conductor.

THE HOLOPHANE COMPANY, New York city, in the November issue of *Holophane Illumination* gives considerable attention to the subject of good lighting in factories. A couple of interesting illustrations are shown of the use of the Holophane-D'Olier metal reflectors, throwing the light just where the workman needs it, and eliminating errors due to bad lighting.

THE GENERAL ELECTRIC COMPANY'S incandescent lamp works at Fort Wayne, Ind., will increase its output fifty per cent, which will mean 130,000 lamps a week. Superintendent H. K. Jones recently returned from a meeting of superintendents held at Harrison, N. J., with instructions to increase the output of the Fort Wayne plant. This will require some additional facilities as well as an increased force of men.

THE GRANT FLAMING LAMP COMPANY, 239 Railway Exchange Building, Chicago, district agent for the Grant flaming-arc lamp manufactured by the German-American Electric Company, New York city, has issued a descriptive folder and price list of lamps and carbons. The Grant lamp is manufactured in two standard types burning ten and seventeen hours, respectively, and its design is believed to present several advantages in operation and efficiency.

THE WESTERN ELECTRIC COMPANY, New York and Chicago, tells in booklet form what it is doing to increase the central-station load. In the past year of depression the company has prosecuted a sales campaign for electrical apparatus and supplies more vigorously than ever before and has met with a gratifying response. A large and important factor of this sales campaign has been advertising in the technical press, trade papers and popular magazines, advocating electric motor drive and electric illumination. The company's business has already been largely stimulated, and in consequence of the greater use of apparatus and supplies, the business of the central station has been correspondingly increased. The pages of the booklet are taken up with some illustrations of Western Electric advertisements that have appeared.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., is distributing the initial number of *Motor Talks*, a monthly house organ whose December issue is seasonably concerned "chiefly about Christmas." The company has prepared a suitable box, covered with holly paper and tied with red ribbon, to contain the electric motors for driving sewing machines and mechanical washing outfits, which it recommends as useful and appreciated gifts.

THE NERNST LAMP COMPANY, Pittsburg, Pa., announces that an order has been received for three-glower lamps to replace the six-glower Nernst lamps in the corridors of the Frick Building, Pittsburg. Nernst lamps have been used in this building for the last five years, and the new lamps will give the same amount of light as the old at a saving of twenty-five per cent in the current consumption. They have the added advantage of simplified renewal at a material reduction in cost.

THE CENTRAL ELECTRIC COMPANY, Chicago, is distributing a fifteen-page circular describing "O. K." fuse-block covers and meter-connection blocks. Thirty-six diagrams illustrate the methods of connecting and testing house meters without interruption to the service. The booklet is entitled "Theft of Current," and it is believed that the use of these connection blocks will effect a very considerable decrease in unaccounted-for current at central stations. A copy of this booklet will be sent upon request.

THE INTERNATIONAL ACHESON GRAPHITE COMPANY, Niagara Falls, N. Y., responding to a very general demand for Acheson graphite, grade 1340, combined with grease, for lubricating purposes, is now supplying several combination lubricants of unusual merit. The purity and smoothness of this product have won for it the highest appreciation as a lubricant. All who have used it are believed to realize that it is free from the impurities of natural graphites, finding this electric furnace product of great benefit in general lubrication.

JAMES BIGGS & COMPANY, 109 Liberty Street, New York city, announce that the Blackburn-Smith feed-water filter and grease extractor has been chosen for the new colliers—Mars, Hector and Vulcan—now being built for the United States Navy by the Maryland Steel Company. The filters are to be placed in the feed lines, securing the double filtration characteristic of the Blackburn-Smith apparatus. These filters are also used for protecting the boilers of stationary plants from floating particles of oil, grease, mud, etc., in the feed water. The manufacturers are distributing an interesting booklet on the subject of feed-water filtration.

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., devotes bulletin No. 56 to direct-current motors for driving sewing machines. The motor is so arranged that pressure on the treadle operates a lever which closes the switch and starts the motor. Further pressure engages the friction wheels of the transmitter and the degree of pressure regulates the friction between the wheels so that by varying the pressure on the treadle any desired speed may be obtained from a single stitch to the full speed of the machine. When the treadle is released a spring attached to the lever disengages the friction wheels, opens the switch and applies the brake.

THE GENERAL INCANDESCENT LAMP COMPANY, Cleveland, Ohio, has moved its general office from the factory at 1811 East Forty-fifth Street to Suite 202-208 Electric Building, Cleveland. Larger quarters were necessary, the company announces, in order to handle the greatly increased volume of business which it has secured since the introduction of the G. I. tungsten lamp. The General Incandescent Lamp Company is one of the oldest of its kind in the United States. It manufactures a full line of carbon, Gem and high-efficiency lamps, including miniature and low-voltage, both tantalum and tungsten lamps, for all voltages and conditions. It also has a special department where any special type of lamp can be promptly manufactured, and solicits this class of business.

THE PETTINGELL-ANDREWS COMPANY, Boston, Mass., dealers in electrical merchandise, is anticipating the holiday season in mailing copies of a handsome little descriptive booklet on Empire miniature lamps. These specialties are particularly useful for decorative purposes at Christmas time or for hotels, public buildings or house decoration at any season of the year. The lamps catalogued include almost every conceivable shape and style of globe and are made in a variety of colors and frostings. Some popular shapes include those designated as twist-flame, festoon, torpedo, candle, limousine and dome, besides a number of special lamps for surgical, instrument and other uses.

THE BOSTON INCANDESCENT LAMP COMPANY, Danvers, Mass., announces that in its page advertisement which appeared in the issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for November 21, an error was made in stating that the lamps mentioned were made in candlepowers from four to fifteen. The company is anxious to have this error corrected, because the majority of the lamps sold are of sixteen candlepower, and at the reduced price at which the lamps are marketed the assumption might be made that only four to fifteen candlepower lamps were advertised, not including sixteen-candlepower lamps. The copy furnished by the Boston Incandescent Lamp Company read "four to sixteen candlepower," and the advertisement as it appeared was incorrect because of a typographical error.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., is equipping the large textile mill of the Windham Manufacturing Company with electric drive. A complete electric power plant, including motors, transformers and switchboards, has just been shipped to the mills at Willimantic, Conn. The equipment consists of nine 550-volt squirrel-cage induction motors aggregating about 500 horsepower, which will be used to drive the machinery in the mill. The generating equipment consists of two 500-kilovolt-ampere generators. Sixty-cycle, three-phase current will be generated at 600 volts and transformed to 110 volts for lighting. The motors are all arranged for ceiling suspension. The transformers for the lighting system and the switchboard were also furnished by the Crocker-Wheeler Company.

THE BUREAU OF ILLUMINATING ENGINEERING, 437 Fifth Avenue, New York city, announces that it is prepared to carry out the work usually alloted to the illuminating engineering of commercial departments of central stations where the amount or character of the work will not permit the company's own engineers to undertake it, and the Bureau will also act as consulting engineer for companies maintaining these departments where advanced information is desirable. Unique contracts are being made in these connections, permitting a central-station company to submit a stipulated number of lighting problems over a stated period of time. In addition to engineering duties, the Bureau designs globes and reflectors, lighting fixtures, and outline, display and decorative lighting effects. Photometric and illuminometer tests are also made, and the Bureau oversees acceptance and performance tests on all characters of artificial illuminants and accessories. Major E. L. Zalinski, U. S. A. (retired), is president of the Bureau, and Albert J. Marshall, chief engineer.

PUBLICATIONS.

THE ELECTRICAL INDUSTRY OF PERU—Vol. II of the descriptive treatise on the electrical industry of Peru, by Emile Guarini, has been published. This covers the possibilities of electrical development in that country and the electrical service established at Lima and its environs. The price of the publication, which is in Spanish, is three sols, and it may be had from the Electrical Section de la Escuela Nacional de Artes y Oficios, Lima, Peru.

UNITED STATES PATENT OFFICE GAZETTE—Commencing with Volume 138, January, 1909, the Official Gazette of the United States Patent Office will be published in monthly instead of bi-monthly volumes. The yearly subscription price, $5, will remain unchanged, but the price of single volumes, unbound, will be fifty cents. Indexes, digests, and title pages for each volume will be furnished regular subscribers and purchasers of unbound volumes. The price of bound volumes will be $2.50.

WIRE INSPECTION BUREAU HANDBOOK—The Wire Inspection Bureau Handbook for November, 1908, issued by the Wire Inspection Bureau, 29 West Thirty-ninth Street, New York city, describes manufacturers' tests for rubber-covered wire and flexible cord. A list of the companies employing the Wire Inspection Bureau to make, supervise and verify tests on wire and flexible cord is given, with a sample of the Bureau's stamp, the presence of which indicates that the wire has successfully withstood the test prescribed.

NEW MANUFACTURING COMPANIES.

MINNEAPOLIS, MINN.—The Minneapolis Electric Motor Company has been incorporated with a capital stock of $50,000, to manufacture and deal in electrical supplies, machinery and fixtures. Walter H. Vilett, John W. Helm and John M. Zeessman are the incorporators.

ALBANY, N. Y.—A certificate of incorporation of the Bell Arc Light Company of Brooklyn has been filed with the secretary of state. The capital is $100,000, and the directors are Charles A. Campbell and Henry W. Van Alen of Brooklyn, and Monroe May of New York city.

NEW YORK, N. Y.—The Tesla Electrotherapeutic Company, of New York, has been incorporated to manufacture and deal in electro-hygienic and electrotherapeutic apparatus. Its capital is $400,000 and the incorporators are: Archibald M. Langford, Morton G. Bogue and Ward W. Pickard, all of New York.

DATES AHEAD.

American Roentgen Ray Society. Annual meeting, New York city, December 28-30.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

American Association for the Advancement of Science. Annual meeting, Baltimore, Md., January, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) November 24, 1908.

904,522. CABLE CONNECTOR. John D. Firmin, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed August 20, 1906. A coupler has two threaded counterpart terminal members with threaded interfitting projections and clamping sleeve screwed over the extensions.

904,524. ELECERIC-LIGHTING DEVICE. Joshua T. Fisk, Rochester, N. Y., assignor to Metal Specialties Manufacturing Company, Chicago, Ill. Filed October 28, 1907. An electrical cigar lighter is provided with a receptacle and a convolute resistance wire mounted in the same.

904,525 and 904,526. OVERHEAD ELECTRIC RAILWAY. Francis M. Frederick, St. Louis, Mo., assignor to Francis T. Moormann, Charles H. Poth, Thomas B. Poth and Frank J. Vollmer, St. Louis, Mo. Filed November 4, 1907. Comprises an elevated track rail, a motor-driven truck operating thereon, a car suspended from the truck and compressed-air means carried by the car for raising or lowering it.

904,529. ELECTRIC FURNACE MUFFLE. John F. Hammond, Prince Bay, N. Y., and Ralph B. Savin, Philadelphia, Pa., assignors to the S. S. White Dental Manufacturing Company, Philadelphia, Pa. Filed February 27, 1908. Consists of a hollow electrically wired inner member, a hollow outer member and a plug fitting in the rear end of the latter.

904,532. ARC-LAMP ELECTRODE. Henry S. Hatfield and Frank M. Lewis, Brighton, England. Filed July 31, 1908. Composed of some eight parts of calcium fluoride, five parts of carborundum, and carbon.

904,540. PROCESS OF ELECTRIC WELDING. Laurence S. Lachman, New York, N. Y., assignor to Standard Pulley Manufacturing Company. Filed March 24, 1905. A process for uniting metal sheets by a number of autogenous spot welds at projections integral with the sheets.

904,541. DEVICE TO PREVENT TROLLEY WHEELS FROM JUMPING. William O. Lane, Cleveland, Ohio. Filed March 12, 1908. A pair of spaced guide arms is arranged to be connected to the pole and held in advance thereof.

904,550. AUTOMATIC FIRE-ALARM, BURGLAR-ALARM AND TELEPHONE SYSTEM. George F. Milliken, Boston, and Frederick W. Cole, Newton, Mass., assignors to Gamewell Fire-Alarm Telegraph Company, New York, N. Y. Filed October 16, 1905. A normally closed circuit connects the central station with subscribers' stations provided with telephone equipment and alarm-transmitting devices.

904,583. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed February 28, 1903. Relates to a supervisory relay associated with the cord circuit.

904,592. ELECTRICAL CONDUCTOR SUPPORT. John S. Allen, Los Angeles, Cal. Filed March 22, 1906. A double petticoat insulator is suspended from a cross-arm and carries the conductor beneath it.

904,603. CONNECTOR. Clarence T. Crocker, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed August 31, 1906. A coupler for cables comprises terminal members having interfitting extensions and a pair of sleeves for clamping them together.

904,609. ELECTRIC INCANDESCENT LAMP. Frederic W. Erickson, New York, N. Y. Filed January 28, 1908. A light diffuser consists of a lamp having a plain globe, a casing about the same made of two interlocking parts, one a reflector and the other of colored glass.

904,616. STARTING MECHANISM FOR INTERNAL-COMBUSTION ENGINES. Henry C. L. Holden, Blackheath, and George K. B. Elphinstone, Lewisham, England. Filed October 28, 1907. Means for insuring that the mechanism used for giving a few turns to the crankshaft can only be brought into action when the sparking circuit is broken.

904,624 and 904,625. DEVICE FOR REVERSING THE DIRECTION OF ROTATION OF INTERNAL-COMBUSTION ENGINES. Leon Le Pontois, New Rochelle, N. Y. Filed August 2, 1907. An electrical ignition governor has an ignition circuit, one of whose electrodes is operated by an air-pump piston.

904,632. VIBRATORY APPARATUS FOR EAR TREATMENT. Eugene Meyer, New York, N. Y. Filed February 2, 1908. A vibratory hammer lever is provided with an armature actuated by an electromagnet.

904,640. ARC LAMP FOR STEREOPTICONS, ETC. Herbert F. Patton, Cleveland, Ohio. Filed May 13, 1907. Comprises means adapted to support two carbons at right angles.

904,645. BATTERY GRID. Franklin W. Post and Archie M. Morley, Los Angeles, Cal. Filed August 21, 1906. A storage-battery grid has opposite sets of spaced ribs disposed in parallel planes.

904,661. CIRCUIT-CLOSING RELAY. Jean F. Webb, Jr., Denver, Colo., assignor to the Electric Signagraph and Semaphore Company, New York, N. Y. Filed May 12, 1908. Two supporting frames for the magnets and armature respectively are arranged to be connected to a local circuit.

904,663. MANUFACTURE OF RAIL BONDS. Walter H. Williams, Mansfield, Ohio. Filed November 14, 1906. A stranded terminal member is made by separating the strands to form an aperture, then inserting one end into this and compressing the whole into a solid mass.

904,677. ELECTRIC-CURRENT BATHING TUB. Friedrich Braun, Dresden, Germany. Filed December 4, 1907. This tub has electrodes at its ends and an insulating partition across the tub and adapted to support the knees of the bather with the feet in one compartment and the body in another.

904,684. METHOD OF ELIMINATING COPPER FROM COAGULATED CELLULOSE. Emile Crumière, Paris, France. Filed February 19, 1908. Consists in passing a current through a solvent in which the cellulose is immersed so as to dissolve the copper and deposit it on a cathode.

904,693. SYNCHRONOUS SPEED INDICATOR. Arthur E. Griffin, Winthrop, Mass., assignor to Sears B. Condit, Jr., Boston, Mass. Filed March 13, 1905. An induction motor has a make-and-break device mounted thereon and operated by its rotor, and an indicator energized by alternating current and by induced current from the make-and-break device.

904,728. ELECTRIC-LAMP RECEPTACLE FOR ELECTRIC SIGNS. Frederick W. Ruby, Jackson, Mich. Filed March 20, 1908. The front edge of the socket is supported flush with the sign surface by two sleeves threaded over the socket.

904,741. ELECTRICALLY OPERATED SEMAPHORE MECHANISM. Jean F. Webb, Jr., Denver, Colo., assignor to the Electric Signagraph and Semaphore Company, New York, N. Y. Filed May 12, 1908. A motor drives a gear carried by the semaphore shaft.

904,743. ELECTRICAL PRINTING APPARATUS. Milton T. Weston, Orange, N. J. Filed September 25, 1901. Contains a number of electromagnetically controlled trip devices.

904,765. SYSTEM OF CONTROL FOR ELECTRIC MOTORS. Arthur C. Eastwood, Cleveland, Ohio. Filed May 9, 1908. There is a manually controlled resistance in series with the main motor circuit and a second resistance automatically cut out when the current in the motor is below a certain value.

904,768. TELEGRAPH SYSTEM. Stephen D. Field, Stockbridge, Mass. Filed December 1, 1906. An electromotive force counter to that of the line current is impressed on the line at the instant when the circuit is open to form the signals.

904,771. ELECTRIC WELDING MACHINE. Weston M. Fulton, Knoxville, Tenn., assignor to the Fulton Company, Knoxville, Tenn. Filed February 7, 1906. Consists of a number of yieldingly pressed rotatable electrodes for welding lapped seams.

904,776. SYSTEM OF ELECTRIC DISTRIBUTION. Caryl D. Haskins, Schenectady, N. Y., assignor to General Electric Company. Filed September 26, 1904. The rotor of a motor meter controls an electromagnet for periodically opening and closing the line switch.

904,780. SYSTEM OF CONTROL. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. Filed March 23, 1907. Comprises a controller for alternating-current operation, a controller for direct-current operation and a master controller for governing both the controllers.

904,782. ROTARY CONVERTER FOR ELECTRIC WELDING. Arthur M. Hoffman, Johnstown, Pa. Filed December 23, 1907. A device for converting direct into alternating current consists of a commutating and resistance-controlling rotor.

904,783. INDICATING AND RECORDING INSTRUMENT. William F. Howe, Schenectady, N. Y., assignor to General Electric Company. Filed September 17, 1907. A motor meter has current and potential coils, a disk armature for the coils, a damping magnet and a pivoted sheet-metal indicating armature mounted in the field of the coils and of the magnet.

904,786. CIRCUIT CLOSER FOR FIRE-ALARM CIRCUITS. William W. Katterjohn, Henderson, Ky. Filed May 20, 1908. A spring connected to the circuit closer and adapted to close the same upon retraction is held in extended position by two series of oppositely placed eyes and cords.

904,788 and 904,789. AUTOMATIC CARRIER SYSTEM. Sam H. Libby, East Orange, N. J., assignor to Sprague Electric Company. Filed March 12, 1906. An electrically operated traveling carrier system is automatically controlled from the loading stations to the unloading stations.

904,794. GENERATION, CONTROL AND TRANSMISSION OF ELECTRIC ENERGY, PARTICULARLY FOR USE ON AUTOMOBILES AND LIKE VEHICLES. Albert H. Midgley, London, England. Filed February 26, 1908. The engine drives a dynamo having two armatures, one of which supplies current to the propelling motor.

904,801. CURRENT-COLLECTING APPARATUS FOR DYNAMO-ELECTRIC MACHINES. Jakob E. Noeggerath, Schenectady, N. Y., assignor to General Electric Company. Filed October 10, 1906. A laminated brush is pressed against the collector by a U-shaped spring on the brush holder.

904,808. INSULATING MATERIAL. George H. Rupley, Schenectady, N. Y., assignor to General Electric Company. Filed August 7, 1907. Is made from a fabric impregnated with a soft, pliable, non-adhesive material and coated with linseed-oil varnish.

904,810. DISTANCE CONTROL APPARATUS FOR TRANSLATING DEVICES. Ernest Schattner, London, England, assignor to General Electric Company. Filed August 6, 1906. A multiple-rate meter connected to a supply circuit has means responsive to currents of different frequency and arranged to set the meter to register at corresponding rates.

904,821. SHADE HOLDER FOR INCANDESCENT ELECTRIC LAMPS. John Weber, Schenectady, N. Y., assignor to August Weber, Sr., Schenectady, N. Y. Filed July 21, 1905. Is provided with telescopically engaging members adapted to interlock automatically with a snap action.

904,826. LAMP REDUCER. Charles Wirt, Philadelphia, Pa., assignor to Charles Wirt and Company, Newark, N. J. Filed March 18, 1907. A turn-down lamp socket has a rotary rheostat ring surrounding it.

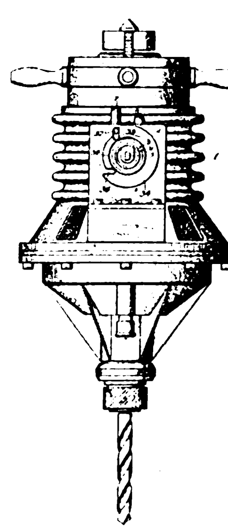
904,831. PROCESS OF MAKING HOMOGENEOUS BODIES FROM TANTALUM METAL OR OTHER REFRACTORY METALS. Werner von Bolton, Charlottenburg, Germany, assignor to Siemens & Halske Aktiengesellschaft, Berlin, Germany. Filed January 5, 1904. Consists in uniting the powdered metal into a coherent mass, then heating this to the melting point by means of an electric current.

904,832. ELECTRICAL FUSE PLUG. Harold E. Bradley, Greenwood, R. I., assignor to Marion C. Happoldt, Providence, R. I. Filed January 3, 1908. A cap engages and can be locked to the casing that receives the fuse.

904,834. ELECTRIC RAILWAY SIGNALING SYSTEM. Yorke Burgess, Washington, D. C. Filed December 7, 1907. Line conductors are formed in sections, each having portions in different planes.

904,850. TELEPHONE SYSTEM. Francis W. Dunbar, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed May 9, 1904. Describes a polarized line-signaling device connected to the line at the central office.

904,851. CONTROLLER FOR ELECTRIC DRILLS. William O. Duntley, Chicago, Ill., and Henry J. Kimman, Cleveland, Ohio, assignors to Chicago Pneumatic Tool Company, Chicago, Ill. Filed January 22, 1906. The drill is provided with grasping handles, a main switch arranged adjacent one of them, a reversing switch and a sleeve concentric with the handle for operating the latter switch.



904,851.—CONTROLLER FOR ELECTRIC DRILL.

904,871. ELECTROMAGNET. George W. Henry, New York, N. Y., assignor to Henderson P. Childress and John L. Lequin, New York, N. Y. Filed July 31, 1907. A magnet has an armature and a lever with a rocking fulcrum bearing and pivotal connection with the armature.

904,877. TROLLEY FOR CARS. John Kaufman, Hazleton, Pa., assignor to H. H. Shellenberger, Easton, Pa. Filed June 5, 1908. Mounted on a trolley pole is a two-part head hinged together on a vertical axis and a contact wheel journaled on the outer end of each part.

904,881 and 904,882. PROCESS OF ELECTRIC WELDING. Laurence S. Lachman, New York, N. Y. Filed May 8, 1907. Renewed April 23 and 27, 1908. The process of uniting two bodies of metals by a spot weld consists in providing at least one of the bodies with a perforation, placing them together and passing a current through them in the region surrounding the perforation.

904,887. VOLTAGE REGULATOR FOR DYNAMO-ELECTRIC MACHINES. George S. Neeley, St. Louis, Mo. Filed November 30, 1906. An alternator has an exciter and means for regulating the field resistance of the latter.

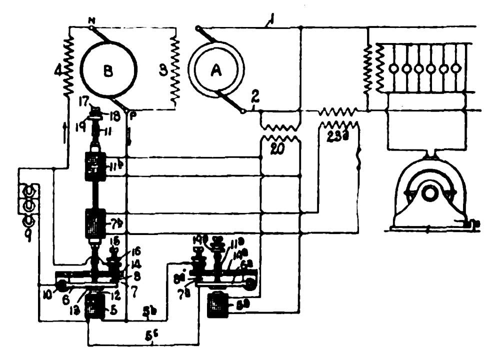
904,889. ALARM DEVICE FOR FIRE-ALARM BOXES. Joshua B. Nicholson and Artemus R. Warfield, Washington, D. C. Filed June 30, 1908. An electric bell adjacent the box is rung when the alarm circuit is closed.

904,890. BRAKE MECHANISM. Frederick H. Osborn, Garrison, N. Y. Filed February 4, 1908. An electrically controlled brake for a phonograph.

904,892. STREAM-POWER ELECTRIC FLOAT. William J. Pattosien, San Rafael, Cal. Filed December 17, 1907. A dynamo, having both field magnets and armature rotatable, is operated by two undershot waterwheels, one for the field magnets and the other for the armature.

904,894. DAMPER REGULATOR. William Roberts and Dellford H. Holloway, Waterford, N. Y., assignors to Charles W. Scoville, Cohoes, N. Y. Filed September 11, 1907. An electrically controlled damper-operating device.

904,897. ROTARY SWITCH. Frank J. Russell, New York, N. Y. Filed May 13, 1907. An electric switch is provided with a base having stationary contacts and rotatable switch plug stamped into rectangular form.

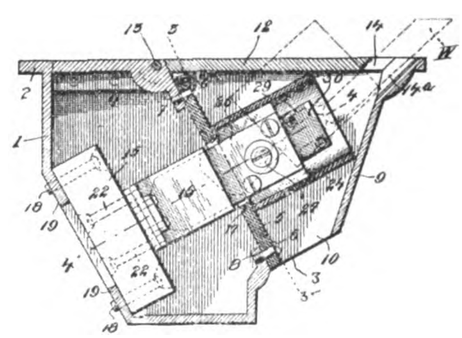


904,887.—VOLTAGE REGULATOR.

904,898. FLOOR-POCKET RECEPTACLE AND PLUG. Frank J. Russell, New York, N. Y. Filed June 7, 1907. A floor box has an inclined shield board which divides the box into separate compartments, a receptacle member in one compartment and a plug member arranged for insertion through the other compartment.

904,902. LINE INTERRUPTER FOR ELECTRIC RAILWAYS. Albert Thode, Hamburg, Germany. Filed July 8, 1908. An insulator has plates attached laterally to it that are adapted to raise a sliding bow from the latter when it passes under the line interrupter.

904,903. TELEPHONE ANNUNCIATOR AND JACK. Henry Tideman, Menominee, Mich. Filed July 6, 1907. A switchboard drop and jack.



904,898.—FLOOR RECEPTACLE.

904,906. DRUM CONTROLLER. Henry J. Wiegand, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Filed March 14, 1907. Combined with a number of reversing switches and resistance switches is a single drum provided with cams for actuating the switches.

904,917. CONDITION-CONTROLLING DEVICE. James I. Ayer, Cambridge, Mass., assignor to Simplex Electric Heating Company, Boston, Mass. Filed October 29, 1906. A pair of contacts is pivotally mounted in a support and a circuit-closing element is movable so as to engage either contact.

904,918. SIGNALING SYSTEM. Garrison Babcock, Rochester, N. Y., assignor to Merton E. Lewis, Rochester, N. Y. Filed May 31, 1906. An alarm system is equipped with substations consisting of a box, a break-wheel mechanism and telephone apparatus within the box.

904,925. SYSTEM OF ELECTRICAL DISTRIBUTION. William L. Bliss, New York, N. Y. Filed August 4, 1904. An axle car-lighting system.

904,928. ATTACHMENT FOR SAFETY FUSES. William J. Boemper, Rutherford, N. J., assignor of one-half to Harry A. Muecke, New York, N. Y. Filed October 4, 1907. A safety-fuse clip is provided with two pivotally connected curved arms.

904,936. TELEGRAPH REPEATER. Lewis B. Cecil, Santa Barbara, Cal. Filed February 25, 1908. Consists of a main-line and a branch-line relay.

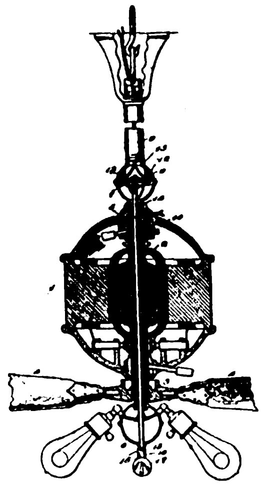
904,945. WIRE BRACKET OR HOLDER AND INSULATOR. Isaac L. Edwards, Aurora, Ill. Filed March 5, 1908. A box made of separable sections united by a joint has an insulator within it formed of separable sections.

904,952. COMBINATION TROLLEY AND TELEGRAPH POLE. James Hackett, Bellaire, Ohio. Filed August 14, 1908. The pole comprises stepped sections, a head carried by the upper one and having extensions for insulators and cable supports.

904,969. LIGHTNING ROD. George R. Kress, Pittsburg, Pa. Filed February 6, 1908. There is in combination a top section, a continuous line rod and a separate Y-shaped joint, connected to the section and rod.

904,971. AUTOMATIC RAILWAY ALARM. Niels Lang, Vancouver, British Columbia, Canada. Filed April 21, 1908. An electric circuit extends throughout the section of track to be protected, one end being connected to the rails and the other to a series of contact plates at intervals along the track.

904,979. HOLDING DEVICE FOR NEWSPAPERS. John K. Morris, Newhall, Cal. Filed May 8, 1908. A pair of jaws works with a rod having a wedge-shaped head on the opposite end and electrical means for ringing a bell when the rod is forced backward by a paper.



905,089.—CEILING FAN.

904,985. EMERGENCY VALVE. Oliver Penn, Pittsburg, Pa. Filed July 1, 1908. A pair of electromagnetic devices operates the valve.

904,991. PROCESS OF SMELTING METALLIC COMPOUNDS AND PRODUCING CARBIDES. Edgar F. Price, Niagara Falls, N. Y., assignor to Union Carbide Company, Niagara Falls, N. Y. Filed July 14, 1904. A process of making calcium carbide consists in preheating a calcium compound and carbon and then electrically heating the mixture.

904,999. BRAKE-SETTING MECHANISM. William A. Rideout, Sr., Oshkosh, Wis. Filed February 24, 1908. An electric circuit includes a magnet to release the valve lever.

905,014. FLEXIBLE SUSPENSION FOR CONDUCTORS. Louis Steinberger, New York, N. Y. Filed September 23, 1907. A cross-arm carries a collar and an insulating sleeve supporting a number of suspension-type insulators.

905,045. ELECTRIC HEATING DEVICE. James I. Ayer, Cambridge, and Horace B. Gale, Natick, Mass., assignors to Simplex Electric Heating Company, Cambridge, Mass. Filed June 13, 1908. The heating element consists of a heat-absorbing body provided with a series of grooves and a ribbon-like current conductor secured in them.

905,048. APPARATUS FOR THE EXTRACTION OF GOLD FROM CRUSHED ORES. Thomas E. Beaumont, London, England. Filed March 29, 1906. An amalgamator forming part of an electric circuit is placed in the base of a vessel in whose upper part is a series of annular electrode plates.

905,066. OUTLET BOX FOR ELECTRIC WIRES. John Fountain, Jr., Elizabeth, N. J., assignor to Sears B. Condit, Jr., Boston, Mass. Filed August 3, 1908. An outlet box has a transverse apertured connector mounted in its wall so as to turn freely in all directions.

905,089. CEILING FAN. Fred P. McBerty, Warren, Ohio, assignor to the Peerless Electric Company, Warren, Ohio. Filed November 20, 1907. Relates to the mounting of an electric motor-driven fan.

905,114. ELECTRIC TRACTION ELEVATOR. De Witt C. Suplee, Philadelphia, Pa., assignor to Suplee Elevator Company. Filed January 3, 1908. The arrangement of a motor-driven cable gear is described.

905,115. ELECTRICAL INTERRUPTER. Henry M. Sutton, Walter L. Steele and Edwin G. Steele, Dallas, Tex. Original application filed September 24, 1904. Divided and this application filed December 2, 1907. Comprises a number of rotatable slotted disks, terminals at the opposite sides thereof and means intermediate each terminal and disk for varying the charging period of the disk.

905,119. INCANDESCENT ILLUMINANT. Orlando M. Thowless, Newark, N. J., assignor to Herbert L. Thowless, Newark, N. J. Original application filed March 8, 1899. Divided and this application filed July 25, 1899. A glower for electric lamps, which is a non-conductor at normal temperatures, but which becomes conductive and incandescent under the action of the current when heated, consists of a mixture of zirconium, thorium and aluminum oxides.

905,126. PRINTING-TELEGRAPH RECEIVER. John Burry, Ridgefield Park, N. J.; Marie Burry executrix of said John Burry, deceased. Filed March 30, 1906. In combination with a lever and a type plate carried thereby, are a number of fulcrums for the lever and electrical means for oscillating the lever on any of the fulcrums.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired December 1, 1908:

464,001. TELEGRAPH REPEATER. R. L. Atkinson, Delaware Township, N. J.

464,005. TREATING FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS. J. Bradley, Massillon, Ohio.

464,025. POTENTIAL INDICATOR. C. E. Kammeyer, Eau Claire, Wis.

464,027. FIELD MAGNET FOR DYNAMOS OR MOTORS. C. E. Kammeyer, Eau Claire, Wis.

464,055. ELECTRIC HEATER. P. Wright, Denver, Colo.

464,063. ELECTRIC MOTOR. M. H. Collon, Denver, Colo.

464,090. ELECTRIC APPARATUS FOR USE ON RAILWAY TRAINS. R. A. Wilder, Cressona, Pa.

464,125. METHOD OF TESTING INSULATED WIRES. R. Varley, Jr., Englewood, N. J.

464,132. ELECTRIC ARC LAMP. Wm. A. Nicholson, New York, N. Y.

464,133. RELAY. R. Varley, Jr., Englewood, N. J.

464,134. ELECTRIC CIRCUIT CLOSER. R. Varley, Jr., Englewood, N. J.

464,136. ELECTRIC REGULATOR. C. W. Holtzer and G. E. Cabot, Brookline, Mass.

464,152. ELECTRIC TRANSMITTING TELEPHONE. R. Eickemeyer, Yonkers, N. Y.

464,156. ELECTRICAL GENERATOR. V. Hirbec, Paris, France.

464,198. ELECTROMAGNET. O. E. Lundstedt, Brooklyn, N. Y.

464,216. ARMATURE FOR DYNAMOS AND ELECTRIC MOTORS. St. John V. Day, St. Louis, Mo.

464,231. ELECTRIC MOTOR. J. R. Robinson, Salem, Mass.

464,244. ELECTRIC FIRE ENGINE. M. W. Dewey, Syracuse, N. Y.

464,245. ELECTRIC HOSE CARRIAGE. M. W. Dewey, Syracuse, N. Y.

464,246. ELECTRICALLY PROPELLED VEHICLE. M. W. Dewey, Syracuse, N. Y.

464,247. ELECTRIC HEATING APPARATUS. M. W. Dewey, Syracuse, N. Y.

464,248. ELECTRICALLY PROPELLED VEHICLE. M. W. Dewey, Syracuse, N. Y.

464,299. ELECTRIC MOTOR. H. A. Florian, Detroit, Mich.

464,347. MAGNETO-ELECTRIC IGNITER FOR COMBUSTIBLE-VAPOR ENGINES. L. G. Woolley, Grand Rapids, Mich.

464,470. ELECTRIC ELEVATOR. W. Baxter, Jr., Baltimore, Md.

464,475. JOINT FOR ELECTRIC CONDUCTORS. H. W. Fisher, Pittsburg, Pa.

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CONTENTS.

LOAD-FACTORS AND DIVERSITY-FACTORS.

Although several definitions have been put forward to explain the meaning of "load-factor" and "diversity-factor," the definitions introduced by Mr. Robert Hammond and also by Mr. Arthur Wright have been generally accepted.

Load-factor is the ratio of the average load, represented by actual sales to consumers, to the maximum load supplied to the feeders at the station, expressed as a percentage; that is to say, it is the number of units sold during the year times 100, divided by 365 times twenty-four times the maximum load.

It is thus evident that even if all the consumers had a steady twenty-four-hour load, the load-factor as thus defined could not be 100 per cent, for the average load represented by the number of units sold, divided by the proper denominator, includes the losses in distribution. This may be a considerable percentage, especially in the case of alternating-current transformer systems. Ambiguity sometimes occurs, because some engineers take the maximum load as the total maximum load on the bus-bars, including the power used on the works. Others take only the maximum load supplied to the feeders, which is conceded to be the more correct way. If the power used at the works is included, the load-factor will often come out at a much lower figure.

The diversity-factor is the ratio of the sum of the consumers' demands to the maximum demand on the feeders at the station bus-bars. It is thus always greater than unity, although there can be a hypothetical case in which the consumers' maximum demands might occur simultaneously, in which case the demand on the feeders would be greater, as it would include the distribution losses; so that, in this instance, the diversity-factor, in accordance with the accepted definition, would actually be somewhat below unity.

In calculating diversity-factor, the station auxiliaries and lighting may be regarded as a consumer if desired, in which case the ratio would be taken as the sum of the consumers' maximum demands and the maximum demand by the station auxiliaries and lighting to the maximum power delivered from the bus-bars, including the power used on the works.

This analysis of load-factors and diversity-factors formed the subject of Mr. W. W. Lackie's address as chairman before the Glasgow local section of the Institution of Electrical Engineers, of Great Britain, last month. Mr. Lackie is engineer-in-chief of the Glasgow Electricity Department. Aside from his very interesting analysis of the definitions and usages of these two terms, Mr. Lackie made a suggestion which provides a very generous portion of food for thought. In Glasgow, as in other large industrial centres, the power-station engineer finds the power load creeping up to, and often overtaking, the lighting load, as electricity becomes more generally used. The power load also is fairly steady, and the variation in total output follows almost directly the growth of the system. On the other hand, the lighting load varies considerably with the season, and also varies from day to day, according to the amount of sunlight which the vagaries of the weather make available. In Glasgow the lighting customers are charged at a flat rate for a maximum demand, and power customers are charged on a similar system, but at a lower rate. If a set of customers do not use their maximum demand, they do not pay all their standing charges, and are therefore a loss to the undertaking, notwithstanding the fact that throughout they have to pay a higher rate under a maximum-demand system. A consumer paying the maximum charge per unit may be an unprofitable consumer, while an industrial consumer paying a lower price per unit throughout for a long-hour power supply will make a solid contribution to the profits of the supply undertaking.

Mr. Lackie states that at present many companies and supply authorities in supplying energy for power purposes allow their consumers to use five or ten per cent, and in some cases twenty per cent, of their consumption for lighting, the whole being charged at power rates. If this is right, he considers we may look forward to a time when the total demand for lighting will be, say, only ten per cent of the total output, the other ninety per cent being used for power and heating purposes; and electrical energy used for lighting purposes will then be thrown in at a price corresponding to our charge for power today. The effect of the metallic-filament lamp helps on this idea by reducing the present demand and corresponding consumption of energy for lighting purposes; whereas we feel certain that no such vital change in the efficiency of motors can take place so as to reduce, in a similar manner, the demand made by our power consumers.

ELECTROBUS COSTS.

What appears to be a reasonably authentic summarization of operating costs and earnings of electrobuses has been made public by one of the companies operating a system of public electric carriers in London, England. When the London system was inaugurated about eighteen months ago, we raised a question as to whether profitable operation would be possible at the rate of fare charged, taking into consideration the heavy depreciation on all parts of the system and the high cost of current for electrical charging of the storage batteries.

From the reports of the auditors of the company operating the electrobuses, it appears that, contrary to general expectations, the service has become very popular, and that as the number of carriages has been increased, the revenue per carriage-mile has also increased. While for the first three months the earnings were considerably less than the cost of operation plus the overhead and establishment expenses, the revenue for the fifteen months ending last October was sufficient to pay operating costs, ulterior expenses, and leave a small profit.

TRANSPORTATION DEVELOPMENTS IN BOSTON.

The opening of the new Washington Street tunnel in Boston on Monday, November 30, marks a definite step forward in the working out of a comprehensive scheme of transportation for the larger community of which that city is the centre. Although the tunnel is but a little over a mile in length, it illustrates the latest ideas in the field of engineering design and construction, and in its relation to the existing elevated system of the city, it assumes a position of fundamental importance. In the past, the most densely populated shopping district of Boston has been well served by surface cars, and later by the nearness of the Tremont Street subway, but today the inauguration of travel in the new tunnel shortens the gap between the residential districts of the north and south and the retail centre and financial section to an extent only a citizen of the Hub can fully appreciate. The restoration of surface car traffic in the original subway will shortly be completed, and with the clear result that on its north and south axis Boston will be finely provided with facilities for real rapid transit.

The completion of the Forest Hills elevated extension and the pushing of the elevated lines into the Malden and Everett section will still further strengthen the situation, and with the East Boston tunnel, will furnish service of a high character radially into and out of Boston through an arc of about two hundred and seventy degrees. Already active plans are under way for the building of a subway to Harvard Square, Cambridge, with a rapid transit extension in the near future to East Cambridge, and a little farther in the future, the building of a subway under the South Embankment of the Charles River for the special service of the directly western suburban territory. Thus, there appears to be work enough ahead to keep both the Boston Elevated Railway Company and the Boston Transit Commission busy for some years to come. Although facilities are often outrun by traffic in these days of urban expansion, each new route opened affords a considerable measure of relief, and the people of Boston are to be congratulated on this latest addition to their underground lines, which avoids the features which experience has shown undesirable in the earlier subway construction and sets a standard toward which future workers may well look in their efforts to develop high speed underground travel according to the most advanced resources of engineering.

THE TRAINING OF WORKMEN.

It is not long since Mr. F. W. Taylor, in his classic paper before a meeting of the American Society of Mechanical Engineers, outlined a system of training and rewarding workmen which attracted the greatest attention from shop managers and educators in general. The optimism with which Mr. Taylor developed and presented his ideas had the hearty support of that master mind, Dr. Robert H. Thurston, but those in charge of large organizations of workmen were skeptical, and there have been few actual trials of the system outlined. It can be stated as a fact, however, that this system, in connection with the other work of Mr. Taylor, has so greately increased the output and reduced the cost of work in the large machine shop of the Bethlehem Steel Company that for the past seven years

Mr. H. L. Gantt has given a large portion of his time to the development of its possibilities. In an address before the recent New York meeting of the American Society of Mechanical Engineers, Mr. Gantt made the statement that the results have far exceeded his expectations.

Under the system outlined by Mr. Taylor, each man has his work assigned to him in the form of a task to be done by a prescribed method with definite appliances, and to be completed within a certain time. The task is based on a detailed investigation by a trained expert of the best methods of doing the work. The task-setter or his assistant acts as an instructor to teach the workman to do the work in the manner and in the time specified. If the work is done within the time allowed by the expert, and is up to the standard for quality, the workman receives extra compensation in addition to his day's pay. If it is not done in the time set, or is not up to the standard of quality, the workman receives his day's pay only.

Mr. Gantt holds that people, as a rule, prefer to work at the speed and in the manner to which they have been accustomed, but are usually willing to work at any reasonable speed and in any reasonable manner if sufficient inducement is offered for so doing, and if they are so trained as to be able to earn the reward. The task and bonus method of training not only furnishes the workman with the required knowledge, due to the assistance from trained and expert instructors, but, by offering an inducement to utilize the knowledge properly, the workman is trained in the proper habits of work.

Habits of work in a mechanic are comparable with habits of thought in an engineer. Our industrial schools should make proper habits of work the basis on which to build their training in manual dexterity. The engineering school does not make engineers, but tries to furnish its graduates with an equipment that will enable them to utilize readily and rapidly their own experience and that of others.

Under the task system, workmen are taught how, and trained to do, at the same time. Knowing and doing are thus closely associated. Many skilled workmen make their skill an excuse for slow work, and unless, when they are taught how to do, they are also taught to do efficiently, they never attain the success which should be theirs and thus continually fall short of the economic ideal which shop management might attain to.

So it is evident from Mr. Gantt's experience that there is an economical as well as a humanitarian advantage in striving to bring out and make the greatest use of the best characteristics of the workman. The ordinary workman becomes a gang foreman, then a general foreman and a shop superintendent, because for his ability he stands out above all others. If, in his progress upward, there have been developed in him the proper habits of thought and a passion for doing his work efficiently, the greatest possible gain has been made both for trade and for posterity. One of the most satisfactory evidences of the value of Mr. Gantt's work and his paper describing it was the enthusiastic commendation which was accorded him at the conclusion of his address by the foremost engineers of the day in attendance at the convention.

CANDLEPOWER—FLUX—ILLUMINATION.

The standard candle adopted by the gas referees in London in the year 1860 as the unit of light will continue, with slight modifications, to be the standard of intensity. As a rating for modern light source candlepower of itself has little value, owing to the fact that lamps are rated at the angle of maximum intensity and the angle varies through ninety degrees even in lamps which can be used for similar purposes. For example: The maximum intensity of the majority of incandescent lamps is in the horizontal direction, while the maximum for the downward type of incandescent and the Nernst glower are directly underneath. In the larger units the enclosed arc varies considerably below the horizontal, while the flaming type have characteristics similar to the downward filament and Nernst types. Instead of the maximum intensity the average intensity has been suggested as a rating.

The unit of flux is the mean spherical candlepower multiplied by four, or the "lumens generated." Some authorities have given mean spherical candlepower as the unit of flux, but in the calculation of illumination the "lumens generated" is held to be the more convenient term. The mean spherical candlepower can be readily determined from the polar diagram, and photometers are now available by means of which this value may be obtained with a single reading. There is a variable of considerable importance which is not taken account of with this rating and that lies in the fact that the losses by reflection will be smaller in the case of lamps giving the larger percentage of the total flux below the horizontal.

The unit of illumination is the foot-candle and not candle feet, as the value is sometimes erroneously stated. The efficiency is expressed in the "lumens effective" (watts per square foot per foot-candle). The last named will vary widely with various colors of ceilings and walls, but under the same conditions the ratio of efficiency as represented by the percentage of lumens which are effective as against lumens generated will be in favor of the unit giving the larger flux in the lower hemisphere.

AN ELECTRIC YACHT CHARGING TENDER.

One of the enterprising yachtsmen of the New York Yacht Club has had built for use as an auxiliary to his electric yacht an electric charging launch, which has been named the Kilowatt. This makes the electric launch independent of short charging stations, and, it is stated, gives the yacht a radius of action practically unlimited. The auxiliary carries 400 gallons of gasoline, enabling her to be operated at full power for 100 hours, during which time she can recharge the batteries aboard the electric yacht ten or twelve times, giving a sailing distance of somewhat over 2,000 miles.

The pleasures of a yacht depending upon electric motive power are well known, and attention need hardly be directed again to the advantages of the elimination of smoke and cinders, the lessened possibility of explosion and conflagration, and the doing away with malodorous fumes and gases. The gasoline tender, it is believed, solves the question of the use of electricity in large motor yachts.

Electric Yacht with Charging Tender.

A gasolene and electric charging launch has recently been built by the Electric Launch Company which is to be used in southern waters as an auxiliary to the electric yacht Cascapedia, owned by Benjamin Douglass, Jr. The launch is named Kilowatt and is thirty-five feet long, nine feet beam and two feet draft.

The boat's power equipment consists of a forty-horsepower, six-cylinder gasolene engine, with mechanical reverse-gear connected to the propeller shaft, the engine driving a thirty-horsepower dynamo which is directly connected to the forward end of the engine. It is so arranged that electricity can be generated when the boat is under way or while lying at anchor. A slate switchboard located on the port side of the cabin, with the necessary instruments and switches, distributes the power to the electric yacht for recharging the batteries. The plant has a capacity for recharging the yacht's batteries in three or four hours.

With the Kilowatt as an auxiliary the electric yacht Cascapedia is not dependent upon electricity ashore for recharging her batteries. On one charge the yacht has a capacity of 200 miles, but in connection with the auxiliary charging launch Kilowatt her radius of action is unlimited. The auxiliary launch carries 400 gallons of gasolene, enabling her to be operated at full power for 100 hours, in which time she could recharge the electric yacht ten or twelve times and enable the Cascapedia to cover 2,000 miles before the auxiliary launch would have to replenish her fuel. This is the first electric auxiliary boat ever built, and it does much to solve the question of the use of electricity in large motor boats. The advantages of electricity for cruising boats are well known: Absence of noise, heat and vibration, absolute safety while afloat, no danger of fire or explosion, and ease of control. One man can handle the largest electric yacht. The boat has been shipped to West Palm Beach, Fla., where the owner will use her during the winter.

Independent Wireless Communication Made Possible.

Bellini and Tosi, two Italian scientists, who, with the sanction of the French Government, have been conducting experiments in wireless telegraphy for eighteen months on the coast of Normandy, announce that they have solved the problem of independent wireless communication.

This result, they say, has been secured by means of two rectangular aerials fixed at right angles and so attached to the apparatus for reception and transmission as to permit the passage of unequal currents. By a simple law of mechanics these two electromagnetic forces unite and produce an electromagnetic field, and the Hertzian waves are projected in a single vertical plane, which can be alternated instantly by means of the Bobine device.

The inventors say that they have picked up messages at will from every English wireless station and from ships at sea, and that they have transmitted messages from Courville to Havre and other points without the waves being perceptible at the other stations lying just off the line of transmission.

They claim that their system insures absolutely independent communication and opens up immense advantages in the use of wireless telegraphy.

New York & Ontario Power Company.

Plans and details of the New York & Ontario Power Company, of Waddington, St. Lawrence County, which proposes to furnish waterpower in Northern New York, have been explained to the Public Service Commission, Second District, at a hearing on November 30, on the company's application for permission to issue $1,800,000 in bonds and $654,741 in stock. The commission reserved decision.

It was shown that the company has a possibility of developing 30,000 horsepower, but proposes at the present time to develop 17,200. The power is to come from a stream which flows into the St. Lawrence River, and as a consequence the company believes continuous power is assured without the necessity of a storage dam.

Receivers for Auto Transit Company.

The Auto Transit Company, Philadelphia, being unable to meet its obligations, has been placed in the hands of receivers. The application for the receivership was made by the Electric Storage Company, which supplied power to the electric omnibuses of the Transit Company and was its creditor to the extent of over $30,000. The city of Philadelphia is also a creditor for $2,500 for unpaid licenses and $4,000 for repairs to streets used by the company's vehicles. The service was begun in July, 1907, and although at first popular was not patronized extensively when the fare was raised from five to ten cents to make the receipts meet the expenditures. Should there be a disposition to pay the higher fare needed for the maintenance of the service it will be resumed and the company reorganized.

Westinghouse Company Solvent.

The receivers of the Westinghouse Electric and Manufacturing Company and the Securities Investment Company were discharged in the United States Circuit Court on December 5, by Judge James S. Young.

Petitions for the discharge of the receivers were presented to the court by George Gordon, representing the various consenting interests. The companies were represented as being in sound financial condition. The debts of the Westinghouse Electric and Manufacturing Company have been arranged for, with the exception of unassenting creditors with claims to the amount of about $700,000, who will at once be paid in cash. The company has cash on hand amounting to about $15,000,000. The cash of the Securities Investment Company now on hand is about $17,000,000, with unassenting creditors representing only about $15,000.

Mr. Gordon asked that no account be filed by the receivers, stating that they had reported the condition of the plant from time to time to the company, and that the making of account would interfere greatly with the company at this time. The judge agreed to this motion.

Alaska-Yukon-Pacific Exposition.

During the summer of 1909 the Alaska-Yukon-Pacific Exposition, produced at an estimated cost of $10,000,000, will be held at Seattle, Wash., a commercial seaport of growing importance on the Puget Sound. The exposition will draw upon the territory named in its official title for the major part of its rich exhibits.

The grounds, 250 acres in all, are a part of the campus of the University of Washington, and are beautifuly situated between fresh-water lakes in the midst of a forest of giant trees and in plain sight of several ranges of mountains, including snow-capped Mt. Rainier, at an altitude of 15,000 feet.

Fifteen large buildings, of handsome architectural design, will comprise the exhibition palaces. Besides, the United States Government has expended $600,000 for its own building and exhibits, and fifteen states will be represented by beautiful edifices. A number of foreign countries will participate. The amusement section of the exposition will be known as the Pay Streak, a suggestive term from miners' vernacular. Residents of Seattle give every assurance of perfect weather during the exposition, which will open June 1 and close October 16.

Lewis Institute Branch, American Institute of Electrical Engineers.

One of the most successful meetings ever held by Lewis Institute branch of the American Institute of Electrical Engineers, was that on the evening of December 2, at which an audience of over 400 assembled to hear an address on "Rehabilitation of Chicago Street Railways," by Ralph H. Rice, assistant engineer, Board of Supervising Engineers, Chicago Traction.

Mr. Rice called attention to the prevailing tendency for the public control of all public utilities, which was well illustrated in the new franchises of the Chicago traction companies, in which the Board of Supervising Engineers, thereby created, corresponds to a public-service commission. In tracing the history of the traction problem in Chicago for nearly ten years back, it was evident that the poor service formerly rendered was due to the uncertainty of franchise renewal caused by the agitation for municipal ownership, which resulted in making it impossible to get capital for improvements and rehabilitation of equipment. It was interesting that in a voluminous report on this problem made by Bion J. Arnold in November, 1902, there were recommended most of the features subsequently incorporated in the franchise ordinances of February, 1907. It took nearly five years to secure their adoption, but in the one-and-one-half years since over half the work has been carried into effect.

The main features of these ordinances were pointed out and shown to be far in advance of anything ever attempted in this line. The functions of the supervising engineers in seeing that the provisions are carried out were explained, and the organization and duties of the engineering corps described. The work done by the different branches of this corps was illustrated by considering in detail the typical methods made use of by the division on power distribution, with which the speaker is connected. Preparations of plans, securing of estimates, inspection of the work and progress reports thereon, checking of the companies' accounts and issuance of the final certificate showing proper expenditures to capital account were explained in proper sequence. The speaker then considered at length the engineering features relating to calculation of a feeder system and practical problems met in its installation.

A brief summary of the work done and the amounts expended was given. The Chicago City Railway Company has completed seventy-five miles of rehabilitated and new single track; the Chicago Railways Company sixty-six miles. The former company has laid 2,800,000 duct-feet of conduit and installed 587,000 feet of cable in fifteen months; the latter company has laid 1,260,000 duct-feet of conduit since April 1. An interesting feature in the new equipment is the use of pay-as-you-enter cars, which were successfully introduced for the first time in this country on the South Side lines a year ago and which are being rapidly put in service throughout the city. To the original valuation of the surface traction properties, placed at $50,000,000 at the time of passage of the ordinances, there has been added $21,000,000, which represents approved expenditures for rehabilitation and new equipment, making the total capital account at the present time $71,000,000.

At the conclusion of Mr. Rice's address he met the members of the branch at close range in an upper hall of the Institute and answered many questions in regard to all aspects of the rehabilitation work and particularly in regard to details of its technical features.

Creosote for Railway Ties.

The Pennsylvania Railroad has determined to treat with creosote ties for its main tracks that their life may be prolonged. Some two years ago the company undertook tree planting upon a large scale. Since that time it has set out some 2,425,000 trees and has handled this year some 625,000.

In order to provide still more completely against the future a contract has just been placed for the construction of a tie-treating plant at Mt. Union, Pa., and, in addition, two large creosote storage tanks to be located at Greenwich Point, Philadelphia, Pa. The Mt. Union plant will be the first creosoting operation undertaken on a large scale by an eastern railroad.

It is estimated that proper treatment will increase the life of cross-ties from two to three fold. Applied to all of the 100,000,000 ties which American railroads use annually, it would greatly reduce the drain on the rapidly-decreasing timber resources. The Pennsylvania Railroad alone uses from 3,500,000 to 4,000,000 ties each year. The average life of these red oak and chestnut ties under present conditions is from three to four years, while white oak lasts from seven to eight years.

Revision of Patent Office Rules.

It has been decided to publish a revised edition of the Rules of Practice of the United States Patent Office because of the changes which have been made in such rules since the publication of the last edition. In view of this fact and in order, if possible, to simplify and improve the rules governing the practice before this bureau the Commissioner of Patents desires to obtain suggestions as to amendment of the present rules and would be glad to hear from those interested upon the subject. It is not proposed to make radical amendments to the present rules, but simply to embody such changes in or additions to the rules as will be beneficial both to the office and to applicants. All suggestions should be submitted prior to January 1, 1909, and addressed to Edward B. Moore, Commissioner, United States Patent Office, Washington, D. C.

$2,000,000 Trolley Line to Connect Urban Roads.

A $2,000,000 trolley line will be built which is to connect the Chicago & Milwaukee (the Frost road) with the Ravenswood branch of the Northwestern Elevated at Kedzie Avenue, Chicago. The corporation has been organized by D. H. Louderback, and the funds secured. Chicago capital, exclusively, is enlisted. The tracks are to run from Central Avenue, North Evanston, tapping the Frost line there, to Rockwell Street, Ravenswood, where connection is to be made with the overhead company, a distance of about ten miles.

This territory is well populated. It embraces several suburbs, including McAllister, which is owned by Louderback and his associates. The new company will not come in competition with any urban transportation service.

Chicago & Milwaukee Electric Railroad —New Receivership.

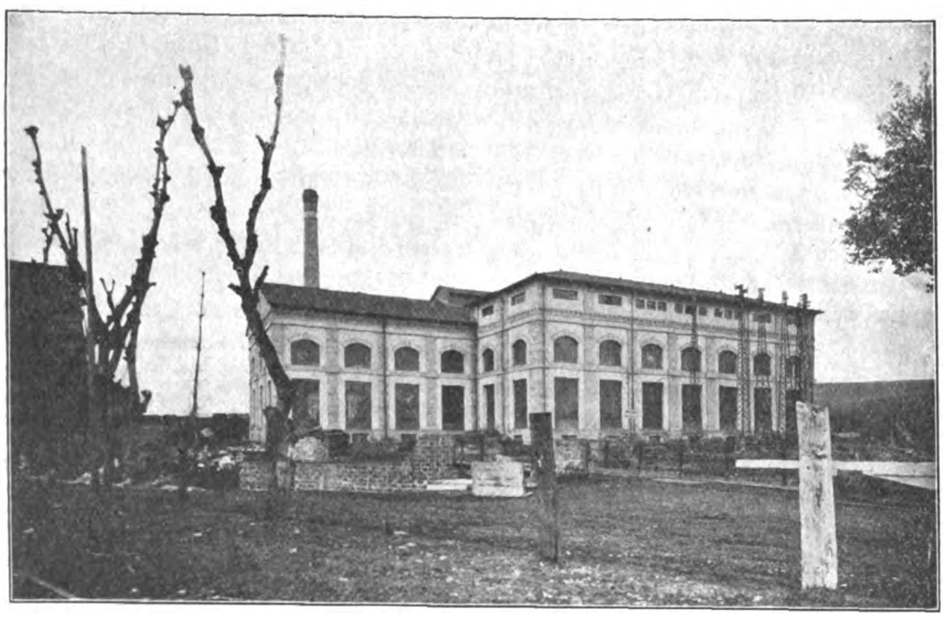
An order assuring the reorganization of the Chicago & Milwaukee Electric Railroad and marking one of the most important steps toward the settlement of the financial difficulties of the interurban line was issued on December 2 by Judge Grosscup. The former receivers were reappointed, but with enlarged duties. The immediate consequence of this action is expected to be the formulation of a plan of financial reorganization, the success of which is apparently assured beforehand by the harmonious action of the holders representing $8,500,000 out of a total of $10,000,000 of bonded indebtedness.

The Power Plant and Transmission System of Castelnuovo-Valdarno, Italy.

BY FRANK KOESTER.

The Societa Mineraria ed Elettrica del Valdarno possesses in the province of Tuscany, near San Giovanni-Valdarno, rich lignite fields. The mining of this coal was not a great commercial success, because it is of a low heating value and contains from forty to fifty per cent moisture. For these reasons it paid to ship only large lumps any distance, and it was not economical to install drying apparatus for that which remained unshipped.

Taking it all in all, the owners of the mine decided to install a steam power plant, in which the inferior coal is utilized to generate electrical energy, which



CASTELNUOVO-VALDARNO PLANT—EXTERIOR VIEW, SHOWING GENERATOR ROOM AND SWITCH HOUSE.

at 33,000 volts is transmitted over five lines to Florence, Prato, Figline, Siena and Valdarno.

The power plant is located directly beside the mine and the boiler room is connected with the latter by a track. The mined coal is exposed to the atmosphere for some time, after which it is conveyed to the overhead bunkers and fed to the boilers of special design. The conveyors are of the bucket type, and besides handling coal are used to remove ashes.

The boiler house is at right angles to the engine room. It is 180 feet long, 98.5 feet in width, and about fifty-five feet high. There are at present installed ten Babcock & Wilcox water-tube boilers having 5,135 square feet of heating surface each. With a coal consumption of 8,100 pounds, each boiler is capable of evaporating 13,200 pounds of water per hour at 190 pounds gauge pressure.

The engine room is 220 feet long and 69 feet wide. The present equipment consists of three horizontal four-cylinder, triple-expansion Franco Tosi engines, having one high, one intermediate and two low-pressure cylinders. Each has a capacity of 2,600 horsepower and is equipped with Lentz valve gearing.

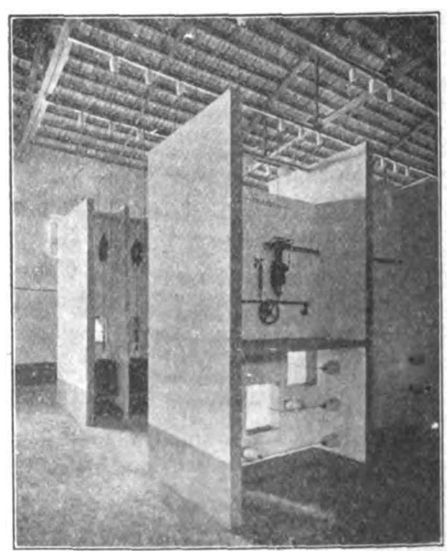
The direct-connected, three-phase generators are of the British Westinghouse make and have a capacity of 1,800 kilovolt-amperes, making 93.7 revolutions per minute and developing 6,000 volts at fifty cycles. Exciting current is furnished from a common set of buses by two 130-kilowatt, 125-volt, six-pole generators, one being driven by a vertical two-cylinder Delaunay-Belleville engine and the other by a 190-horsepower induction motor supplied with three-phase, 220-volt, fifty-cycle current.

For long-distance transmission the 6,000-volt generator potential is stepped up to 33,000 volts. The equipment of transformers and other high-tension apparatus is among the most interesting features and has been installed by the Maschinenfabrik Oerlikon of Switzerland.

In the accompanying wiring diagram it will be noticed that the ultimate equipment will be seven main generator units, and that the present five main outgoing feeders are arranged symmetrically to the former. Current may be thrown on the 6,000-volt bus-bars or on the transform-

CASTELNUOVO-VALDARNO PLANT—600-KILOVOLT-AMPERE, 6,000-33,000-VOLT, FORCED-DRAFT-COOLED TRANSFORMERS.

ers direct. The current for the mines and auxiliary motors installed in the power plant is drawn from the generator bus. Auxiliary 6,000-volt buses feed the transformers supplying 220 volts to these vari-



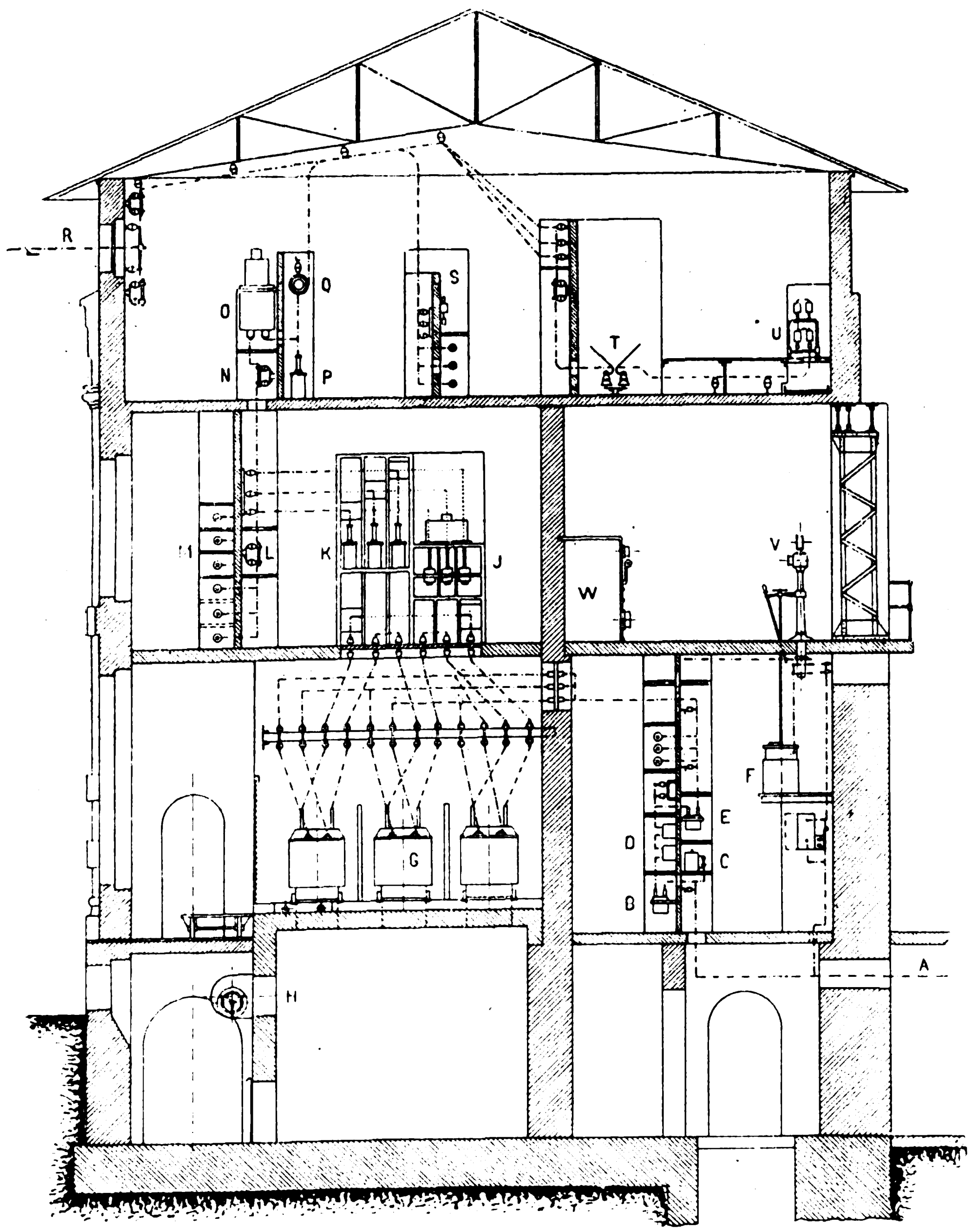
CASTELNUOVO-VALDARNO PLANT—ELECTROMAGNETIC SWITCH AND AUXILIARY BUS FOR GROUND TESTING.

ous motors. The exciter bus will be supplemented in the future by the storage battery indicated.

The 33,000-volt bus is of the ring system, frequently found in continental practice. One thing especially noticeable is the number of sectionalizing switches employed, there being no less than fifteen to accommodate five outgoing feeders. By this scheme each transmission line may be fed by a generator, and in case of necessity may draw from any other generator, or the whole may operate in parallel.

In order to divide the whole bus and main partition wall, separating the two lower floors into high and low-tension divisions.

The 6,000-volt generator switch compartments are located on the main floor nearest the generators. Behind them and on the other side of the partition wall are the 6,000-33,000-volt transformer com-



CASTELNUOVO-VALDARNO PLANT—CROSS-SECTION OF SWITCH HOUSE.

A—Generator leads; B—Automatic overload oil-switch, 6,000 volts; C—Potential transformer; D—Series transformer; E—Selector switch; F—Generator rheostat; G—Transformers; H—Blowers; J—Automatic overload oil-switch, 33,000 volts; K—Series transformer, 33,000 volts; L—Hook switch; M—Busbars, 33,000 volts; N—Hook switch; O—Automatic overload feeder oil-switch; P—Series transformer; Q—Choke coils; R—Outgoing line; S—Ground-detector equipment; T—Horn gaps; U—Water rheostats; V—Instrument column; W—Switchboard.

operate it in two distinct parts each end is provided with series and potential transformers, a voltmeter, three ammeters and one recording polyphase wattmeter.

The switch house possesses many novel features and is one of the most up to date in European practice. This house has, besides the basement, three main floors, which are divided longitudinally by a partments, and above these are the 33,000-volt oil switches and bus-bars. In front of the latter and above the 6,000-volt switch compartments is the controlling room for the generators and high-tension feeders. The upper floor is similarly divided. Above the control room are the protecting devices for the outgoing lines, while in the middle is the ground-detecting equipment, and on the other side are automatic circuit-breakers, choke coils, etc., for the outgoing feeders.

The generator leads are bare conductors carried on ribbed insulators and run to the switch compartments, which are made of reinforced concrete. Each contains a potential transformer for the voltmeter, two for the potential coils of the reverse current relay and polyphase wattmeter, and two remote-controlled oil-switches for throwing the generator on the bus or directly on the transformers.

On the back of each switch compartment is an automatic oil circuit-breaker with a time limit and reverse-current relay, a series transformer for an ammeter, two for the relays and two for the polyphase wattmeter. Referring to the cross-section of the switch house, the arrangement of the switch compartments is indicated by the letters B, C, D and E. Opposite these compartments are the field rheostats located on a shelf indicated by F. They are actuated from instrument columns, V.

The generator instrument columns are arranged in groups of three, between which and in the middle of the gallery are located the columns for controlling the exciters. Upon each generator column are mounted one ammeter for the generator and one for the exciter current, a double voltmeter, a polyphase wattmeter and two pilot lamps for the overload switch. There are also three levers, one for the overload and two for the selector switches.

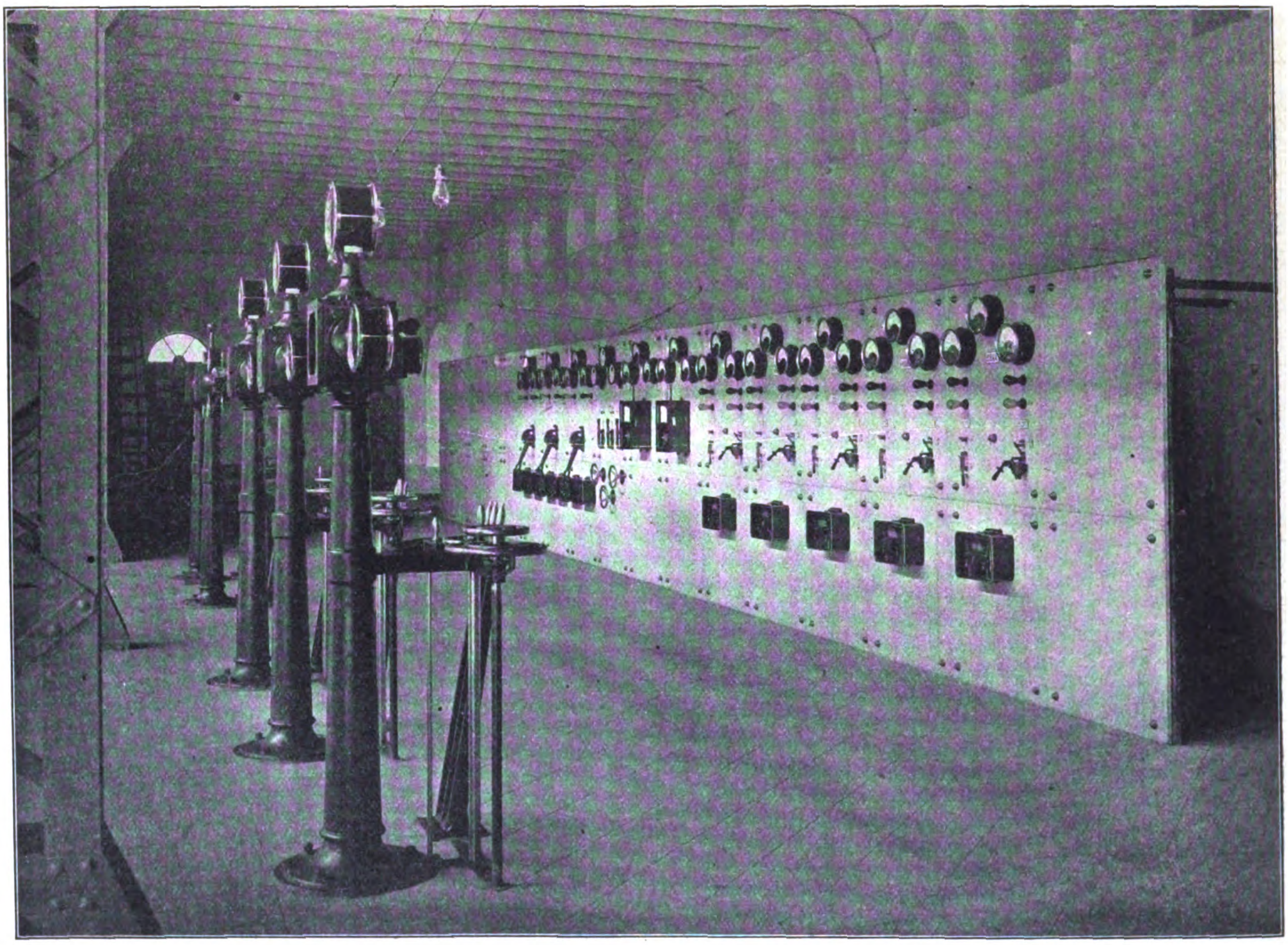
Provision is made by means of a mechanical interlock located between the generator and selector switches, so that when the generator is to be thrown in for parallel operation one of the selector switches must be closed before the main switch, and on the other hand the main switch must be opened before the selector switches.

The exciter current is controlled by two-point carbon switches, operated from the instrument columns by worm gearing. The rheostat for regulating the field of each main generator has two successive contact devices, for which two handwheels are provided on the instrument column. The excitation and main generator switches are so interlocked that the latter cannot be closed when the former is open; on the other hand, the field switch cannot be opened before the main switch. Synchronizing is facilitated by means of a double voltmeter and voltmeter selector switch, so that the voltage and phase of an incoming machine can be compared with those in operation.

Of the two exciter columns, one serves for a future storage battery and the other is provided for each machine with an ammeter, a voltmeter, a handwheel for the automatic overload switch and one for the exciter field rheostat. There are also signal lamps and a starting device for the induction motor.

The transformers are arranged contrary to the usual practice, in groups of three compartment, or three transformers) suspended from a wall of the air chamber in the basement. A novel feature of these transformers is that the core is not surrounded by a casing, but instead the lower half only is surrounded by glass plates.

There are seven compartments for the accommodation of twenty-one transformers, nine of which are at present installed. Another compartment contains four open, air-cooled 6,000-220-volt transformers, each of 250 kilovolt-ampere capacity. pole time-limit relays, are actuated from the controlling board by means of levers, cables and bell cranks. Each transformer group has its own panel on the main control board. Each panel contains a lever for the automatic oil-switch, three ammeters, two signal lamps for indicating the position of the switch, together with a two-pole overload time-limit relay and a two-pole overload reverse-current relay for the generator which belongs to the group.



CASTELNUOVO-VALDARNO PLANT—SWITCHBOARD AND CONTROLLING GALLERY.

in a common compartment, in which they are separated from one another by concrete slabs 6.5 feet high. The ends of the compartments open into a common corridor and are provided with corrugated-iron swinging doors. By means of casters on the transformers they can be moved onto a small truck in the side aisles and the whole conveyed to the repair room.

All the transformers are of the Oerlikon single-phase, air-cooled, open-core-type, connected in delta. Each has a capacity of 600 kilovolt-amperes. The air is supplied to the transformers by means of motor-driven blowers (one for each These serve for the operation of the exciter group and motor pumps for condensing and boiler-feed purposes, as well as for lighting the station. Three of these transformers have their primaries connected in delta and the secondaries in star. The fourth is kept in reserve, and by means of hook switches it is readily cut in.

Instead of being connected in the transformer compartment the high-tension leads run to the floor above, where they are connected in delta, joining here the oil-switches and then the bus-bars. These oil-switches, provided with two-

The feeder automatic oil-switches are provided with overload time relays and are electromagnetically operated from the main control board. Each can be isolated on either side by hook switches. The current passes three series transformers for the ammeters and relays, then through a choke coil and finally through a hook switch out onto the line. Passing under the outlet for each feeder is a common ground bus, which by means of a hook switch is easily connected to each circuit. This arrangement was thought necessary because a number of the substations have synchronous motor-generator sets with storage batteries, and as the sets may sometimes be inverted, being fed by the batteries, there is the possibility that the synchronous motor will feed back into the line.

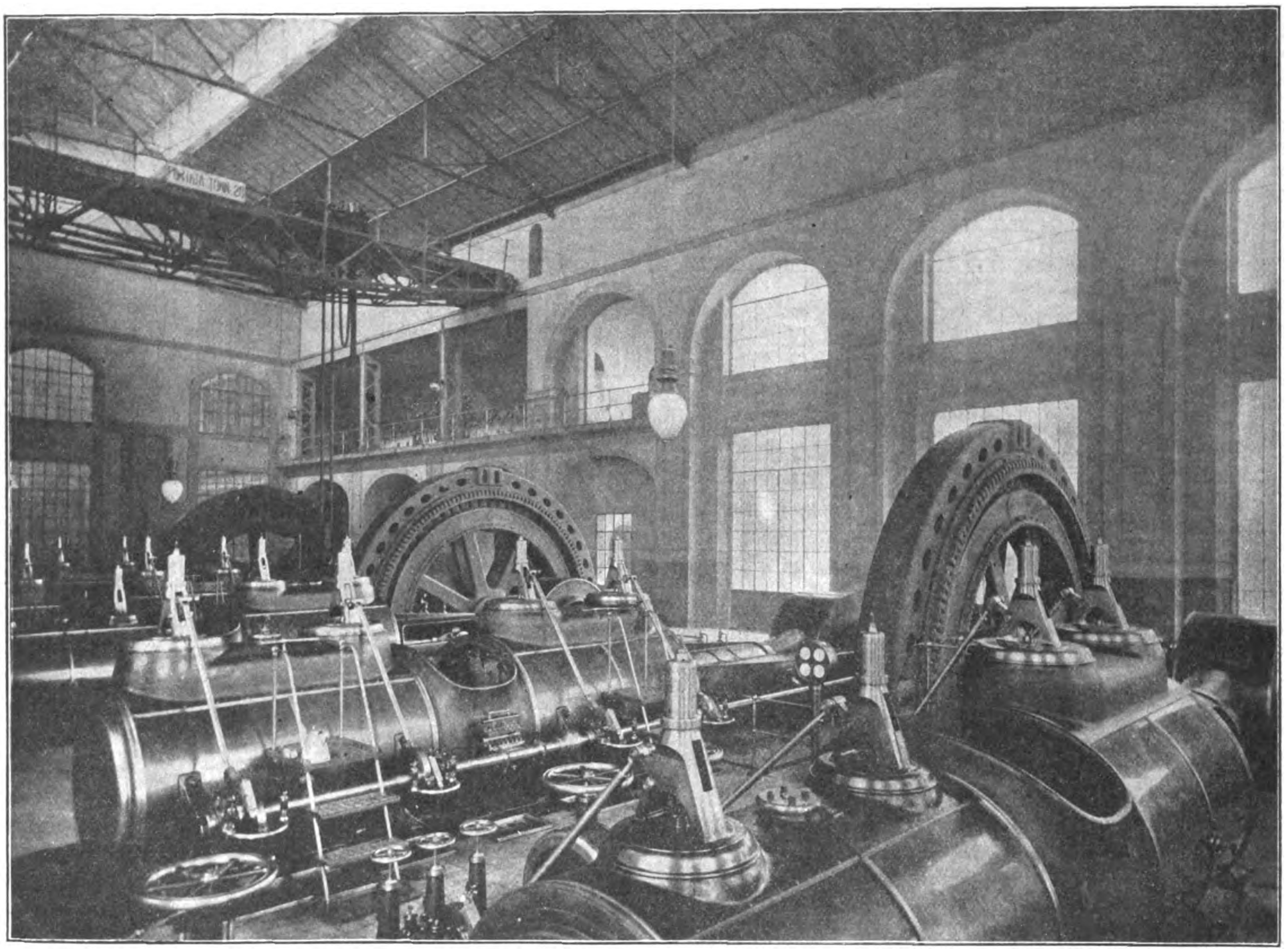
The outgoing circuits are well protected against lightning and other atmospheric discharges. To take care of direct lightning strokes each phase is provided with a horn gap connected in series with four tile water rheostats. The lighter discharges are led off by the Oerlikon water-flow grounders, much used in Swiss and Italian high-tension practice.

There is a very elaborate system for testing the lines for insulation and grounds. It consists of separate auxiliary bus-bars, high-tension oil switches, etc., so arranged that not only can the individual circuits be tested separately, but the phases of the circuits can be tested independently. An electric lock prevents more than one phase from being tested at a time. By means of this equipment the exact location of a ground on a line is readily determined. The method of procedure is as follows: When a grounded line is thrown on the auxiliary bus the ohmmeters give a certain indication. An artificial line is then built up in the station using dry cells. After a few trials the required number of cells to give the same deflection on the ohmmeter as did the line is obtained. As the resistance and other factors of the artificial line bear a certain ratio to the same conditions of the main line, by checking up the elements of the Siemens dry batteries and other factors and multiplying by the ratio the precise location of the trouble is determined.

A separate panel on the main switchboard is set aside for the ground-testing instruments, consisting of three ohmmeters, three single-pole switches for cutting in a battery of seventy-eight Siemens dry cells and a handwheel to facilitate making adjustments.

Each panel for the outgoing lines contains three ammeters, a control switch with two pilot lamps for governing the oil-switches and two-pole time-limit relay, and a control switch with pilot lamps for ground tests. Thorough precautions for safety have been taken. All non-current carrying exposed metal parts, such as brackets carrying insulators, etc., are grounded.

There are at present installed five 33,000-volt transmission lines. One line to Florence is 15.6 miles long; parallel to the same and continuing past Florence is a circuit 30.6 miles long to Prato. Just outside of Florence is a switching station whereby the two lines can be run in parallel as far as the latter city. One line runs southward 16.75 miles to Siena. Another line goes to the iron works at San Giovanni, 3.6 miles distant. Parallel to this and branching off near the substation at San Giovanni runs a circuit six miles long to Figline.



CASTELNUOVO-VALDARNO PLANT—INTERIOR OF GENERATING ROOM.

The transmission towers are of steel lattice construction; the lowest insulator is about forty-five feet from the ground. They are set in concrete blocks which are about six feet deep. The insulators are of the three-piece, triple-petticoat type with a porcelain base, the total being about ten inches high. The head is about nine inches in diameter. They are mounted on wooden brackets with a spacing of thirty inches between the conductors.

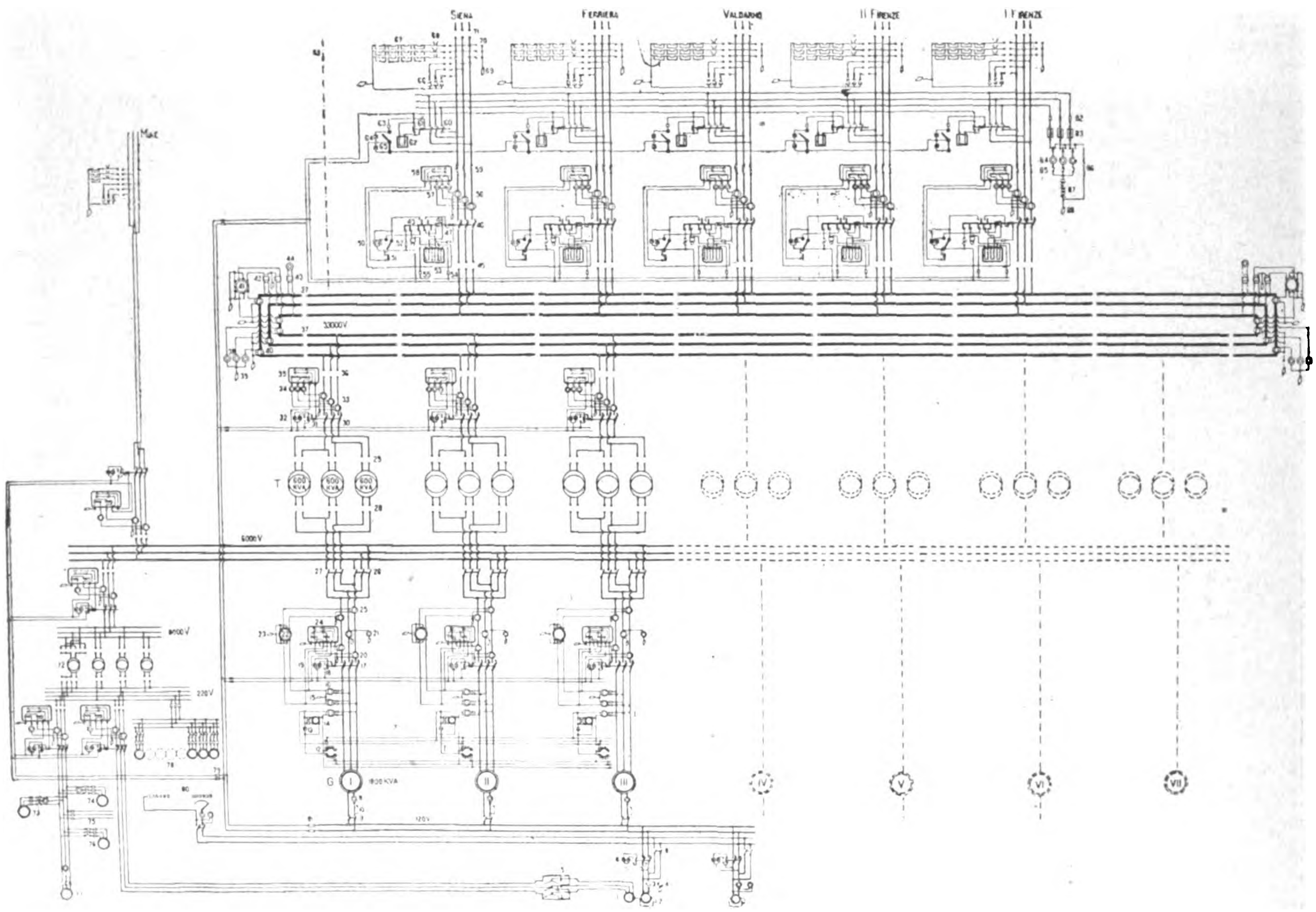
In the substation at Florence are installed four 300-kilovolt-ampere, single-phase transformers (one being kept in reserve) to step down from 31,000 to 5,200 volts. The substation has been designed to accommodate twelve transformers. There are also installed two three-phase, fifty-kilovolt-ampere transformers to step down from 5,200 to 260 volts.

The substation at Prato has been designed to accommodate six 300-kilovolt-ampere, single-phase transformers; four of these are at present installed, one being kept in reserve. There are also two fifty-kilovolt-ampere, three-phase transformers. The former step down from 30,000 to 5,000 volts, the latter from 5,000 to 300.

At Siena the substation is designed to accommodate six 300-kilovolt-ampere single-phase transformers, three of which are at present installed.

At the ironworks in San Giovanni there are six 300-kilovolt-ampere, 32,000-3,000-volt, single-phase, oil-insulated, water-cooled transformers. Provision is made for twice as many. At Figline there is but one oil-cooled, 125-kilovolt-ampere, 31,000-3,000-volt transformer.

All these transformers are of the Oerlikon make, and, with the exception of those installed in the last two stations, are of the forced-air-cooled type.



WIRING DIAGRAM OF CASTELNUOVO-VALDARNO PLANT.

1—Three-phase asynchronous motor; 2—D. C. generator for excitation; 4—Ammeter and voltmeter for exciter; 5—Starting device for three-phase motor; 6—Signal lamps; 7—Automatic overload switch; 8—Double-throw switch for storage battery; 9—Switch for exciter current; 10—Generator field rheostat; 11—Ammeter for exciter current; 12—Three-phase voltmeter switch; 13—Phase lamps; 14—Double voltmeter; 15—Ground; 16—Potential transformer; 17—Automatic overload switch (6,000 volts); 18—Reverse-current switch; 19—Signal lamps for above; 20—Series transformer; 21—Ammeter for generator current; 22—Double wattmeter; 23—Ground; 24—Maximum and reverse-current relay; 25—Current transformer; 26—Oil-switch; 27—Oil-switch; 28—Hook switch; 29—Hook switch; 30—Automatic circuit-breakers (33,000 volts); 31—Blow-out coil for above; 32—Signal lamps; 33—Series transformer; 34—Ammeter; 35—Overload time relay; 36—Hook switches; 37—Hook switches; 38—Bus ammeter; 39—Ground; 40—Current transformer; 41—Doube-recording wattmeter; 42—Potential transformer; 43—Potential transformer; 44—General voltmeter; 45—Hook switch; 46—Automatic oil circuit-breaker remote controlled; 47—Tripping magnet; 48—Closing magnet; 49—Double-threw trip indicator switch; 50—Signal lamps; 51—Pilot switch; 52—Switch for annunciator; 53—Rheostat; 54—Fuses; 55—Fuses; 56—Current transformer; 57—Feeder ammeter; 58—Overload time relay; 59—Choke coils; 60—Multiple switch for ground detectors; 61—Closing magnet; 62—Preventive resistance; 63—Fuses; 64—Signal lamps; 65—Pilot switch; 66—Water-flow grounders; 67—Water rheostat; 68—Horn lightning-arrester; 69—Ground; 70—Hook switch; 71—Hook switch; 72—Transformers for auxiliary motors; 73-77—Various auxiliary motors; 78—Ventilator motors; 79—Fuses; 80—Storage battery; 81—Fuses; 82—High-tension fuses; 83—Choke coils; 84—Ohmmeter; 85—Switch; 86—Shunt resistance; 87—Dry battery; 88—Ground; Ground testing equipment; 89—Future transmission line connection.

Third Rail for Pennsylvania Tunnel.

The Pennsylvania Railroad Company has announced that it has adopted the direct-current system of electric traction, generally known as the "third rail," for its New York and Long Island tunnel extension. This system of electric traction is now in use on the lines of the Long Island Railroad, with which lines the tunnel extension will be directly connected, and with which it is expected to facilitate suburban development in Long Island and New Jersey.

SMOKELESS COMBUSTION.

BY CHARLES L. HUBBARD.

(Concluded.)

From both an economical and a smoke-suppressing standpoint there are three generally recognized methods for hand stoking a boiler furnace to produce the best results. These are commonly known as "coke firing," "alternate firing" and "spread firing," and have been described in some detail by the writer in a previous article.

Some bituminous coals have little or no coking quality, but will fall into a more or less loose powdery form. Such coal will stand but little moving about on the grate after it has once been charged into the furnace. Other coal when heated will swell up and fuse into a pasty mass, forming a crust on top of the firebed, but after the volatile matter has been distilled from the coal the coke can be easily broken up and moved to any desired position on the grate. Sometimes two such coals can be mixed in such proportion as to give better results than either alone.

Coke firing is best applied to furnaces in which the gases pass over a bridge-wall at the rear of the furnace, or where a brick arch is provided, extending over the firebed for some distance toward the rear. In charging fresh coal into the furnace it is piled inside the door instead of being thrown directly upon the fire, and may occupy about one-third of the length of the grate, extending across the full width. The heat of the furnace will cause a slow distillation of the volatile matter from the coal, and these hydrocarbon gases passing over the incandescent bed of coke in the presence of an abundant supply of highly heated air will be completely consumed. When most of the volatile gases have been distilled from the coal the newly formed coke may be pushed back upon the grate, thus forming a new bed of practically smokeless fuel, and a supply of fresh coal may then be fired in the same manner as before.

After the fireman once becomes familiar with this method of firing in a properly constructed furnace he will be able to secure practically smokeless combustion with no greater difficulty than in the case of any rational system of firing. The economy of this method will vary in different cases, but in nearly every instance will show a saving in fuel. The disadvantages are the length of time it is necessary to keep the fire doors open for charging and cleaning, which allows a large quantity of cold air to rush into the furnace, not only checking combustion but also cooling the boiler parts and causing severe strains. These objections are overcome in various ways as will be described later.

In alternate firing the coal is placed on one side of the furnace at a time, and the result is somewhat like that obtained in the coking system, the gases being burned over the bright side of the firebed as they are given off. After the freshly fired coal has been changed to coke and is burning brightly without smoke the other side of the grate may be fired.

In spread firing fuel should be added at regular intervals, only one or two shovelfuls at a time, and each put where it is most needed. If there are two doors to a furnace, only one should be fired at a time. In other words, fire lightly and frequently. If the work is light and the draft good, smoke may be almost entirely prevented in this way. If the work becomes heavier, fire oftener but do not put on more than three shovelfuls at a time. If much smoke is noticed just after firing, leaving the furnace door ajar an inch or so for about a minute will prevent this.

Having described some of the more important points to be noted in hand firing, let us now consider some of the devices which can be applied to boilers already set without too radical changes.

One of the simplest of these is the steam jet for use when fresh coal is first charged into the furnace. This may be used with the ordinary flat grate and is of great assistance in preventing smoke and promoting combustion generally. The steam jet alone is of very little value, and should always be used in connection with some form of air supply over the fire, as the real benefit derived is not from the steam itself but from the artificial draft which it produces. Immediately after firing, more air is needed than can readily pass through the grate, and if this additional demand is not at once provided the fuel will smoke. If there are two or more steam jets over the furnace door, pointing downward toward the rear of the grate, and suitable air inlets in front or at the side of the grate, the opening of the steam jet will induce a draft and supply the needed air. The supply of steam and air should be gradually shut off as the fresh coal becomes coked. In some patented steam jets or blowers the arrangement is such that the air is drawn in through the blower itself by means of suitable openings provided for this purpose.

The value of any device of this kind depends upon the care which it receives. If of good design and properly used, it should prevent a large proportion of the smoke and at the same time increase the economy somewhat. But if the air-ways become clogged or the tips of the jets are allowed to burn off, or the fireman neglects to turn on steam, the device becomes useless. In order to overcome these objections to some extent, automatic means are often provided, one of which consists of a dashpot which is pushed up by opening the fire door. This in turn opens the valve on the steam jets, opens a hinged flap in the furnace door to admit air over the fire, and closes a check draft in the uptake to increase the draft. As soon as the door is closed the dashpot piston begins to fall and reverses these operations. The time of the falling of the piston may be regulated according to the amount of air needed by the particular kind of coal used. There are several devices working upon the same principle, but differing more or less in detail. It is claimed by some that a steam jet is injurious to the grates and boiler plates; but if the steam and air are well distributed there should be no danger of local injury. The amount of steam used need not be large, as it is only required intermittently, that is, when fresh coal is fired.

The furnaces mentioned thus far have been fired by hand and depend largely for their success upon the skill and faithfulness of the fireman. Briefly, the directions given may be summed up as follows: Keep the fires clean and bright and do not allow the grates to become clogged; carry as thin a fire as is sufficient for the work to be done, but do not allow air-holes to form; put on coal in small quantities (unless the coking system is employed) and as often as may be necessary, spreading it thinly and evenly, so that it may burn brightly at once; in cleaning do not tear the fire to pieces and uncover large spaces of grate, but clean one side at a time and cover the grate with red-hot fuel before putting on fresh coal; keep all flues and heating surfaces clean, and when firing heavily leave the doors slightly ajar for a couple of minutes or so after firing.

If, after improving the conditions by more skillful firing, it is desired to take a more radical step toward the elimination of smoke, one of the reliable forms of automatic stoker should be installed, which, with proper care and adjustment, should be able to furnish steam to the full capacity of the boiler without an objectionable amount of smoke. The reason for their superiority over hand firing depends principally upon their uniform action and the avoidance of opening the fire doors for the introduction of fuel. The stoker feeds the coal to the fire regularly instead of intermittently, and the air supply can be easily graduated to correspond. When a stoker produces smoke regularly it is usually due to the fuel not feeding forward properly, and to its clogging and sticking to the bars. Either the stoker, the fuel or the fireman may be at fault for this condition; the stoker by improper shape and setting of its grate, the fuel by melting and forming clinkers, and the fireman by not adjusting the stoker to the fuel used.

Mechanical stokers may be divided into three general classes, as follows: Those with rocking or shaking bars placed in an inclined position, traveling or chain grates, and under-feed stokers.

The first type is unsuitable for burning a coking coal, the only satisfactory fuel in this case being one which burns freely, forming a light ash and little clinker. Stokers with inclined grates have not always given the best satisfaction as smoke preventers on account of the fuel sticking to the top of the grate and leaving holes in the fire below. This makes it necessary to poke the fire from time to time, which is liable to result in rolling considerable masses of burning fuel to the bottom of the grate, and carrying more or less unburned coal with it.

Chain-grate stokers are particularly well adapted to large plants carrying a uniform load, and have the advantage of being self-cleaning and are very efficient in the prevention of smoke. They usually consist of an endless chain having a width equal to that of the furnace, running over sprocket wheels at the front and rear. The coal is fed onto the grate at the front and the ash is dumped over the rear end.

Under-feed stokers rank next to chain-grates in the prevention of smoke, being practically smokeless except at the times of cleaning the fire or when the side doors are open.

In addition to mechanical stokers, there are several furnaces of special design which give very good results. One of the most successful in smoke prevention and economy is the so-called down-draft furnace, which is built on the principle of a kerosene lamp. The coal in this furnace burns from the bottom, that is, the flame is led away from the fuel just as with a candle or lamp.

The gases are thus distilled slowly and afforded an opportunity to come in contact and mingle with the proper amount of heated air. The upper grates supporting the fire must, of course, be water grates, otherwise they would be burned. Below the water grate is a common grate for catching and burning the coke which falls through the upper grate when the fire is sliced. In this furnace the excess of heated air which passes through the lower grate is necessary for complete combustion of the hydrocarbons which may pass through the water grate with a deficient amount of air. With this form of furnace an almost entirely smokeless chimney and a considerable gain in economy can be obtained if handled with a reasonable amount of intelligence.

Another form of special furnace has a grate made up of two parts, the forward part being stationary and sloping moderately from the fire doors toward the dumping grate at the rear. A fire-brick arch is built across the center of the furnace over the rear grate. Fuel is fired upon the front or sloping grate and after the gases have been given off it is pushed back upon the dumping grate. Air is admitted through both grates from the ash-pit and also above the fire through a special opening in the front wall. The arch serves to deflect the air and gases downward toward the incandescent coke upon the dumping grate, which insures complete and smokeless combustion if proper care is used in firing.

Another form differs from the ordinary furnace in having two vertical walls, with a narrow opening between them, built back of the bridge wall near the end of the boiler. In addition to these, there is a fire-brick arch over the combustion chamber and a series of short walls or piers back of the bridge wall. Coal is fired alternately upon one-half of the grate at a time and the smoky gases from the freshly fired side and the excess of very hot air passing through the bed of bright coal on the other side are brought together by passing through the narrow opening between the two vertical walls, and combustion is therefore made much more complete.

One important matter in the design of a furnace for smokeless combustion is to obtain the proper area of grate surface to burn the fuel used to the best advantage. First, the particular kind of coal to be used should be selected, and then the rate of combustion determined. This will vary for different coals. A writer in *The Engineer* gives the following, based upon a series of tests, as giving average results:

Kind of Coal.		Pounds Burned per Square Foot of Grate per Hour.
Anthracite	Steam sizes	15
Semi-anthracite		16
Semi-bituminous		18
Eastern bituminous		20
Western bituminous		30

It is an important matter to have the grate bars properly spaced to give room for the air to pass to the fuel bed and combustion chamber beyond it. If an excessive amount of ash occurs in the fuel used, shaking grates should be used (if hand fired), so as to easily keep the air openings clear, and thus facilitate the passage of air through the grates and fuel.

In drawing up smoke ordinances it is necessary to state what degree of density constitutes an offense. It will be found in practice that a certain latitude must be allowed, as there are usually periods of two or three minutes in the case of hand-fired boilers when smoke will be emitted from the chimney, and it is well in framing such an ordinance to state that smoke above a certain degree of density will not be permitted for periods of over a given length of time.

There are several ways of determining the density of smoke; the one most commonly used at present is known as the Ringelmann Chart. This is composed of six rectangles, the first being perfectly white, while the sixth is entirely black, and the intermediate rectangles placed between these two extremes have a series of black lines ruled upon them at fixed distances apart, as indicated below:

No.	Black Spaces.	White Spaces.
0	....	All White
1	1 m. m. wide	9 m. m. wide
2	2.3 m. m. wide	7.7 m. m. wide
3	3.7 m. m. wide	6.3 m. m. wide
4	5.5 m. m. wide	4.5 m. m. wide
5	All Black.	....

This chart is placed between the observer and the chimney, and at a distance of some fifty feet it will be seen that the ruled lines upon the rectangles are blended together to form a succession of tints, so that the observer may compare the tint of the chart with the gray or black smoke as it issues from the chimney.

In Australia a telegram is carried 3,000 miles at the rate of two cents a word across the territories of six governments and states.

INDEPENDENT TELEPHONE CONVENTION.

THE CLOSING SESSIONS—THE EXHIBITS.

The twelfth annual convention of the International Independent Telephone Association, held in Chicago during the week of December 1, was brought to a successful close after a belated session on Thursday afternoon, when the final business and election of officers was finally transacted. The convention was marked by lively interest and general attendance on the part of the delegates, representing "four million telephones and seventeen million users," and the manufacturers of Independent telephone apparatus were on hand with an instructive array of equipment and exhibits estimated at a total value of about $50,000.

As reported in full in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of last week, the three sessions of Tuesday were given over to preliminary business and the consideration of certain important technical matters. On behalf of Mayor Busse, George M. Bagby, assistant corporation counsel for the city of Chicago, welcomed the members of the convention, and his cordial words were given a pointed response in the reply of R. D. Critchfield, president of the Wisconsin Telephone Associaton, who urged upon the city administration the importance of telephone connection with the large majority of Independent subscribers in the vicinity of Chicago.

Tuesday afternoon was devoted to technical discussion relating to local line operation. Roy Owens, of Columbus, Ohio, presented a paper on "The Telephone Engineer in His Relation to the Telephone Business." J. H. Ainsworth, of Dayton, Ohio, discussed "Some Economies in Handling Maintenance Men." G. E. Bickley, of Waterloo, Ia., read a brief paper on "Maintenance Economies." J. P. Boylan's paper on "Handling Trouble" was read by B. H. Brooks.

At the evening session matters of interest to toll-line operators were taken up. Frank F. Fowle, consulting engineer, Chicago, delivered, in abstract, his exhaustive paper on "The Economical Development of Toll Territory." George K. Gann, Lincoln, Neb., related in brief the contents of his paper, "Handling Long Distance Traffic." Both afternoon and evening technical discussions were in charge of Gansey R. Johnson, of Columbus, Ohio.

The early part of the session of Wednesday morning was given over to the reading of the reports of various state and local Independent telephone associations, affording a favorable account of the progress of the Independent movement throughout the country. The convention then listened to the paper on "The Supply and Preservation of Poles," by W. F. Sherfesse, an expert in the employ of the Forest Service.

ANNUAL CONVENTION OF THE INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION, AUDITORIUM HOTEL BANQUET HALL, CHICAGO, ILL., DECEMBER 2, 1908.

Mr. Sherfesse spoke of the relative advantages of the preservatives used in the prevention of the decay of wood. These are corrosive sublimate, copper sulphate, zinc chloride and creosote. The first two are being supplanted by the latter in the preservation of telephone-line material. Zinc chloride may be painted over, but has the disadvantage of being soluble and will bleach out of the wood. Creosote has a higher first cost and possesses the added disadvantage of a rather limited supply.

The preservative treatment of impregnation may be carried out in the presence of either artificial or natural pressure. The pressure treatment involves first subjecting the wood to a steam bath, then exposing it to a partial vacuum, to exhaust the moisture and air from the pores and cellular interstices, and finally applying oil under pressure. This treatment is giving way to the "open-tank" treatment of the butt, which requires less expensive apparatus and is simpler to effect. Air-dry wood is placed in an open bath of hot oil. The oil is then cooled, or run out and its place taken by cold oil, or the wood is removed and plunged into a receptacle containing cool oil. The preserving compound penetrates the sapwood easily, but longer duration of the treatment is required for its effective entrance into the heartwood.

The benefits of the preservation treatment are manifested by the increased life given to the ordinary run of timber, and the possibility of use of a cheaper grade of wood otherwise entirely unsuitable. Thus, southern loblolly pine can be treated and made useful for telephone purposes, and fire and insect-killed timber becomes as available as that thoroughly seasoned.

Business and financial matters of Independent telephone operation were discussed during the session of Wednesday afternoon. "Damage Suits—Their Prevention and Defense" was the subject of a paper by William S. Hart, an attorney of Waukon, Ia. C. E. Wilson, of Philadelphia, Pa., read a paper on "Pernicious Political Pull" and J. B. Hoge, Cleveland, Ohio, presented the matter of "Insurance—Liability and Fire."

The programme of the afternoon session was interrupted by the committee on finance, which issued a call for funds to carry on the campaign of education and legal enactment in the interest of the Independent telephone movement. Following the call, the convention scene was an enthusiastic one as the delegates rose in quick succession to pledge duplication of the subscriptions of state associations, companies and individuals for the year before, or to increase or propose new amounts. Under the active invitations of James S. Brailey, Jr., chairman of the finance committee, in an incredibly short time the total amount subscribed reached $95,000.

At the annual association banquet, held at the Auditorium Hotel in the evening, the following toast list was given, with Dwight E. Sapp of Mt. Vernon, Ohio, presiding at the speakers' table:

"The Telephone President." H. D. Critchfield, Milwaukee, Wis.

"The Crowning Triumph." W. S. Hart, Waukon, Ia.

"Mergers and Alliances." D. J. Cable, Lima, Ohio.

"Competition versus Monopoly." Judge C. W. Showalter, Parkersburg, W. Va.

"The Telephone and the Law." Clarence Browne, Toledo, Ohio.

"Our Emblem." Manford Savage, Champaign, Ill.

On Thursday morning, following the reading of the reports of the remaining state and local associations, Secretary Ware read the paper on "A Sound Financial Policy," by E. B. Fisher, Grand Rapids, Mich.

"Some Telephone Problems" was the title of a paper by Morgan Brooks, professor of electrical engineering at the University of Illinois, which received the interested attention of the convention.

Success in the telephone field has been due to the engineer rather than the inventor, premised the writer. He then directed attention to the priority of use of the telephone induction coil over the transformer for the transmission of electric currents to great distances. Professor Brooks reviewed briefly a number of problems of construction, the matter of "loading" long lines, and the increasing danger and annoyance from high-tension power lines near telephone circuits. The advent of the single-phase alternating-current railway has brought in a large share of troubles which simple expedients of transposing or insulating the telephone line have been unable to remedy. A three-phase high-tension power transmission system carrying a balanced load creates only a slight disturbance, since the wires are comparatively close and the sum of the currents in any two wires at any instant is equal to that in the third. However, the single-phase railway employing a single conductor of comparatively high voltage (3,300 to 6,600 volts) with a ground return, introduces conditions of noise and even dangerous induced potentials which cannot be well avoided without removal of the telephone wires outside of the disturbing zone.

The engineering experiment station of the University of Illinois, said Professor Brooks, is now building an experimental line, paralleled by power wires, one mile in length, and arranged so that any required conditions can be obtained. That actual danger exists to men working a telephone line near a high-tension circuit, Professor Brooks cited a laboratory experiment in which an insulated wire five feet away from a 6,000-volt line showed an induced potential of 500 volts. While this represented only the slight static charge of the line, the capacity of the wire being, of course, very small, the professor believed that a long line under certain conditions might deliver a fatal current. The improving insulation of telephone lines of course tends to conserve the charge, and with improved conditions in this direction the danger from induced shocks is increasing. A telephone line within 200 or 300 feet of a single-phase trolley line will likely be rendered inoperative, and the effect of the alternations has been noticed at a distance of several miles.

Following Professor Brooks' discussion of high - tension alternating - current sources of annoyance and danger, Secretary Ware read a paper on "Western Electric versus Independent Telephone Apparatus."

At the afternoon session a number of committee reports were heard and before the convention was finally declared adjourned the following officers were elected: President, E. H. Moulton, Minnesota; first vice-president, P. C. Holdoegel, Iowa; second vice-president, E. B. Fisher, Michigan; treasurer, Manford Savage, Champaign, Ill.; secretary, A. C. Davis, West Virginia.

Directors for one year: A. E. Boqua, Arkansas; J. W. Barnes, West Virginia; M. L. Colladay, Missouri; P. H. Griswold, New York, and A. E. Yaxlor, Illinois. For two years: F. D. Houck, Pennsylvania; Frank C. Hoge, Kentucky; W. H. Nelson, Kansas; Dr. J. E. Demers, Canada, and H. D. Critchfield, Wisconsin. For three years: Frank L. Beam, Ohio; Manford Savage, Illinois; James H. Shoemaker, Iowa; Charles B. Norton, Indiana, and E. B. Fisher, Michigan.

The next convention will be held in Chicago in December, 1909.

A direct outcome of the Independent telephone convention in Chicago is the amiable consideration given by the city administration to the matter of long-distance connection with the large proportion of Independent subscribers in the adjoined states.

A committee from the telephone association held a conference with the council committee on gas, oil and electric light, which resulted in the association being requested to submit a concrete proposition at an early date.

A. C. Lindemuth of Chicago went into details regarding the proposed service before the council committee, and in reply from queries from Aldermen Pringle and Snow, gave data regarding the operations of the Bell company. The committee for the telephone association was told that a local service might not be considered at this time, but that a long-distance service, built along the lines proposed by Mr. Lindemuth, might be accepted by the council.

EXHIBITS AT THE TELEPHONE CONVENTION.

The North Electric Company, Cleveland, Ohio, presented one of the most interesting and novel of the exhibits in the shape of a section of the new Clement Automanual switchboard it has begun to install at Ashtabula, Ohio. The Automanual system, as the name implies, combines certain features of both the manual and automatic switchboards. As explained in a circular given out by the North company, any standard common-battery subscriber's instrument can be used in the new system, as the subscriber calls in the usual way, verbally, giving the number wanted to the operator, who sets it up on a keyboard similar in appearance to that of an adding machine. From this point the operation of selecting a trunk, connecting and ringing the called subscriber is all performed automatically. Immediately the operator has set up one call she is ready for another, and the calls are automatically distributed among the positions, the simple duty of the operators being to set up the numbers. Clearing-out is automatically effected by hanging up the receivers. Edward E. Clement, the inventor of the Automanual system, was present and answered the questions of a great many interested inquirers.

The Sandwich Pole-Changer Company, Sandwich, Ill., showed an operating exhibit of its product which is adapted to supply either alternating or pulsating current. The three contact springs are provided with heavy platinum contacts, and in other respects the Sandwich pole-changer is of extremely rigid and compact construction.

Stanley & Patterson, New York, N. Y., showed a number of sections of the Patterson wireless dry-battery holder, with the special form of dry cell adapted to fit in this convenient holder. One of these types of cell is provided with both the standard binding posts and the screw-thread contacts. The Patterson holder is made with an automatic bridge which restores the continuity of the circuit if any cell is removed.

The Everstick Anchor Company, St. Louis, Mo., showed a number of anchors made on its well-known mechanical principle, so arranged that after the anchor is inserted in an eight-inch hole it may be tamped to expand its plates out into the undisturbed earth.

The Miniature Telephone Booth Company, New York, N. Y., demonstrated two popular forms of its telephone container by the use of which one may secure the utmost privacy in the use of his instrument without actually entering a sound-proof box.

Middleton Bros., Monadnock Block, Chicago, gave practical demonstrations and instruction in the use of testing instruments for locating telephone troubles. The Universal test set was used in these demonstrations.

The Dayton Telephone Lock-out Manufacturing Company, Dayton, Ohio, exhibited the Kneisly-Billman lockout for use on party lines. The hook switches of any subscribers on the line, not called, are effectually locked down until released by the central operator with this system.

The Duplex Metals Company, New York, N. Y., had an interesting exhibit of Monnot copper-clad steel wire, which is manufactured in a variety of forms and sizes for telephone and electrical use. The two metals are welded with a perfect autogenous joint, and the wire combines with the strength of the steel the superior conducting and non-oxidizing properties of the copper covering.

The Baird Manufacturing Company, Chicago, showed its new Baird chronograph. Any number of toll tickets may be "started" in this machine and then "finished" in any order whatsoever, while the machine will print on each the actual duration of the call as well as the time and date.

The Holtzer-Cabot Company, Brookline, Boston, Mass., made a very complete demonstration of its new and leading products. One of these is its new four-frequency multicycle vibrating converter. Another is its composite multicycle motor-generator set. For use with these there is a frequency meter which operates on an escapement principle. A full line of pole-changers, switchboard and telephone parts made up the rest of the exhibit.

The Excelsior Supply Company, Chicago, exhibited two handsome Excelsior autocycles, which are coming to be used to an increasing extent by telephone men in going quickly to the scene of line and other trouble.

The Universal Specialty Company, Terre Haute, Ind., offered a few suggestions on the construction of telephone drop circuits by the use of its Universal insulators adapted to carry two wires.

The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., held the interest of the operators of magneto exchanges with its self-restoring gravity drop and magneto switchboards.

The Homer Roberts Telephone Company, Chicago, Ill., had a number of operating lines of its local-battery party-line system, on which calling is accomplished by lifting the receiver off the hook, as in a common-battery exchange. By an emergency arrangement the subscribers' signaling means is always available, whether his own or any other instrument is in use, so that the line cannot be effectually tied up by any subscriber.

The Illinois Electric Company, Chicago, made a feature of its exhibits of pole seats and circle tops. The latter is somewhat of an innovation in distributing circles, as the entire ring, twenty-one inches in diameter, is of gaspipe covered with circular loom.

The Indiana Steel and Wire Company, Muncie, Ind., exhibited its extra double-galvanized telephone and telegraph wire.

The Fibre Conduit Company, Orangeburg, N. Y., was represented by W. W. Smythe, Jr., western manager, and had on exhibit all sizes of the socket-joint type of Orangeburg fiber conduit as well as its thin-wall-type linaduct and distributing-pole bends and reducers. Sections of four-duct subway showing these products installed in concrete were also shown.

The Automatic Electric Company, Chicago, took the occasion of the Independent telephone convention to introduce its new dial-type of instrument as well as its small calling switch which can be applied to any common-battery set. The Automatic Company operated a complete exchange with a number of instruments equipped with automatic ringing, doing away with the necessity for the calling subscriber's pressing the button.

The American Electric Telephone Company, Chicago, showed a full complement of its line of switchboards, telephones and parts.

The Century Telephone Construction Company, Buffalo, N. Y., manufacturer of switchboards, telephones and parts, occupied Room 628 with an exhibit.

The Chicago Telephone Supply Company, Elkhart, Ind., had rooms 420 to 426 inclusive for its exhibition of telephone apparatus.

The Cracraft-Leich Electric Company, Genoa, Ill., demonstrated the telephones and switchboards of its well-known make.

H. E. Cobb, Chicago, occupied a room on the parlor floor of the Auditorium Hotel with rubber-covered and galvanized wire, general supplies and protective devices.

Frank B. Cook, Chicago, showed some of the latest of his large line of telephone protective apparatus.

The Corwin Telephone Manufacturing Company, Chicago, exhibited intercommunicating switchboards.

W. H. Couch, Boston, Mass., showed a general line of telephone apparatus.

The Dean Electric Company, Elyria, Ohio, made a feature of its harmonic ringers in addition to its general exhibit of switchboard and telephone parts.

The Electric Appliance Company, Chicago, made an exposition of general telephone supplies.

The Fox & Borden Manufacturing Company, New York, N. Y., showed a number of telephone specialties in Room 647.

The H. S. Green Battery Company showed batteries.

Frederick Grier, president, and A. L. Hasse, sales manager, of the Harvard Electric Company, were in daily attendance at the convention.

J. Wiley, of the Standard Underground Cable Company, was a prominent figure among the manufacturers' representatives.

The Manhattan Electrical Supply Company, Chicago, exhibited small power devices.

The Miller Anchor Company, Norfolk, Ohio, demonstrated its expansible anchors for guying.

The Monarch Telephone Manufacturing Company, Chicago, exhibited telephone instruments and switchboards on the convention hall floor.

The Ohio Brass Company, Mansfield, Ohio, had an exhibit of line material.

The National Carbon Company, Cleveland, Ohio, interested the local-battery telephone men with its exhibit of dry cells.

F. W. Pardee, Chicago, showed batteries, wire, receiver shells and cable reels.

The Pierce Specialty Company, Elkhart, Ind., made an exhibit of telephone construction material.

The St. Louis Malleable Casting Company, St. Louis, Mo., showed a number of telephone specialties.

The Sterling Electric Company, Lafayette, Ind., occupied the hotel writing room with a diversified array of the apparatus of its manufacture and exhibited as a rather novel departure a compressed-air and vacuum cleaning system.

The Swedish-American Company, Chicago, showed a complete exhibit of telephones, switchboards and parts.

The Vote-Berger Company, La Crosse, Wis., demonstrated the simplified common-battery exchange circuits made possible by the use of its well-known ballasted lamp. In series with an iron ballast the lamp is placed directly in the line circuit, and on account of the temperature coefficient of the ballast the lamp will come to approximately the same brightness over a considerable range of impressed voltage.

The Warner Electric Company, Muncie, Ind., exhibited a complete line of the well-known Warner pole-changers.

The Westinghouse Machine Company, Pittsburg, Pa., exhibited storage cells of interest to common-battery men.

The Wireless Cable Tester Company, Cedar Rapids, Iowa, had a representative on hand with some faulty cable and by means of a tone-test and exploring coil located the "bug" promptly.

The Influence of High-Tension Lines on Hailstorms.

In a paper before the French Academy of Science, Mr. von Fagniez recently presented evidence of the effect of a three-phase, 45,000-volt line on a hailstorm.

A hailstorm, introduced by a few ball-lightning strokes, followed the course for 8.5 miles. The high-tension line runs parallel to a chain of mountains some two miles away. Previous to the construction of the transmission line, observations established the fact that the mountain chain attracted hailstorms. This is explained, in that the numerous cross valleys diverted the route of the storms so that they followed the main chain.

Contrary to former observations (the line has been in existence about a year), the hailstorm jumped over all cross valleys and followed the course of the transmission line.

The members of the Academy of Science agreed that the storm was influenced by the high-tension line, but were undecided whether the line was the direct cause of the hailstorm.

Western Electric Annual Report.

The annual report of the Western Electric Company for the fiscal year ended November 30, 1908, will show gross sales for the year, running close to $36,000,000, as compared with gross sales of $52,724,168 for the previous year. In 1907 the Western Electric Company earned $1,217,000 applicable for dividends, paying $1,200,000, or eight per cent, on its capitalization of $15,000,000. The economies effected by the company in operating expenses and the reduction of its floating debt and bills and accounts receivable, from the large amounts of former years, will, it is believed, enable the company to declare seven per cent dividends, if not the rate of the previous year.

October is the best month so far this year, and orders were booked at the rate of $44,000,000 a year. November shows the greatest increase in new business, according to the *Wall Street Journal*. One in close touch with the company's affairs says:

"The electrical business has shown a decided improvement during the last few months. Contracts and new developments, held up on account of financial stress, are now being placed under way again, but we look for the greatest improvement to come after the first of the year. The electrical supply business is the most active branch at the present time. We are also meeting with considerable success in demonstrating a low-pressure turbine which will be placed on the market shortly. During the slack times we conducted a more aggressive educational and sales campaign than ever before. Our advertisements appear in seventeen leading periodicals and numerous electrical and machinery trade papers, and we are getting excellent results both in inquiry and orders booked."

There is now little likelihood that the $15,000,000 five-per-cent bond issue, which was authorized some time ago, will come to light in the immediate future, as the conditions which seemed to make the bond issue necessary no longer exist. The bills and accounts receivable item which, for the year ended November 30, 1906, reached the large total of $24,555,074, was reduced to $18,252,060 in the year ended November 30, 1907, and this year's report will show as great a rate of decrease over the preceding year. The floating debt of $11,500,000 for 1907 is now in the neighborhood of $5,000,000, and as the last report showed quick assets of $21,025,669 and a surplus of $18,252,060, a bond issue is not imperative.

Train Dispatching by Telephone.

The use of the telegraph as an instrument for the dispatching and operation of trains on American railroads will soon become obsolete as the result of a recommendation made by a committee at the recent Chicago meeting of the American Railway Association, which represents over 240,000 miles of railroads.

After an investigation extending over nearly a year by a committee appointed to consider the subject it has been found that the telephone is not only as safe as the telegraph for directing the movement of trains but is more efficient and economical. Therefore the railroads are advised to substitute the newer system for the telegraph gradually.

This has already been done on a large number of roads with marked success on steadily increasing sections of their lines. Railroads running out of Chicago have already installed the telephone on over 3,000 miles of line, and as a result of the decision of the association the installations will be rapidly extended. The two systems have been used side by side in many cases, as the same wires can be used for both, but the investigation of the committee has shown that the telephone is so far superior that there is little object in retaining the telegraph except for commercial purposes. The main advantages, according to the committee, are in the saving in time and in the fact that the telephone can be used by anyone.

The investigation of the possibilities of the telephone and the decision to recommend it as a standard instrument are largely the direct result of the workings of the nine-hour law. This made it necessary for the roads to have three instead of two operators at many stations, and to employ 8,000 additional men, increasing their expenses by over $10,000,000 a year. As the Order of Railway Telegraphers has refused to allow its members to instruct student operators it was in many cases difficult to secure the new men, and the roads immediately turned to the telephone as a possible remedy for the situation.

North Shore Electric Officers.

The annual meeting of the North Shore Electric Company, operating in the suburban belt surrounding Chicago, was held November 30. Directors were re-elected as follows: Samuel Insull, Charles H. Randle, Charles F. Spaulding, Edward P. Russell, William A. Fox, Louis A. Ferguson and Frank J. Baker.

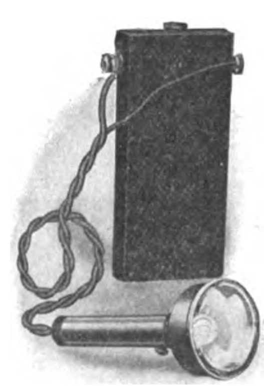
There was represented at this meeting 28,604 out of a total of 29,896 shares.

Electric Head Lamps for Chicago Street Sweepers.

To protect its night workers and sweepers against being run down by the many automobiles which dash rapidly through

STREET CLEANER EQUIPPED WITH ELECTRIC LAMP.

Chicago's boulevards and parkways the South Park Commission has equipped its scavengers with electric head lamps, as shown in the accompanying photograph. The unusual spectacle of these brilliant



PORTABLE ACCUMULATOR AND USUAL FORM OF FLASH LAMP.

little lamps bobbing across the highways in the stretches between the park lights has attracted the curiosity of all who see them for the first time. The lamps are serving their purpose effectively and are a source of very evident pride to their humble wearers.

A two-volt tungsten lamp arranged in a special socket for mounting on the hat of the wearer derives its current from a single pocket storage cell rated at six ampere-hours. This is sufficient to maintain the little lamp from twelve to fifteen hours on a single charge, it is asserted. The storage battery uses lead plates and an electrolyte of so-called "solidified" sulphuric acid, giving a compound of the consistency of table jelly. The cell is about an inch in thickness and measures two and three-quarters by six and one-half inches. It weighs one and one-half pounds.

The charging rate of the cell is one-half ampere, requiring twelve hours for a complete charge. The cell is conveniently charged from a 110-volt direct-current circuit by inserting it in series with an ordinary sixteen-candlepower incandescent lamp.

The outfits, with the exception of the special socket arranged to be fastened on top of the hat, are similar to those used by workmen in oil and gas works, paint factories, etc., and by watchmen, and were furnished by the Vesta Accumulator Company, 1336 Michigan Avenue, Chicago.

Long Trip in an Electric Automobile.

Oliver P. Fritchie, president of the Fritchie Automobile and Battery Company, of Denver, Colo., completed a trip of 1,800 miles, from Lincoln, Neb., to New York city, in an electric victoria of his own manufacture, on Saturday evening, November 28. Mr. Fritchie arrived at the Hotel Knickerbocker, in Times Square, after having been on the road just twenty-eight days.

The motor on the car has a maximum output of ten horsepower, and is geared up to nineteen miles an hour. On one charge it will travel about 100 miles, although on one day it is stated that this distance was exceeded by twenty-five miles, when Mr. Fritchie drove from Toledo to Wooster on one charge. The shortest run was over the blue-clay roads of Iowa, which were sticky and slippery from bad weather, when only forty-five miles was covered.

Although the trip establishes the fact that, under certain conditions, an electric car may be relied upon to travel 100 miles on one charge, it is the opinion of Mr. Fritchie that this record could not be made in an ordinary electric car unless it was handled by an expert electrician.

Proposed Modern Power Plant for India Coal Fields.

Writing from Calcutta, United States Consul-General William H. Michael says that many of the India collieries will have to put in new machinery, some of them complete new equipment, and that to meet this need a company has been organized in Calcutta called the Coalfields Power Syndicate, with a capital of $700,-000.

The object is to provide cheap power for coal-mining purposes. The prospectus of the company says that ten per cent of the coal mined in India is consumed at the mines for power, which for 1907 would be a consumption of 915,296 tons, worth $3 per ton.

It is to try and greatly reduce this unnecessary expenditure that the company has come into existence. It is proposed to sell electrical current at one anna (two cents) per unit, and besides power the company will handle up-to-date colliery equipment, kept in stock, in order to meet any emergency. It is believed that the gross revenue will be $113,666 for sale of power and $31,150 from rentals of colliery equipments. In reference to the need of such a syndicate, the prospectus says:

At the present time many collieries have to face an early replacement of much of their plant, and it is partly owing to this that the present demands on the syndicate for power are so large. It is only since the construction of the railways that the coal fields have been seriously worked, and although the progress for many years was slow, the development has been extremely rapid of late, as the following table of coal raised in Bengal will show:

Year.	Persons Employed.	Output in Tons.	Number of Companies.	Capital.
1904	14,896	7,058,980	28	$6,964,366
1905	33,496	7,234,103	33	7,916,152
1906	36,194	8,677,820	37	8,448,517
1907	39,365	9,993,348	77	15,358,000

The above table shows that the number of companies and their capital employed in coal mining increased very slowly until 1907; since then the expansion has been very rapid, but, as will be noticed from the column of output, there has not yet been time for the new companies to develop their mines, and a large part of the increased capital is therefore not yet productive. A natural result of this expansion is the shortage of labor from which the coal fields are now suffering, and which is considerably restricting the operations of fully developed mines. In fact, as shown in the table, the number of miners available has not kept pace with the output, and shows little elasticity in spite of a greatly increased demand. The slow development of the recently-opened mines is also largely due to deficient labor.

Seasoning and Treating Telephone Pole Cross-Arms.

There are used every year in the United States about 14,000,000 cross-arms for telephone and telegraph poles. Of these, perhaps one-fourth are now treated with preservatives to increase their durability, and there are at least five plants, at New York city, Norfolk, Va., New Orleans and Slidell, La., and West Pascagoula, Miss., at which cross-arms are treated. Because of their small size as compared with the strength required and the weakening effect of the holes for insulator pins, and their constant exposure to all kinds of weather, cross-arms should receive a thorough treatment. A good treatment with creosote will at least treble their durability.

A large portion of the supply of cross-arms comes from the South; they are sawed from the loblolly or old field pine, of which there is a large quantity throughout this region. This tree grows rapidly, but contains much sapwood which is difficult to season. It has been said that "loblolly pine sapwood will rot before it will season in the warm, damp climate of the South." While this is probably overdrawn, it is necessary so to pile the cross-arms that the air may circulate freely about them, and to protect them from rain and snow by a roof of loose boards.

Sapwood absorbs preservatives so much more readily than heartwood that when both cross-arms in which sapwood abounds and those in which heartwood predominates are treated in the same run the former absorb an excessive amount before the latter have received what they require. This is not only a needless expense but a detriment, inasmuch as the excess of creosote in the sapwood later oozes out and drips on those who walk beneath. To solve this difficulty, the cross-arms should be sorted in three classes, as sapwood, intermediate and heartwood, and treated in different runs.

Cross-arms are treated in large, horizontal cylinders varying from ninety to 180 feet in length and from six to seven feet in diameter. Into these the arms are run on skeleton trucks, and the doors are then bolted air-tight. Creosote is next run until the remaining space in the cylinder is filled. Pressure is sometimes then applied by pumps to force the preservative into the wood. In some instances before the preservative treatment, the cross-arms are treated to a bath of living steam, followed by the drawing of a vacuum, to remove moisture and secure rapid penetration of the wood by the preservative.—*From Circular 151 on "Creosoting Loblolly Pine Cross-arms," issued by the United States Forest Service, Washington, D. C.*

Electro-Acoustic Method of Measuring Distances at Sea.

Debrix has invented an ingenious method of measuring the distance of a vessel which cannot be seen, because of darkness, fog, or intervening objects. The method is based on the difference between the velocities of sound and Hertzian waves.

At the receiving station, which we may suppose to be a lighthouse or semaphore station on the coast, a train of clockwork causes a pointer to move over a divided dial at the rate of one division per second. The clockwork is started by a Hertzian wave, which is sent out by the ship simultaneously with a sound wave, produced by a gun, siren, or whistle. As the propagation of Hertzian waves is practically instantaneous, the pointer may be regarded as starting at the instant at which the sound wave leaves the ship. The observer on shore watches the pointer and notes its position at the moment the sound reaches his ears. The distance of the ship is then obtained by multiplying the number of divisions traversed by the pointer by the velocity of sound (about 1,100 feet per second).

The position of the ship can be determined with greater precision, says the *Scientific American*, if the Hertzian and auditory signals are received by two shore stations, which can communicate with each other by telegraph or telephone. The distance of the ship from each station having been found, the ship's position on the chart will be at the intersection of two circular arcs drawn about the stations, as centers, with radii equal to the two distances. The result might then be telegraphed to the ship.

A still better plan would be for each of the chain of coast stations to emit, at regular intervals, simultaneous Hertzian and auditory signals (the stations being distinguished by peculiarities in the signals, as lighthouses are now differentiated). Then any ship provided with the simple receiving apparatus described above could determine its position at any time and make its way safely to port.

Ampere Tablet Unveiled.

A bronze and tile memorial tablet in honor of the French scientist, Andre-Marie Ampere, has been set up in the Lackawanna railroad station at Ampere, N. J., by Dr. Schuyler Skaats Wheeler.

The ceremonies were opened by the acceptance by Vice-President Caldwell, of the Lackawanna Railroad, of the tablet, which His Excellency, the French Ambassador, was requested to unveil.

Dr. Wheeler said that the assemblage had gathered in order to honor the name of Andre Marie Ampere, one of the great founders of electrical science, who was born at Lyons in 1775, and died at Marseilles in 1836. His name has been given to the unit of electrical current, and in every civilized country in the world the word "ampere" is used as much as "pound," "second," or "inch." The present site of the unveiling was named Ampere twelve years ago, but until the Lackawanna Railroad completed the new station there was no appropriate place for such a tablet.

DR. SCHUYLER SKAATS WHEELER, DONOR OF THE AMPERE TABLET.

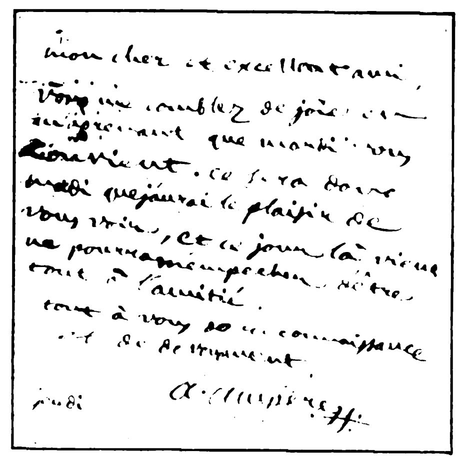
His Excellency said that nothing was more touching for a man from France, and especially for the representative of France, when traveling in America, than to notice so many places bearing French names, recalling ancient French history. There are so many towns and cities recalling the names of Joliet, Marquette and La Salle, and all those early pioneers who settled in the valley of the Mississippi and the north of this great country, and also the famous series of names, Lafayette, Rochambeau and La Luzerne, which are written on the map and also in the hearts of the people. It must not be believed that America is allowed to honor French names without French reciprocation. In France American names confront one at every step. In Paris will be found a boulevard named after Franklin, a street named after Washington, and one named after Lincoln. These names tell of an ancient blessed and solid friendship.

THE AMPERE TABLET, UNVEILED BY HIS EXCELLENCY, THE FRENCH AMBASSADOR, AT AMPERE, N. J., DECEMBER 3.

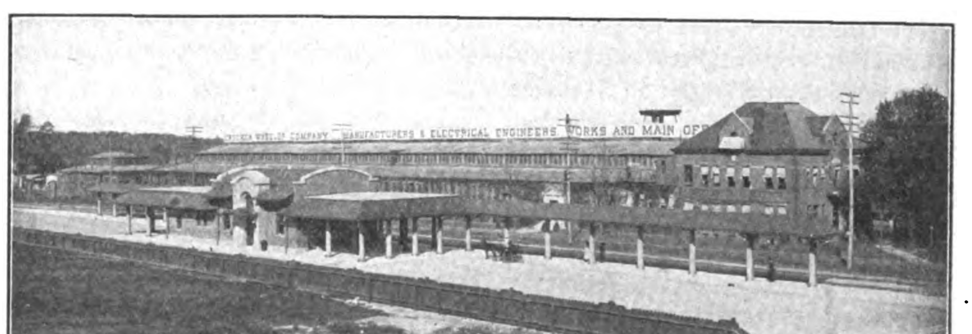
His Excellency is a native of the same town—Lyons—as Ampere. This is one of the oldest cities in France and one of the most peculiar. It is a Roman town, and for a long time was one of the foremost in France, being the first to receive Christianity, and during the Renaissance was at the head of the towns receiving the new learning. Ampere belonged to one of the austere French families. His father was a justice of the peace, and during the revolution followed the dictates of his conscience, and suffered for it. A few hours before his death he wrote in a firm, steady hand his farewell to his wife. He said: "I have in my heart as a consolation the knowledge that I did my duty without fail. I leave you poor, but you will remember that it was through no squandering of mine; no lack of care. The only expense into which I went with some extravagance was for the purchase of mathematical and geometrical books for our little son. There is nothing that I do not expect of him." That little son was the great man who was thus being honored. Ampere's name will survive in books, but, owing to Dr. Wheeler, it will also survive in another way; it will survive on the map of the United States, and the name of Ampere will last forever. His Excellency closed by saying: "As a Frenchman and compatriot I wish prosperity and happiness to Ampere."

Production of Platinum in the United States.

The decline in price of ingot platinum on the New York market from $38 per troy ounce on January 1, 1907, to $25 per ounce on December 31 of the same year, was accompanied by a notable decrease in production of fine platinum—from 1,439 ounces, valued at $45,189 in 1906, to 357 ounces, valued at $10,589, in 1907. Of the total output in the later year 300 ounces came from Butte, Del Norte, Humboldt, Placer, Plumas, Trinity and Sacramento counties, in California, and fifty-seven ounces from Coos, Curry and Josephine counties, in Oregon.


Mon cher et excellent ami,
Vous me comblez de joie en m'apprenant que mardi vous reviendrez. Ce sera donc mardi que j'aurai le plaisir de vous voir, et ce jour là rien ne pourra m'empêcher d'être tout à l'amitié.
Tout à vous de reconnaissance et de dévouement.
A. Ampère

AN AMPERE AUTOGRAPH LETTER.



BIRD'S-EYE VIEW OF THE CROCKER-WHEELER COMPANY'S WORKS AT AMPERE, N. J.

THE NEW YORK MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

ANNUAL MEETING, DECEMBER 1-5. PAPERS AND DISCUSSION.

The subjects attracting the greatest attention at the annual meeting of the American Society of Mechanical Engineers, held December 1-4, in the Engineering Societies Building, New York, were the conservation of national resources, machine-shop practice, aeronautics and the training of workmen. But one paper was presented on this latter subject. The ensuing discussion, however, was most enthusiastic and of a most illuminating character.

The convention was opened on Tuesday evening, with President M. L. Holman's address on the conservation of our national resources. Mr. Holman was present at the recent conference called by President Roosevelt, as the representative of one of the four great engineering societies. In his address he reviewed briefly the work of this conference and the scope of the movement. He touched on the importance of the health and life of the people as a national resource, and the work that is being done along this line. The conserving of the timber supply is another subject of considerable importance. The work of the irrigation engineer enters here as making arid lands available for timbering, and the timbering of land conversely reacts favorably on the fertility of the country. Closely allied to irrigation problems are those of waterpower, although this latter cannot be properly called a problem of conservation. It is merely one of development; the water is there, and its use or non-use for power development does not decrease or increase the available supply. The only real interest in this subject from the conservation standpoint is the preserving to the public good the water rights of available power possibilities. The address went deeply into the subject of mineral resources, chief among which are fuel and iron ore. Improved methods of mining are necessary, both to avoid waste of the material mined and to decrease the awful loss of human life, which is far worse in America than in foreign countries. An interesting point brought out in connection with the conservation of iron ore was that eventually only enough ore would have to be mined to replace the losses of wear and tear. There are thousands of tons of iron in scrap piles which are not utilized because it does not pay to rework it. As the available supply of ore diminishes the scrap dealer will be a much more important factor than he now is.

Following the presidential address, Dr. John A. Brashear was presented to the society for honorary membership, which was conferred on him by President Holman. Dr. Brashear then delivered a most brilliant lecture on stellar photography, in which he traced the formation of planets, etc., illustrating his talk with some remarkable photographs of nebulæ and other celestial objects. He also outlined the method of calculating siderial distances and other computations in the field of astronomy.

The Wednesday morning session was partially given up to a paper on the relation of the engineer to the people, by Morris L. Cooke, who thought that many present-day conditions, among them the broadening of human knowledge, and the generally recognized necessity for co-operation, will force the engineering profession and the individual engineer to take a more direct interest in affairs affecting the public. If engineering is to take full possession of the field which the public is willing it should occupy, more effort must be made to enlighten the public as to the objects and achievements of engineering, more effort must be put forth along lines of purely public interest, and every opportunity given the public to cooperate with the engineer. The discussion on this paper emphasized the necessity of acquainting the public more fully with its vital relationship to the engineering profession, and the necessity of having legislation which involves questions of engineering guided by the national engineering societies. It was shown how proper co-operation between the public and other professions, such as medicine and architecture, had served to bring about an increasing appreciation of their value to the public.

The principal feature of this session was a comprehensive paper by Major George O. Squier, of the Signal Corps of the United States Army, which dealt with the present status of miltary aeronautics. This paper outlined quite completely the types of successful military balloons in the United States and foreign countries, detailing the construction of the dirigible French types, of Count Zeppelin, and of the United States and England. It also took up the problems of design of these types, and then discussed aeroplanes in much the same fashion. The work of Herring, Farman, the Wright brothers and others was explained, and the action of airshps was compared to that of vessels navigating the water. The application of airships to warfare was considered, and it was shown, and the manner in which they would work for peace and delimit frontiers was brought out.

In connection with this subject, Lieut. Frank P. Lahm, also of the Signal Corps, gave a stereopticon lecture on Wednesday evening, which was also illustrated with moving pictures, showing in flight the Zepplin dirigible balloon, and the Wright brothers' aeroplane.

The Wednesday afternoon session comprised two papers on fuel-oil burning, by C. R. Weymouth, of San Francisco, Cal., and two others on the total heat of saturated steam and on a method of obtaining ratios of specific heat of vapors. In Mr. Weymouth's first paper are presented results of tests at the 15,000-kilowatt power plant of the Pacific Light and Power Company, Redondo, Cal., having steam-engine prime movers, crude oil being used as fuel. The fuel economy is stated for tests on a 5,000-kilowatt plant unit at various uniform loads, approximating 2,000, 3,000, 4,000 and 5,000 kilowatts; on a variable railway load; and also for the entire station on a similar variable railway load. The operating and test conditions are fully described.

The results given indicate a remarkable plant economy under all conditions, but the particularly striking feature is the almost uniform fuel economy for the plant unit for all fractional loads from about one-half load up to the maximum load tested. The author believes that the results warrant a careful investigation as to the possibilities in the line of superior plant fuel economy, using the more modern types of steam engines as prime movers.

The second paper described the unnecessary losses in firing fuel oil and an automatic system for eliminating them as installed in the Redondo plant.

An oil-pump governor actuated by variations in the boiler steam pressure so varies the oil pressure in a common oil main, and accordingly the simultaneous rate of firing in all burners, as to maintain practically uniform steam pressure at the boilers. This variation of pressure in the oil main is the secondary means for controlling the supply of steam to the burners for purposes of atomization, and also for controlling the amount of damper opening, and thus the air supply for combustion. Due to this automatic and synchronous adjustment of all the functions of the boiler and furnace, there results on plants subject to fluctuating load an increased boiler economy, which is due to the more uniform rate of firing, the saving in steam used for atomizing the oil and the reduction to a minimum of the air supply for combustion.

In the discussion which followed these papers, the speakers almost uniformly took exception to the implied statement that reciprocating engines were largely responsible for the good showing made, and to the statement that as a steam turbine would only show high economy in connection with a good vacuum, the vacuum should be charged back against the turbine. This was considered to be most unfair to the turbine. The speakers all contended that turbines, operating under similar conditions, would show just as high if not higher economy than the engines.

A. R. Dodge's paper on the specific heat of vapors considered a method of obtaining ratios of specific heats which does not involve the use of available steam tables conceded to be too inaccurate for such investigations, nor a condition in which the steam is presumed to be without moisture or superheat. This method is based upon the expansion of initially superheated fluid in a throttling calorimeter, and tables are included showing data for steam.

Harvey N. Davis' paper on the heat of saturated steam stated that Regnault's formula for the total heat of saturated steam, $H = 1091.7 + 0.305 (t - 32)$ British thermal units, is considerably in error. This conclusion is confirmed by computing H above 212 degrees, in terms of H_{212}, from the throttling experiments of Grindley, Griessmann and Peake, and the direct specific-heat determinations of Knoblauch and Jakob. The result is: $H = H_{212} + 0.3745 (t - 212) - 0.000550 (t - 212)^2$. The best value of H_{212} seems to be 1150.3 British thermal units. The range of the new formula is from 212 degrees to about 400 degrees. The greatest error in Regnault's formula in this range is six British thermal units at 275 degrees, but if extrapolated to higher temperatures the error in it increases very rapidly. Below 212 degrees the observations of Dieterici, Smith, Griffiths, Henning and Joly show a thoroughly satisfactory agreement among themselves, and prove that Regnault's formula runs high, the error reaching eighteen British thermal units at thirty-two degrees. There are corresponding errors on the specific volume values ordinarily used.

Most of the speakers discussing these two papers did so by means of complicated formulæ on the blackboard, which it was impossible for the audience to follow.

The papers presented on Thursday morning were almost wholly devoted to machine-shop practice. A. L. De Leeuw read one on efficiency tests of milling machines, which points out the desirability of indicating the power of a machine tool by the amount of metal which it is capable of removing. It shows the results of tests made for finding the net horsepower required to remove a given amount of metal under given conditions. Other tests were made to determine the efficiency of the feed and driving mechanism. In this connection an electrical method was used, comprising two machines, rigidly connected at their spindles, one being driven by a motor, and the other driving a generator. The power input was determined, from the electrical readings, the efficiency curve of the motor being known, and the output of the generator was also measured. From the difference in power of the two electrical machines the efficiency of the milling machines was easily determined. The discussion on this paper, and on the one which followed, describing a new high-speed milling cutter, dealt mostly with questions of the proper shape of metal cutting tools, and incidentally touched on the revolution in machine-shop practice brought about by the motor drive.

A paper on interchangeable involute gear-tooth systems, by Ralph E. Flanders, gave diagrams showing the effect of varying the pressure angle and addendum on the various practical qualities of gearing, such as interference, number of teeth in continuous action, side pressure on bearings, strength, efficiency, durability, smoothness of action, permanency of form, etc. After comparing typical examples of interchangeable gear systems in these particulars, the author concludes that a new standard for heavy, slow-speed gearing is advisable.

The paper provoked a rather aimless discussion which showed mainly that there were yet many things to be learned about gearing. The discussion was so protracted that it had to be continued at an afternoon session, at which Norman Litchfield's paper on spur gearing in heavy railway-motor equipments was read and which dealt with the breakage of gearing in heavy electric-railway service, as typified by the equipments of the Interborough Rapid Transit Company, New York, which operates the elevated and subway lines. A resumé is given of the methods employed to overcome the breakage, and the strains in the teeth as calculated by the Lewis formula are shown. Attention is called to the fact that this formula is not entirely applicable on account of the difficulty in maintaining alignment of gear and pinion.

The paper attracting the most attention at the regular Thursday afternoon session was Henry L. Gantt's on training workmen in habits of industry. In this paper Mr. Gantt says that until within a few years the mechanic was necessarily the source and conserver of industrial knowledge, and on him rested, therefore, the responsibility for training workmen. With the advent of the scientifically-educated engineer capable of substituting a scientific solution of problems for the empirical solution of the mechanic, the responsibility of training workers naturally shifts to his shoulders. If he accepts this responsibility, and bases the training on the results of scientific investigation, the efficiency of the workman can be so greatly increased that the manufacturer can afford to give those that take advantage of this training compensation in excess of that usually paid for similar work.

Many speakers warmly praised Mr. Gantt, who was associated for many years with F. W. Taylor while the latter was developing his system of shop management. It was brought out that men trained under Mr. Gantt's principles made better workmen, better managers, received higher pay and were more contented than the average man. The speakers especially commended the helpful and humanitarian tone of Mr. Gantt's paper, in which it was shown that the operation of the principles therein enunciated was to the benefit of employer and workman alike. The testimony of all who had used the systems developed by Mr. Gantt and Mr. Taylor was to the effect that the results were far beyond their most sanguine hopes.

A liquid tachometer was described at this session by Amasa Trowbridge, of great accuracy and simple construction.

A paper of considerable interest was that of C. J. Mellin on articulated compound locomotives, which was discussed by S. M. Vauclain by means of lantern slides which traced the development of the Mallet locomotive.

Another paper of considerable interest, also accompanied by lantern slides, was that of S. Ashton Hand, on industrial photography. Mr. Hand outlined the steps necessary to attain success in photographing machinery, and gave a resumé of the methods used by him to correct errors of focusing, exposure, developing and printing. The paper was most interesting and was well received.

At the meeting of the Gas Power Section, held Thursday afternoon, L. H. Nash gave some reminiscences of gas-engine design, which formed a brief outline of certain features that have been tested from time to time, many of which have taken their places in the development of the gas-engine art, some being abandoned after trial for commercial use. The intention of the article is to stimulate thought along the lines referred to. Among other things, is a brief mention of a method of operation for marine purposes, many of the chief features of which are in more or less active service today, although there are others which seem to possess value enough to warrant their being brought to the attention of the engineering profession.

Another paper presented at this session was entitled "Possibilities of the Gasoline Turbine." This was by Prof. Frank C. Wagner. In order to reduce the temperature of the gases at the turbine wheel, either an excess of air or water injection may be used. The relative efficiencies of the two methods was shown to depend upon the amount of compression used, and the efficiencies of the turbine and the air compressor. The work required to compress the air may be materially reduced by using two-stage or three-stage compressors with intercoolers. It appears that with high compression the gasoline turbine may be expected to give efficiencies comparing favorably with the reciprocating gasoline engine.

The papers read at the Friday morning session attracted but little attention, due mainly to the many excursions arranged for this time, which cut into the attendance on the professional session. The papers were on the slipping points of rolled boiler-tube joints, on the storage and transmission of carbonic acid and on an averaging instrument for polar diagrams. There was almost no discussion, and the meeting adjourned at an early hour. During the meeting it was announced that Jesse M. Smith, of New York, had been elected president, and that 191 new members had been elected. Preliminary steps for the formation of a section on the machine shop were also taken.

The entertainments and excursions provided for the meeting were on an elaborate scale. In addition to the two illustrated lectures noted above, and the regular reception, there were excursions to various power stations around New York, to the Pennsylvania tunnels and terminals, to the Queensboro bridge, to the high-pressure fire-service stations, and to many manufacturing plants.

Hudson River and Pennsylvania Telephone Companies Absorbed by the Bell.

Stockholders of the Hudson River Telephone Company and the New York & Pennsylvania Telephone and Telegraph Company have been advised by Francis G. Wood, secretary of the companies, that their stock holdings will be exchanged for stock in the Bell Telephone Company of Pennsylvania. The exchange will be made on the basis of one share of Bell Telephone Company of Pennsylvania stock for two shares of New York & Pennsylvania Telephone Company stock. In the case of the other company, the offer is on the basis of one share of Bell Telephone Company of Pennsylvania for one-and-one-half shares of Hudson River Telephone Company.

The outstanding capital stock of the Hudson River Telephone Company is $3,909,900, of which $2,033,100 is owned by the American Telephone and Telegraph Company. The latter company also owns half of the $1,000,000 capital stock of the New York & Pennsylvania Telephone and Telegraph Company.

The Bell Telephone Company of Pennsylvania operates throughout a large part of Pennsylvania, New Jersey, and Maryland, and in a portion of Delaware and the District of Columbia. It embraces such cities as Philadelphia, Harrisburg, Allentown, Wilkesbarre, Lebanon, Williamsport, Camden, Wilmington, and other points, and further south it includes Baltimore and Washington.

The gross earnings of the Bell Telephone Company of Pennsylvania, in 1907, were $7,670,439; net earnings were $2,410,953. This was an increase of $925,931 in gross over 1906, and $456,835 in net earnings.

The Bell Telephone Company of Pennsylvania has paid a dividend of six per cent for a number of years. The Hudson River Telephone Company has paid no dividends since the latter part of 1907, when it paid four per cent. The New York & Pennsylvania Company has paid no dividends since 1900.

Steam Railroads Must Exchange Carload Freight with Indiana Electric Lines.

The Indiana Railroad Commission has rendered a decision making it incumbent upon a steam road to enter into an interchange of carload traffic with an interurban road, regardless of whether two or more steam roads have entered into an agreement not to exchange their car traffic. The decision followed litigation between the Winona Interurban Railway Company and the Big Four Railroad, wherein the former sought to compel the latter to deliver any cars to the interurban railway at Warsaw. The Commission holds that interchange of traffic such as is involved in this case, and where there is a physical connection between the steam and interurban line, would enlarge the opportunities of the shipping public, and would also bring steam and interurban roads into rightful competition.

The contention of the officials of the steam line that the interchange of traffic in carload lots with interurban roads would bring their equipment under the control of the interurbans and their rolling stock into use for interurban business, the Commission holds is not well taken since the Commission can and will prevent any such abuse of equipment by the interurban companies. The decision is regarded of great importance, and it remains to be seen if the steam road will make any further resistance to the order of the Commission. S.

Pennsylvania Trolley and Light Merger.

The United Gas and Electric Light Company and the Irondale Electric Light Company, of Bloomsburg; the Standard Gas Company, of Danville; the Berwick Electric Light Company, of Berwick, and the Columbia & Montour and the Danville & Bloomsburg Electric Railway companies, all in Pennsylvania, have been merged into one corporation.

The electric power houses in some of the towns mentioned will eventually be dispensed with, it being the purpose to secure some of the power necessary for operating the trolley roads from Harwood, near Hazleton, where a mammoth plant, which uses the culm from nearby banks for fuel, has been erected.

The personnel of the new company is not announced. The deal was consummated by E. R. Sponsler, of Harrisburg, and A. W. Duy, of Bloomsburg, who have been working on it for several months.

It is understood that a number of improvements will be made.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

ONEIDA RAILWAY COMPANY.

The report of the Oneida Railway Company for year ending June 30 shows as follows: Gross operating revenue, $288,972; operating expenses, $184,448; net operating revenue, $104,524; taxes accrued, $5,830; operating income, $98,694; other income, $1,279; gross corporate income, $99,974; fixed charges, $3,910; net corporate income, $96,064; cash on hand, $23,657; profit and loss, surplus, $91,095.

MASSACHUSETTS ELECTRIC.

The Massachusetts Electric Companies has issued its ninth annual report, covering the year ended September 30, 1908. The consolidated income account shows as follows: Gross, $7,809,010; expenses, $5,001,517; net, $2,807,492; charges, $1,784,437; balance, $1,023,054; dividends, $880,773; surplus, $142,281, as against $174,462 for the previous year. The profit and loss statement of the parent company compares as follows: Dividends on stock owned, $880,841; miscellaneous interest on notes, $107,961; total income, $988,802; total expenses, $19,395; net income, $969,407; interest on notes, $157,500; surplus, $811,907; total surplus, $2,378,791, which compares with $1,566,884 for the preceding year.

The number of passengers carried by the Boston & Northern and Old Colony street railways, constituent companies of the Massachusetts Electric Companies, during the fiscal year ended September 30, 1908, was 149,649,383, against 148,554,127 in the 1907 fiscal year, an increase of 1,095,256, or three-fourths of one per cent. The 1907 increase over 1906 was 5,990,991, or 4.2 per cent.

The annual meeting of the Massachusetts Electric Companies will be held at Tremont Temple, Boston, December 16, at noon. Shareholders will be asked to authorize the trustees to sell the six per cent preferred stock of the subsidiary companies, which the railroad commissioners recently authorized.

NORFOLK & PORTSMOUTH TRACTION.

The report of the Norfolk & Portsmouth Traction Company for the month of October and ten months ended October 31 shows as follows: October—gross, $156,795; expenses, $88,316; October—net, $68,479, as against $98,561 for October, 1907. Ten months' gross, $1,552,029; expenses, $923,587; ten months' net, $628,442, as compared with $875,190 for 1907.

SYRACUSE RAPID TRANSIT.

The Syracuse Rapid Transit Railway report, as filed at Albany, for the year ended June 30, 1908, is as follows: Gross, $1,292,886; expenses, $822,197; net, $470,689; other income, $19,405; total income, $490,094; charges, $334,606; surplus, $155,488; dividends, $70,188; year's surplus, $85,300, which compares with $127,808 for the preceding year. Cash on hand, June 30, $85,300; profit and loss surplus, $439,931.

UNITED TRACTION OF ALBANY.

The United Traction Company's report, as filed at Albany, for the quarter ended September 30, 1908, is as follows: Gross, $520,679; expenses, $302,187; net, $218,492; other income, $40,014; total income, $258,506; charges, $98,877; surplus, $159,629, as against $174,854 for the preceding year.

HUDSON VALLEY RAILWAY COMPANY.

The Hudson Valley Railway Company's report, as filed at Albany, for the quarter ended September 30, 1908, shows as follows: Gross, $196,474; expenses, $135,558; net, $60,916; charges, $56,661; surplus, $4,255, a decrease of $34,418, as compared with the corresponding quarter of 1907.

NORTH SHORE ELECTRIC.

For the fiscal year ended September 30, 1908, the North Shore Electric Company, which supplies electrical energy in the suburbs about Chicago, reports gross earnings of $815,551; expenses (including taxes and rentals), $533,619; net earnings, $281,932; interest on bonds, $159,283; special depreciation reserve, $64,100; dividends, $42,702; balance, $15,847; total surplus, $119,970. The plants, real estate, franchises, etc., were valued at $7,110,924 and the total assets at $8,096,745. The outstanding capital stock was $3,780,000; bonds amounted to $3,715,000. The profits for the year were equal to substantially three-and-one-half per cent on the capital stock.

LONDON UNDERGROUND.

The Underground Electric Railways of London report earnings for each division of the system for the week and twenty weeks ended November 14 as follows: Baker Street and Waterloo, £3,145; Piccadilly, £5,445; Hampstead, £3,530; District, £10,106; Tramways, £5,192; total, £27,418, an increase of £2,354 over the same week of 1907. Total twenty weeks to date, £560,511, compared with £484,362 for the preceding year, an increase of £76,449.

DETROIT UNITED.

The report of the Detroit United Railway Company (all properties) for the month of October and ten months ended October 31 is as follows: October gross, $613,127; expenses and taxes, $412,650; October net, $200,477; other income, $6,363; total income, $206,840; charges, $133,379; October surplus, $73,461, which compares with $66,122 for October, 1907. Ten months' gross, $5,937,982; expenses and taxes, $3,807,903; ten months' net, $2,130,079; other income, $51,420; total income, $2,181,499; charges, $1,352,239; ten months' surplus, $829,259, as against $954,363 for the corresponding months of 1907.

ROCHESTER & EASTERN RAPID.

Rochester & Eastern Rapid Railway's report, as filed at Albany, for the year ended June 30, 1908, is as follows: Gross, $279,816; expenses, $221,520; net, $58,296; other income, $207; total income, $58,503; charges, $106,214; deficit, $47,711, which compares with a deficit of $30,095 for 1907.

MONTREAL STREET RAILWAY.

The report of the Montreal Street Railway Company for the month of October is as follows: October gross, $328,608; expenses, $168,124; October net, $160,484; charges, rentals, etc., $27,480; October surplus, $133,003, as compared with $119,455 for the corresponding month of 1907.

TOLEDO RAILWAYS AND LIGHT.

The report of the Toledo Railways and Light Company for the month of October and ten months ended October 31 is as follows: October—Gross earnings, $218,074; operating expenses, $119,982; net earnings, $98,092; other income, $187; total income, $98,279; charges and taxes, $71,953; surplus, $26,326, as against $30,138 for October, 1907. January 1 to October 31—Gross earnings, $2,082,897; operating expenses, $1,139,806; net earnings, $943,091; other income, $3,260; total income, $946,351; charges and taxes, $707,696; surplus, $238,655, a decrease of $11,786 from the surplus for the corresponding period of 1907.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER II. (PART I).—GENERATORS.

TYPES OF ALTERNATING-CURRENT GENERATORS.

In order to generate an electric current there must be relative motion between a conductor and a magnetic field. So far as the production of the current is concerned, it is immaterial whether it is the conductor or the magnetic field that is in motion.

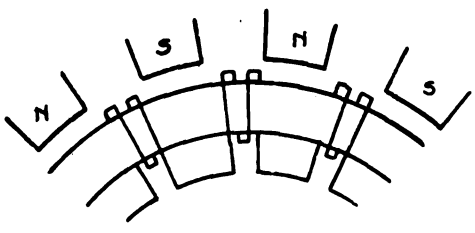


FIG. 38.—RING-WOUND ARMATURE.

In an alternating-current generator in which the conductor rotates and the magnetic field is stationary we have what is known as the rotating-armature type of alternator. It is similar to the direct-current generator in arrangement of analogous parts.

When the magnetic poles are rotated past a stationary armature in which the electromotive force is induced, the machine is called a rotating-field alternator.

In the inductor type of alternator both armature and field parts remain stationary, while the rotation of a magnetically-conducting element past the parts effects an alternating shunting of the field flux through the armature coils, securing the relative motion defined as necessary to electromagnetic induction.

THE ELECTROMOTIVE FORCE OF AN ALTERNATOR.

The electromotive force generated by an alternator as read by a voltmeter at the terminals is as follows:

$$\text{Terminal voltage} = \frac{2\pi f \phi N}{\sqrt{2}\, 10^8} = \frac{4.44 f \phi N}{10^8}$$

where N represents the number of turns of wire in series enclosing the magnetic flux, ϕ the number of lines of force from each pole passing through the winding in which the electromotive force is generated, and f the cycles per second, which equals the number of revolutions per second multiplied by one-half the number of poles. The voltage is thus proportional to the strength of the magnetic field, the number of conductors in the armature, the number of poles and the speed.

ROTATING-ARMATURE GENERATOR.

The rotating-armature generator is a type that has played a very important part in the development of alternating currents, although it is now being displaced by machines in which the field coils rotate.

The armatures of this class of machines have been wound in various ways. At first the armatures were in the shape of discs. Later they took the form of iron rings wound with insulated conductors, as shown in Fig. 38. The type generally in use in this country, however, is the so-called drum armature, illustrated in Fig. 39. It is similar in appearance to that used in a direct-current generator, although the simple alternator has no commutator, being provided with only collecting rings. In some machines, however, there is a commutator for rectifying part of the current for exciting the fields. The armature windings are embedded in slots in the laminated iron core. The more iron around the conductors and the less air-gap between them and the magnetic poles, the greater will be the magnetic flux. The iron is laminated transversely to the axis to decrease the eddy-current losses.

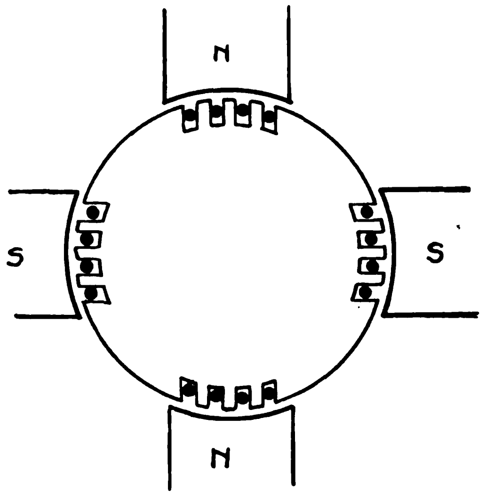


FIG 39.—DRUM-WOUND ARMATURE.

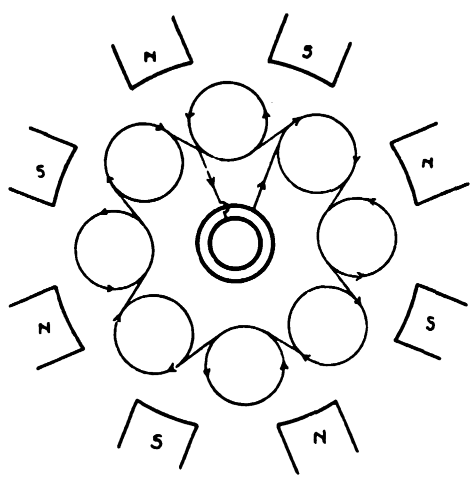


FIG. 41.—METHOD OF CONNECTING ARMATURE COILS OF AN EIGHT-POLE ALTERNATOR.

A six-pole generator of this type is illustrated in Fig. 40. The six pole windings are arranged symmetrically within the iron frame. The armature windings are in six corresponding coils, all connected in series; the terminals are connected to the collecting rings in the center, as shown. The magnetic lines of force pass from an N pole across the short air-gap into the iron core within the surrounding coil of insulated conductor, and then divide, part of the flux passing in one direction through the iron and up through the coil opposite one of the adjacent S poles, and part to the S pole on the other side.

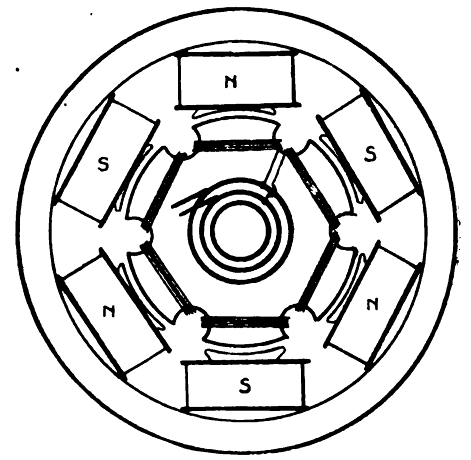


FIG. 40.—SIX-POLE, SINGLE-PHASE ALTERNATOR.

METHOD OF CONNECTING COILS.

The method of connecting the coils is shown more clearly in Fig. 41. Consider the loops as filled with iron, the coil being wound within the slots opposite the pole pieces. Adjacent coils are wound in opposite directions, as the adjacent poles are of opposite polarity. They are all connected in series, as shown, and the terminals are connected to the collecting rings in the center. The current is taken from these by means of brushes (not shown).

EXCITING CURRENT.

A direct current in the field coils is necessary to produce the magnetic flux. This is usually obtained by means of a small direct-current generator. The alternator is then said to be separately excited.

MAGNETIC SATURATION.

When an alternator is driven at constant speed and no load, no current being drawn from its armature, its electromotive force increases, approximately as the current through the field coils increases, up to a certain point, as shown in Fig. 42. At the maximum the iron is said to be saturated with magnetism, since any further increase of the field current is

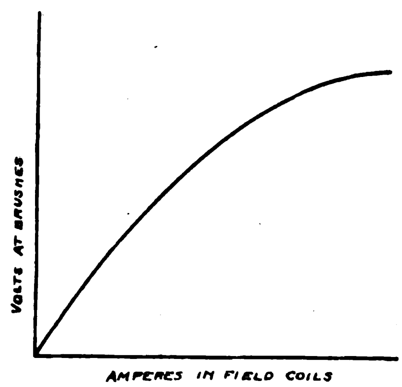


FIG. 42.—MAGNETIC SATURATION OF ALTERNATOR FIELD.

without effect on the electromotive force generated.

When iron is magnetized it may be considered that some of its component particles swing into line just like so many compass needles near a magnet.

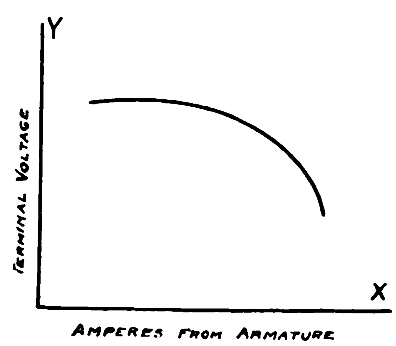


FIG. 43.—DROP OF ALTERNATOR ELECTROMOTIVE FORCE WITH INCREASE OF LOAD.

The more the iron is magnetized the greater the number of particles are to be thought of as lined up in the same direction, until finally, when they are all in line, the magnetic "saturation point" is reached.

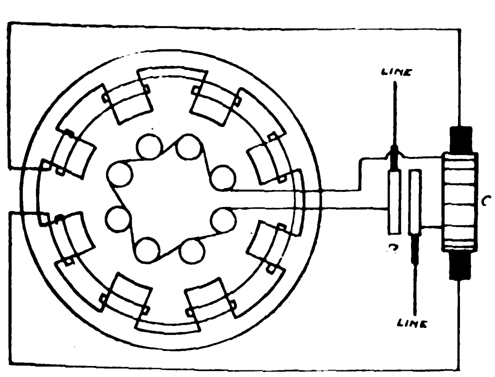


FIG. 44.—SERIES-WOUND ALTERNATOR.

RELATION BETWEEN TERMINAL VOLTAGE AND LOAD.

As the load on an alternator changes, the field excitation remaining constant, the electromotive force drops, as shown in Fig. 43. The voltage at the terminal of the generator is plotted along the axis OY, and the current drawn from the armature is plotted along the axis OX. As the load increases, the voltage decreases. Increasing the current through the field coils will again increase the electromotive force generated. This can be done by hand regulation of a rheostat placed either in the external circuit of the direct-current exciter or in the field circuit of the exciter in case the latter is a shunt-wound machine.

SERIES-WOUND ALTERNATOR.

When all of the current is rectified and passed through the field coils, the gener-

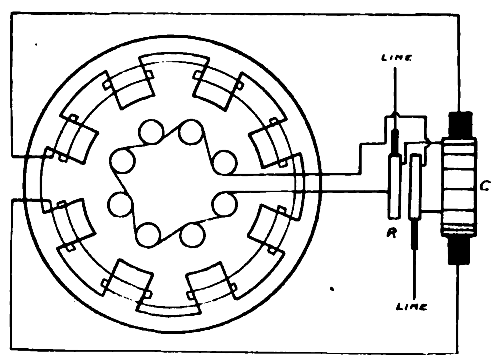


FIG. 45.—SHUNT-WOUND ALTERNATOR.

ator is series wound and is much like the series-wound direct-current machine. The method of connection is illustrated in Fig. 44. The armature windings are represented by the inner coils; one of the ter-

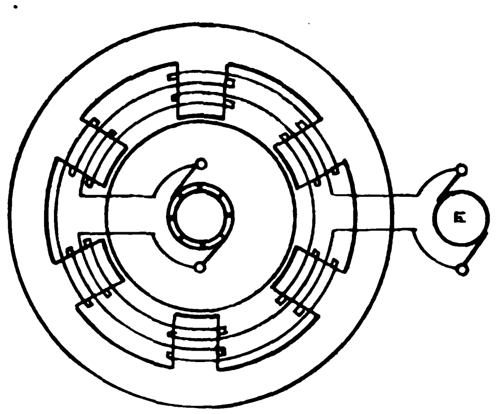


FIG. 46.—COMPOSITE EXCITATION OF ALTERNATOR.

minals is connected to one of the collecting rings R and the other to the commutator C, which is again connected to the other collecting ring. The current is thus unidirectional only while passing through the field coils.

SHUNT-WOUND ALTERNATOR.

In the shunt-wound type the commutator difficulties are not so great, for only a part of the current passes through the field coils, as shown in Fig. 45. The armature is connected directly to the collecting rings, and the field coils are connected in parallel through the commutator.

SEPARATELY-EXCITED ALTERNATOR.

A very common method of excitation is by means of a direct current from a storage battery or a small direct-current generator belted or direct-connected to the alternator, or to the prime mover. The current through the fields is usually controlled by hand regulation by means of a rheostat in the alternator field circuit or in the shunt winding of the exciter. This is known as a separate excitation.

COMPOSITE EXCITATION.

In some cases there are two separate windings in the field coils, one for self-excitation, the other for separate excitation, as shown in Fig. 46. The regulation of the alternator is then partly automatic, but subject at the same time to hand regulation, thus making a very practical combination.

[*To be continued.*]

Electrician's Helper—United States Civil Service.

The United States Civil Service Commission announces an examination on January 13, at the usual places, to secure eligibles to fill a vacancy in the position of electrician's helper, $50 a month, in the office of the Secretary, Department of Agriculture, and other vacancies requiring similar qualifications.

With reference to the above specific vacancy the Department states that the length of time that it will be able to retain the services of an electrician's helper depends on the amount of work that comes into the shop and also the funds available for the employment of a helper, both of which are impossible to determine in advance.

The examination will consist of subjects weighted as indicated:

Letter-writing, over 125 words, 10; practical questions, elementary in character, relating to the wiring of buildings and installation and care of minor electrical apparatus, 45; experience as electrician's helper, 45.

Applicants whose applications show that they have had less than one year's experience as electrician's helper will not be admitted to the examination. Age limit, eighteen years or over on the date of the examination.

Applicants should at once apply either to the United States Civil Service Commission, Washington, D. C., or to the secretary of the board of examiners at any of the usual places, for application Form 1093.

Developments in Electrification of Railway Terminals.

At a regular meeting of the Western Society of Engineers, held on the evening of December 2, H. H. Evans, secretary of the Chicago council committee on local transportation, presented an interesting paper on "Developments in Electrification of Railway Terminals." It was based principally upon the investigation of the subject made by Mr. Evans and other city officials of Chicago relative to the electrification of the Chicago terminals, particularly that of the Illinois Central Railroad, and which resulted in a voluminous report that was recently completed and which was abstracted in the WESTERN ELECTRICIAN of October 31.

Mr. Evans said that electrification of terminals may be brought about for three distinct reasons: 1, to obviate the nuisance to the public in general and to the passengers in particular; 2, to effect a saving in operation, or 3, to increase the capacity of the system. Each of these factors may be involved to a degree, although usually one of them predominates.

The density of traffic is a vital factor in determining the feasibility of any electrification project. A number of these projects have been carried out in cities that have tunnel entrances to the terminals. In such a situation electrification is practically imperative on account of the danger to life from smoke and sulphurous fumes in the tunnels. The damages caused by smoke, cinders and other objectionable features of steam locomotives both to property adjacent to the lines and to the discomfort of passengers are becoming elements that are bringing about electrification in an increasing number of instances.

The advantages of electrification to any railroad, particularly at its terminals, are manifold. Less cleaning and therefore less wear will be required of the passenger coaches. Decidedly longer life will be allowed to viaducts, bridges and other steelwork over or adjacent the tracks. This will be due to the elimination of sulphurous corrosion, which has weakened and greatly shortened the life of such structures; a viaduct in Boston that was recently examined was a forcible illustration of this fact. Less wear and tear will result on the rolling stock because of the uniform tractive power of the electric motor.

A higher working speed and therefore considerably more mileage is possible with electrical equipment because of the much higher acceleration produced. There will be much less dead movement and dead switching, as the electric locomotive does not have to go to the roundhouse after each run. The New York Central has cut down its dead mileage at the New York terminal more than one-half. There will result a much greater economy in coal consumption, about one-half of that of steam being found sufficient. This factor is of much greater importance where the cost of coal is fairly high. This saving in coal has led to the electrification of at least one or possibly two roads near San Francisco.

The electric locomotive is always ready for operation. Its cost of repairs is decidedly less. This has been found to run about three cents per mile against eight to eleven cents with the steam locomotive. This item is still less on electrically-equipped coaches, particularly where the multiple-unit system is used. With the latter system the entire cost of repairs of steam locomotives in suburban service can be saved. No dead weight has to be hauled as in the case of the locomotive tender loaded with coal and water. Greater loads are possible on an electrified system, since these are limited only by the strength of the drawbar. Delays due to bad weather are very much diminished when the electric locomotive is employed. Its efficiency, if anything, is increased in cold weather, whereas that of the steam engine is much reduced.

The higher speed attainable with electrified service results in a much higher car-mileage capacity. The reasons for electrifying suburban service have generally been rather for getting more revenue from it than for saving money in its operation. The higher speed attracts a greatly increased traffic. With stations as near together as they usually are in suburban service the increased acceleration permits of this higher speed. Operation on the multiple-unit system allows much more frequent service, which is another factor in building up the traffic.

One hour is the maximum limit that people going to and from work care to spend in traveling, even to the remotest suburbs. Increased and faster service on the street cars has increased the distance to which people are being daily carried and has resulted in building up the suburban districts. As the city builds up, however, the zone of the congested traffic steadily widens and this element limits the speed of street-car service. To reach the desirable suburbs, therefore, the most satisfactory means of transportation are by elevated or subway lines, both of which are very costly to build, or by means of the steam railroads that pass through the suburbs. Electrification of their lines seems the very best and cheapest way of building up the suburban districts.

While most electrification projects have at first been confined to suburban traffic only, the complete equipment of the road, so as to provide for the through passenger and freight service as well, results in a very much better load factor on the generating station, since freight is generally moved at other than the rush hours.

Real estate required for the large terminals in our great cities is steadily becoming more expensive. In order to provide for the gradually increased traffic enlarged capacity is necessary, and the cheapest way to obtain it is by electrification, as the present facilities can then be made to accommodate an increased number of trains. To even out the load factor a light freight and express traffic may readily be developed to accommodate the large merchants of the city. This may be arranged to deliver parcels to suburban districts frequently and quickly.

Where the cost of real estate is as high as for instance in New York city, the plan of building an office or warehouse structure over the tracks may be resorted to where these are electrically equipped. It has been proposed to build eighteen or twenty-story warehouses over such an electric terminal. The New York Central makes use of a double-deck terminal, separate levels being provided for the through passenger and suburban trains. This is possible only with electrified service.

At the conclusion of Mr. Evans' address he cited and described at considerable length a great many of the electrification projects that have been so far carried out. He described the New York Central, the New Haven, the Long Island and the Pennsylvania projects in and near New York city, the Baltimore and Ohio tunnel, the North Shore and Southern Pacific lines near San Francisco, the electrified roads around London and Paris, electrified Italian roads, and also the recently-planned project for Melbourne, Australia, where 298 miles of track will be electrified ultimately. He concluded with a brief reference to the situation on the Illinois Central Railroad in Chicago.

The discussion of the paper was opened by P. Junkersfeld, who spoke of a number of ways in which the fixed charges of an electrification project can be reduced and how the load factor on the station can be improved. One suggestion in this connection was that the time of leaving for several competing trains be made different instead of having them leave practically at the same hour. The importance of more frequent and better service on suburban lines that is permissible with electrification is very great in increasing the revenue of these roads.

E. N. Lake said the elements of electrification are very simple. The only element of a steam road as now equipped that is affected by electrification is the steam locomotive, which represents an investment of but five per cent of the total railroad property. He cited Mr. Wilgus' figures on depreciation and fixed charges as being forcible arguments in favor of electrified service. He believes that it is a good thing that there has been the competition between the single-phase overhead and the direct-current third-rail systems on practically similar lines, as it has compelled the manufacturers to perfect their equipment to the highest possible standard and therefore to make it as reliable as can be expected.

James Lyman stated that while electric operation has been regarded hitherto by many as experimental, it is no doubt true that it has passed through these stages, as is shown by the large number of lines already successfully in operation. The standardization of electrical equipment is being achieved to a high degree, as is shown on the various elevated railroads in New York, Chicago, Boston, etc., and on the New York Central and other heavy railroad projects.

It is planned to continue this discussion at the meeting on December 11.

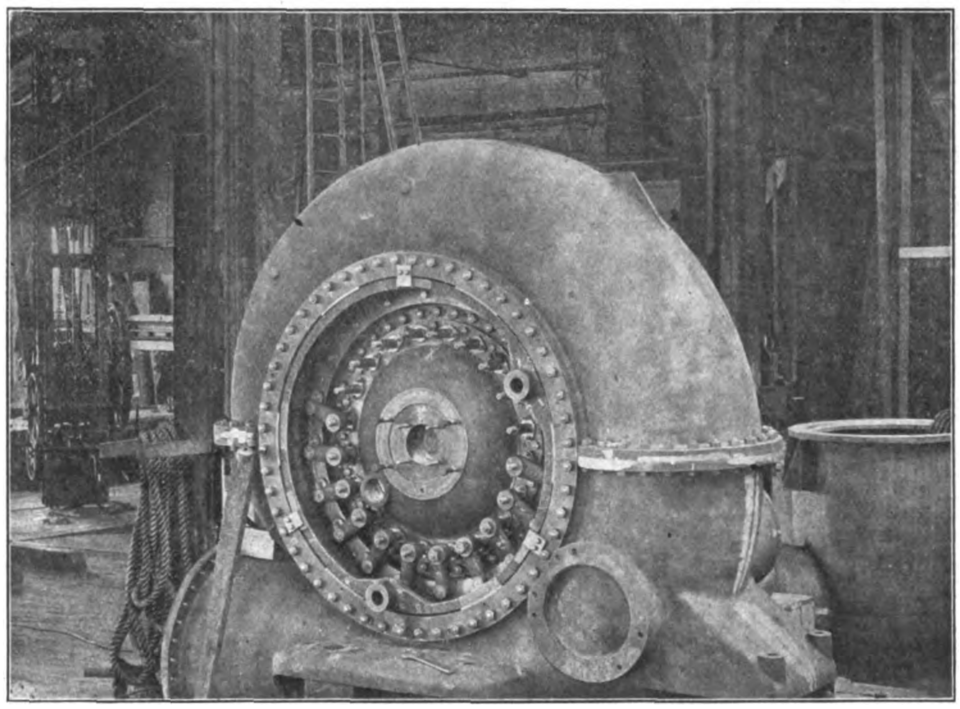
An Electrical Method of Fusing Silica.

The fusing of silica and quartz has been attended with considerable difficulty on account of the high temperature required. A German firm has recently developed an electrical method of fusing silica and molding it into any desired shape. A form of electric furnace is used in which the silica is placed in a carbon tube forming one electrode. This is inserted in a larger tube forming the other electrode and the space between filled with powdered carbon. Current is passed between the carbon tubes and readily causes the fusing of the silica in a perfectly controllable manner. By using an inner core or plug the silica when thoroughly molten can be molded into various shapes.

The Rejuvenation of a Decadent Mining District.

The "bonanza" days of the mining industry are now largely of the past, for men are no longer content to work only the highest "pay dirt" and throw the remainder on the dumps. Now by means of labor-saving machinery and the application of power the mining industry has been reduced to a conservative business proposition which has for its object merely a fair return on the investment actually made.

In order to obtain the best efficiency at least cost it is absolutely essential that cheap power shall be available, whether in coal, oil or waterpower. Without power, working the property is expensive and out of all proportion to the returns.



ALLIS-CHALMERS 5,000-HORSEPOWER HYDRAULIC TURBINE AT THE GUANAJUATO POWER AND ELECTRIC COMPANY'S PLANT, SONORA, MEXICO.

The Guanajuato district of Mexico is an example of what cheap power has done for an otherwise valuable district. What is now one of the most important mining centers in the republic was once hardly a promising proposition. A few years ago the camp was practically dead, most of the large properties having drifted into the hands of a few of the wealthy but inert Mexicans. Two English companies had for years been endeavoring to let go after having made a protracted failure of the attempt to operate in the district, while a few Americans were struggling to save enough bullion out of the low-grade ore to pay the heavy cost of fuel.

Then something happened which transformed the camp into what it is today. It was the advent of a party of Americans with the capital and the courage to build a hydro-electric plant 120 miles away, from which power could be transmitted to the mines.

The hydraulic turbine installed was a 5,000-horsepower Allis-Chalmers single horizontal-type unit in a cast-iron spiral casing with quarter-turn discharge. The waterpower development consists of a diverting dam, a canal five miles long, and two pipe lines, each 3,300 feet long, leading to the waterwheel. There is a cross connection at the power house so that the turbine can be operated from either pipe.

The head under which the turbine operates is 320 feet and the speed is 514 revolutions per minute. The plant was built by the Guanajuato Power and Electric Company, Sonora, Mexico, with Francis O. Blackwell, of New York city, as consulting engineer. The accompanying photo shows the Allis-Chalmers turbine during construction.

Mexican Light and Power.

The English interests in the Mexican Light and Power Company announce they will put through the lease of the company to the Mexico Tramways Company, notwithstanding the fact that the board of directors of the power company has condemned the lease. The English interests now have control of the power stock. The board of directors, which will be forced to resign, includes some of the leading interests in the Bank of Montreal. The English interests are headed by Sperling & Company, of London.

SPUR GEARING ON HEAVY RAILWAY-MOTOR EQUIPMENTS.[1]

BY NORMAN LITCHFIELD.

In the operation of ordinary street-railway motors the gearing is not a serious factor, on account of the low horsepower required, and it is not until the equipment becomes similar in proportions to that of a steam railroad with congested traffic that its importance begins to be felt. With the installation of electric-train service on the Manhattan Elevated Railway in 1901, however, the gearing question forced itself on the attention of the engineers through the large number of failures immediately occurring. On the New York Subway equipments the breakages were still more numerous, for these trains are more powerful than any heretofore used, an eight-car subway express train having motors aggregating 2,000 horsepower, equivalent to a locomotive of about the same power as the new electric locomotives of the New York Central Lines, but differing from the latter in that all the power is transmitted by gears, while the Central's locomotives are gearless.

It is evident that the greatest work done by the gearing on any locomotive is during the period of acceleration, and that for a given mileage the total amount of work done will depend upon the rate of acceleration, weight accelerated per gear, and total number of such accelerations or starts. During the evening rush hours in the New York Subway, the total load per gear is about thirty-five tons, and this weight has to be accelerated at the rate of 1.25 miles per hour per second every third of a mile, that being about the average distance between stations.

How serious a matter the breakage of one gear in the rush hour becomes will at once be realized when we state that at one of the many stub-end terminals of the system thirty-seven trains in and out per hour are handled during the period of maximum traffic. For the purpose of comparison the train movement at the Grand Central Station of the New York Central Railroad may be cited, the maximum number of trains there being thirty-five per hour, and this is, we believe, considered rather extraordinary congestion. One such breakage in the evening rush hour therefore means an inevitable delay to service of half an hour or more and the disruption of the train schedule for the rest of the day, thus entailing great discomfort to the traveling public.

Both the elevated and subway trains of New York are operated by the Interborough Rapid Transit Company, and there is no doubt that the conditions under which these trains operate are unique, further evidence being furnished by the failure of various apparatus other than gears which had proved entirely successful on other roads. We believe, therefore, that the data obtained by this company may be taken as measures of the limitation of power transmission by gearing in railway service.

As is probably familiar to all, the electrical operation of the Manhattan Elevated was commenced some three years previous to the opening of the New York Subway, and our earlier experience was therefore with the equipment for the former. The initial gearing installation on the 125-horsepower motors consisted of wrought-steel pinions and solid cast-steel gears of three-diametral pitch, this pitch being adopted on account of the economical current consumption thereby obtained. The pinions at once began to fail at the rate of about fifteen per month. The failures continuing, it was decided to withdraw all of the gearing then in service and replace it with two-and-one-half pitch, on account of the greater tooth section thereby obtained, although, as before stated, this meant some loss in economy of current consumption. This change practically ended the failure of the pinions, but not entirely of the cast gears, and it was decided that greater reliability could be obtained by adopting a composite type of gear consisting of a cast-steel center on which a wrought-steel rim was shrunk. This combination of a wrought-steel pinion and wrought rim gear of two-and-one-half pitch has proved generally satisfactory for the elevated service, and the improvement to be looked for is therefore in the line of greater wearing life.

On the subway division the motors are of 200 horsepower each and the original gearing equipment consisted of solid cast-steel gears with wrought-steel pinions, diametral pitch two-and-one-half, and teeth of the Brown & Sharpe standard fourteen-and-one-half-degree involute. As on the Manhattan division, so on the subway, it soon became evident that the design was not proper, but in contrast to the elevated road it was the gears which first caused the trouble. The cast-steel gears, therefore, were all scrapped and replaced by the wrought-rim type.

This improvement practically ended the gear breakage, but unfortunately the pinions began to go, the breakages averaging over one a day, and, furthermore, we find it unsafe to run a pinion the teeth of which measure less than three-sixteenths inch at the top. We are, therefore, compelled to scrap material which should be available for wear.

To what, then, shall we look as a remedy? Three suggestions have been advanced by the gear manufacturers:

a. Diametral pitch less than two-and-one-half.

b. Steel with elastic limit of 90,000 pounds per square inch and over, as compared with our present 45,000.

c. Twenty-degree stub teeth.

The first suggestion we are unable to accept on account of some local conditions, but the combination of the other two seems to have possibilities of success, and we are now replacing all our gearing with specially treated carbon steel with stub teeth. Let us now consider the loads the teeth have to carry and determine why it is that we have to resort to the use of special designs and material in order to make our gearing stand up.

Fig. 1 illustrates an express run in the subway, giving the power consumption per train of eight cars, five of which are motor cars, each carrying two motors, thus making ten gears per train. On the same diagram curves are platted showing the fiber stress in a standard fourteen-and-one-half-degree involute and a special twenty-degree involute tooth, both worn to our present limit of three-sixteenths inch at top of tooth. The force acting at the pitch line of the tooth has been figured from the power-consumption curve and the motor.

Referring to the diagram, it will be noted that the worst condition occurs just at the commencement of the motor curve, this being the point at which the gearing is transmitting the maximum torque at the greatest speed obtained during the period of acceleration, the maximum torque occurring, of course, only during this period. Under the conditions shown the fiber stress at this point is 13,370 pounds per square inch in the standard fourteen-and-one-half-degree involute tooth, and at this instant the train is running at 17.3 miles per hour, with a corresponding gear speed of 1,168 feet per minute. On account of this speed, therefore, we require a material which will permit the use of a safe working stress at no speed, equal to 39,400 pounds per square inch. The elastic limit of the material

[1] Abstract of a paper presented at the annual meeting of the American Society of Mechanical Engineers, at New York, December 3.

we have had heretofore runs about 45,000 pounds per square inch, and we therefore have a factor of safety of only 1.1, which is obviously low.

In these calculations we have considered the elastic limit of the material rather than the ultimate strength, on account of the dynamic character of the load, each pinion tooth receiving nearly 1,800 blows per mile. The greater the ratio, therefore, between the fiber stress and the elastic limit of the material (the other physical properties remaining of proper value), the greater the life, and some relief should therefore be obtained by the adoption of the special twenty-degree stub tooth which reduces the fiber stress nearly thirty per cent and increases the minimum factor of safety from 1.1 to nearly 1.6.

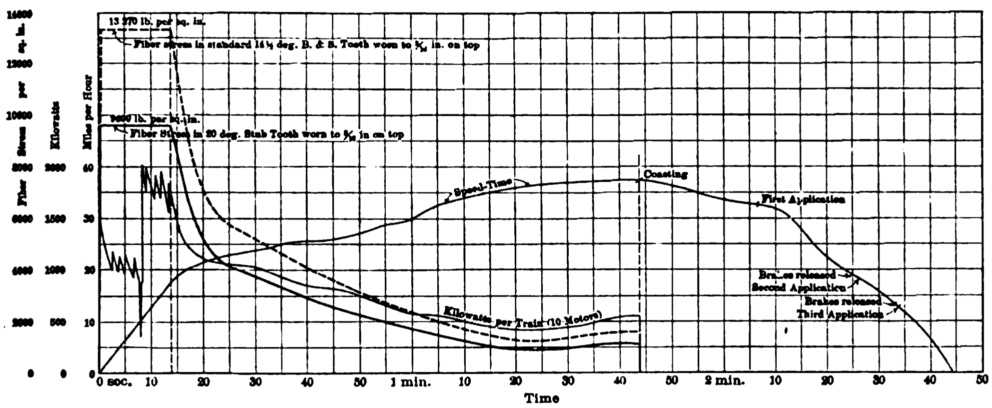


FIG. 1.—STRAINS IN TEETH DURING EXPRESS RUN—SUBWAY DIVISION, INTERBOROUGH RAPID TRANSIT COMPANY, NEW YORK CITY—CALCULATED BY LEWIS METHOD.

A much greater relief, however, may be looked for by the use of steel with a high elastic limit, say, 90,000 pounds per square inch, which, used in conjunction with a design of stub tooth, increases our minimum factor of safety to 3.2 as compared with our present 1.1.

It will be noted that the foregoing calculations are all dependent upon the use of the Lewis formula, the fundamental assumption of which is that the teeth bear across the whole face. Consideration, however, must be given to the fact that in practice it is not possible always to maintain perfect alignment between gear and pinion on account of the necessarily rough design of the motor and its assembly on the truck. The effect of this disalignment is shown in Fig. 2, which is a photograph of a pinion which broke in service. In this the lower half of the teeth have been battered over by the loose piece jamming between the gear and pinion. It is the upper half of the teeth which cracked, however, showing that these cracks were not caused by the jamming of the loose piece, but by the gradual hammering of the pinion against the gear in service. The points gave away successively, until at last the loose piece was caught and ripped out, and we find this typical of all the failures. The break ordinarily starts at the inner face of the pinion, due to the natural tendency of the armature to cock that way, but in some cases it starts at the outside, probably caused by running a new pinion with a gear which had previously worn taper.

Furthermore, the breakages cannot be attributed to so-called crystallization or "gradual fracture," for in many instances the teeth are practically new having broken after inconsiderable mileage. The necessity of having a high ratio between the theoretical working stress and the elastic limit thus becomes evident and justifies us in the adoption of the special means we have described to overcome the abnormal failures.

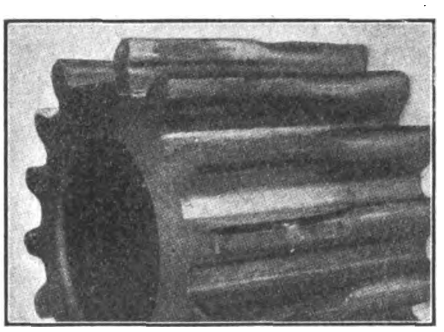


FIG. 2.—THREE-QUARTER VIEW OF PINION, SHOWING CRACKED TEETH.

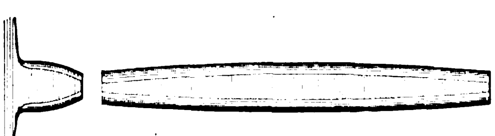


FIG. 3.—SUGGESTED FORM OF TOOTH.

The lack of alignment of gear and pinion above mentioned is probably one of the chief causes which necessitated the use of these special means, and we have therefore endeavored to find some other method of overcoming the difficulty. This led to the suggestion that as we are actually obtaining only a short bearing on the tooth, it would be better to assure this bearing being at the center of the face rather than at the end, which might be accomplished by the use of a tooth something as shown in Fig. 3, in which the central portion is left the standard outline and the balance tapered off both ways toward the ends. No investigation has been made as to the practicability of cutting such a tooth or of its desirability, and it is suggested for consideration merely as one possible way of compensating for the lack of alignment occurring in railway-motor gearing.

Electric Tramways in Germany.

United States Consul-General Richard Guenther writes as follows about the electric tramways of Frankfort:

The Frankfort electric-tramway lines at the close of the fiscal year (1907) had a length of thirty-eight English miles and carried during that year 74,250,000 passengers. There are 612 cars for the passenger service, and the total number of employes is 2,124. As most of these are married, the Frankfort tramway service furnishes means of living for about 10,000 people. On an average the electric cars run over 30,000 English miles per day. During the great International Turner festival last July the number of miles run on some days exceeded 60,000. Though the fares are lower than in American cities (ordinary fare is ten pfennigs, not quite two and one-half cents), yet the net profit derived from the service turned into the municipal treasury was 1,315,000 marks ($312,970). The profit realized during the year by the city from its electric lighting and testing plant aggregated $400,200.

The stride tramway travel has taken in Frankfort in the last decade can be discerned when comparing the above statistics with those of 1897, when the city bought out the then-existing horse-car lines which belonged to a Belgian joint-stock company. Then the total length of line was nineteen and one-fourth miles, number of cars 197, which carried during that year 26,500,000 passengers and covered a running distance of 3,375,000 English miles.

A new high-speed trolley line is to be built from Boston to Beverly at a cost of $11,000,000, to be known as the Boston & Eastern Railway. A 7,200-foot tunnel is to be built under the harbor at Boston costing $2,750,000.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

THE COST OF OPERATING ELECTROBUSES.

The London Electrobus Company, Limited, has recently issued a subscription circular asking the shareholders of the company to contribute $250,000 to a new issue of stock. A letter accompanying the prospectus gives some interesting figures dealing with the cost of operation. The company started service with six buses, in July, 1907, and in the first three months 179,909 passengers were carried. In the three months from July 15 to October 15, 1908, 925,959 passengers were carried. Over a period of fifteen months, from July, 1907, to October, 1908, the average number of passengers per bus has been nearly eleven, and the earnings about twenty-eight cents per bus-mile. In connection with the maintenance of storage batteries, it is stated that, with the exception of a few experimental batteries, the entire battery maintenance has been done under contract at four cents per bus-mile; that these contracts are still in force, and that offers have been made to maintain 100 electrobuses at the same rate for three years. The statement issued by the company's auditors makes it appear that the earnings during the first twelve months exceeded operating expenses by $3,714.54. This fell short of the establishment and overhead expenses. For the three months, July, 1908, to October, 1908, the earnings exceeded the operating expenses by $7,632.18, which is about sufficient to pay the establishment and overhead expenses. These expenses, it is stated, would not be materially increased if the number of buses were doubled, and the experience of the company indicates that as the number of carriages has been increased, the takings per bus-mile have also increased. From the auditors' statement it is found that for the year ended July 15 the number of passengers was 1,596,831. The total receipts were $43,638.18. The average receipts per bus-mile were 27.6 cents, and the total operating expenses were $39,923.64. For the three months ended October 15 the total income was $25,034.20, and the income per bus-mile 28.76 cents. These figures do not include provision for establishment, supervision or head-office charges, nor repairs to buildings. The total of these, excluding depreciation, for the same three months, was $7,582.89.—*Abstracted from the Electrician (London), November 20.*

THE MANUFACTURE OF METALLIC LAMP FILAMENTS.

In the present installment of this serial, which has been previously referred to in

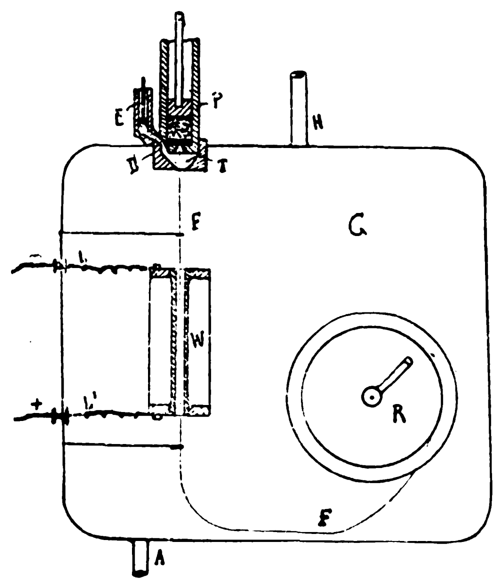


FIG. 1.—PROCESS OF MAKING METALLIC FILAMENTS.

these columns (ELECTRICAL REVIEW, November 21), Engineer B. Duschnitz describes the arrangement employed by

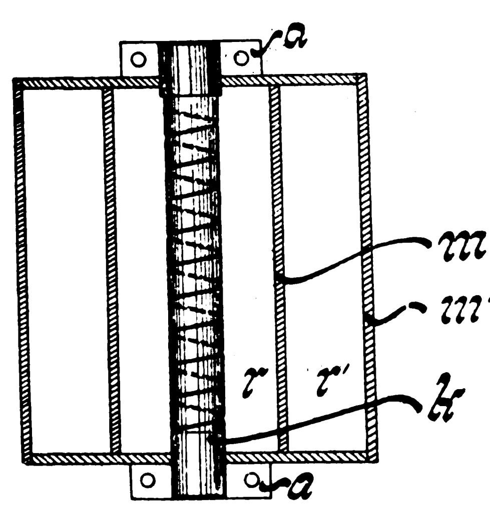


FIG. 2.—ELECTRIC FURNACE FOR THE MANUFACTURE OF METALLIC FILAMENTS.

Gebrüder Ruhstrat, of Goettingen, for manufacturing metallic filaments. The object of the arrangement is to lead the filament, consisting of wolfram oxide, for instance, through a furnace heated to about 2,000 to 2,700 degrees, and put it through the complete fusing process therein, and when it has passed through the furnace and is still aglow and flexible, to wind it on a spool provided for this purpose or cut it into definite lengths. By the aid of suitable means the filament can also be wound directly on frames to be inserted in lamps. The arrangement is diagrammatically illustrated in Fig. 1. P is a filament press, W an electric furnace, G an enclosure, through which hydrogen is made to flow and which contains the furnace and winding device, and L and L′ are conductors leading the current to the electric furnace. The method of manufacturing the filaments is as follows: The press P is filled with wolfram oxide paste and a thin filament F is pressed from it, led through the hot furnace W and wound on the spool R or a frame, or else cut into definite lengths. The case G protects the entire arrangement from the air and is filled with an indifferent gas, as hydrogen, which is injected at H and withdrawn at A. If very thin filaments are to be pressed, the auxiliary cylinder E is filled with a suitable binding material, which is pressed through tube D into the space T, where it covers the filament issuing from press P, in order to give it greater strength before it is fused. The furnace is of special construction. The heating body *k* (Fig. 2) is a carbon tube cut lengthwise into a spiral of a pitch of about ten millimetres. The space *r* is filled with heat-resisting material consisting of 100 parts of coke, eighty parts of sand and twenty-six parts of table salt. This mass is enclosed in a protecting covering *m*. The space *r′* is filled with a mixture of magnesia and carbon, and a second covering *m′* surrounds the entire furnace: *m* and *m′* consist of asbestos. Metal plates *a a* are provided for attaching the electric conductors. According to Ruhstrat's statements the filament is moved through the furnace at the rate of two millimetres a second. The arrangement would thus be capable of manufacturing a filament 7.2 metres long in an hour, sufficient for about twelve lamps of 100 volts and twenty-five candlepower.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), November 8.*

THE ELECTRICAL INDUSTRY IN ENGLAND AND ABROAD.

For the topic for his presidential address before the Institution of Electrical Engineers of Great Britain, on November 19, W. M. Mordey made a comparison between the condition of the electrical industry in England, as indicated by statistics of returns relating to electricity supply, with the electrical industry in other countries, particularly in Germany. He took exception to the repeated statements that England was in a backward condition as compared with other countries in respect to practical application to the industrial and social requirements of the nation. As a basis for comparison, Mr. Mordey said that it was necessary only, so far as the service of the public is concerned, to find the extent to which the systems of supply of electrical energy in different countries provide for the requirements of the public; in other words, to find the average consumption in units per inhabitant, and the average price per unit actually paid. Tables giving this information for a large number of towns in England and abroad, particularly in Germany, based upon what are essentially authoritative data, were examined, and this information supplemented with particular references furnished in response to his own applications. Mr. Mordey concludes that in the large towns in Germany electrical energy costs twice as much per unit, and the consumption per inhabitant is half as much as in the large English towns. In the medium-sized towns, the price in Germany is thirty-three per cent higher than in England, and the consumption is about the same as in the medium-sized English towns. In the small towns in Germany the price is forty per cent higher, and the consumption about the same as in England. The public generating stations contain two-and-one-quarter times as much power per inhabitant of the whole country as those of Germany. In electric-tramway work England does not compare unfavorably. Only where the advantage of cheap and ample waterpower in a few places has enabled an extensive supply to be given at low prices, notably in Lyons, Geneva and Grenoble, does any advantage exist. But in this direction also a British town, Bolton, with an average of 2.36 cents per unit, has the cheapest supply. Mr. Mordey considers that there is nothing in British electrical work to justify in any way the charges that have been made against it. The alleged backwardness does not exist. The country is ahead, and well ahead. There are hindrances, legislative and otherwise, to going still further ahead, but there is no more justification for the statements about scientific and technical education being behind other countries than for the statements about the backwardness of British electrical engineering. Technical education should be judged, not by the wealth of the equipment of laboratories, but by the engineering results achieved in the country.—*Abstracted from Electrical Engineering (London), November 26.*

ALTERNATING-CURRENT TELEPHONY.

Attention is called by the author, August Maior, to the importance of alternating currents in telephony over lines of any length. While engaged in experiments on the application of alternating currents to multiple telephony, he observed that, in general, the speaking currents superimposed on the alternating currents are of a more complicated form and are not an exact reproduction of speech. The rattling and long-drawn sounds assume more nearly their natural character the closer resonance is approached. The frequency of the currents employed is of great influence on the clearness of speech, and a perfectly clear reproduction of the sounds is attained only when a frequency is used which no longer audibly affects the diaphragm of the telephone receiver. The intensity of the sounds is also greater with the higher frequencies. But if, eventually, a microphone which is in series with another self-inductionless resistance, is connected in parallel with the self-induction coil of the resonating alternating-current circuit, very great variations in the strength and period of the alternating current may be produced by slight changes in the suitably-chosen parallel resistance without self-induction. In this manner the problem of the telephone relay can be most easily and most naturally solved. If the alternating current is in resonance, the speaking currents superimposed on it are virtually also in resonance, and in this way the injurious influence of self-induction and capacity of lines of any length can be easily removed, the damping constant being diminished as much as possible without impairing the strength of the transmitted sounds, which may even be increased, as before indicated. This is not always possible by the insertion of Pupin coils in the line, as is well known.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), November 19.*

ALUMINUM AS A CONDUCTOR IN THE ELECTRICAL INDUSTRY.

In Great Britain the employment of aluminum as a conductor has not had much vogue, though in the United States it has been used to a great extent for some time. The Niagara, Lockport & Ontario Power Company uses an aluminum transmission line from Niagara to Syracuse, a distance of 162 miles; while the Standard Electric Company, of California, has an aluminum transmission line 200 miles long. That aluminum has not been used to a greater extent in Great Britain is not altogether a matter for surprise. In the first place, there is the well-known British inertia to be overcome, while, owing to the meagre adoption of overhead work for public supply, it has hardly received proper consideration. The question whether it can be economically used for cables is an interesting one, comprising many interesting factors. During the past two years the price of copper has fluctuated between \$560 and \$270 per ton. Though to some extent disturbed by this variation, consequent on a demand which the manufacturers were not able to meet, aluminum is now available in any quantity, and its price has been reduced, until today it is quoted at the same price per ton as copper. As, however, for equal conductivity, only half the weight of aluminum is required as of copper, a net saving of fifty per cent on the cost of the raw material is effected by employing the former metal. In the installation at Snoqualmie Falls, where 12,000 horsepower is transmitted by aluminum conductors, some thirty-two miles to Seattle, and forty-four miles to Tacoma, in the state of Washington, the spans between the poles vary from 120 to 150 feet. From Electra to San Francisco, in California, the poles are about 130 feet apart, and the distance over which power is transmitted is 154 miles. The maximum span reached by aluminum conductors is 2,192 feet, across the Niagara River.—*Abstracted from the Electrician (London), November 27.*

Dr. Steinmetz to Lecture in Chicago.

At the special invitation of the Chicago Section, American Institute of Electrical Engineers, Dr. Charles P. Steinmetz will deliver a lecture on "Light and Illumination" at 8 p. m. on December 17, in Fullerton Hall, Art Institute. All members of the Chicago section, as well as the local branches at Armour Institute of Technology and Lewis Institute, are urged to attend and bring their friends with them.

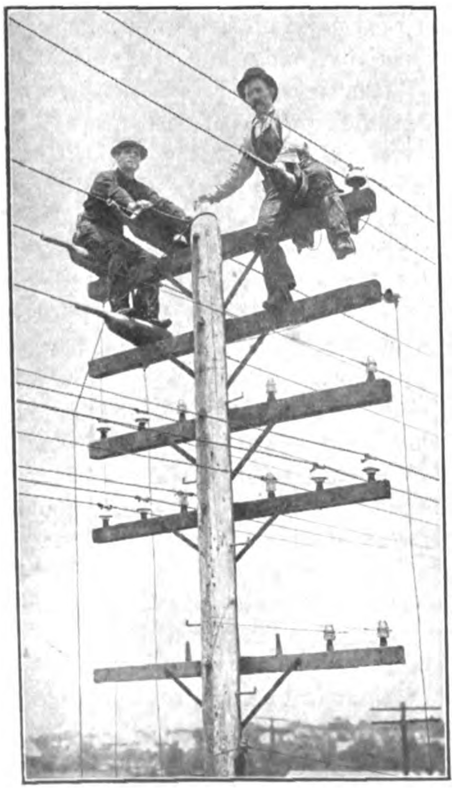
INDUSTRIAL SECTION

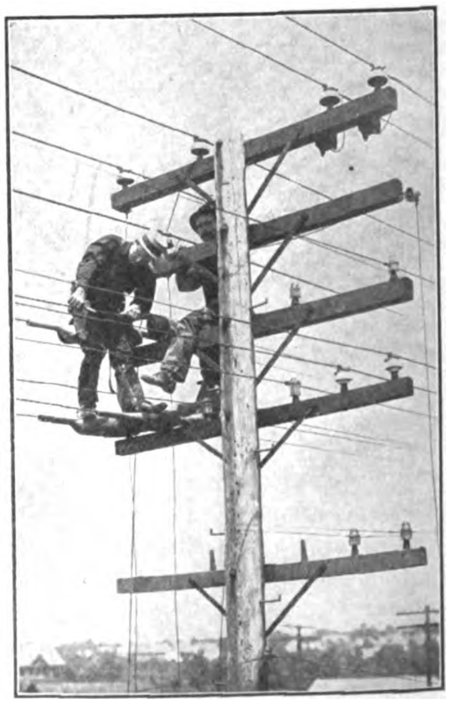
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A Linemen's Protective Shield.

In these days when every effort is being made to safeguard life and limb, the introduction of a shield which will minimize the dangers to linemen working on live high-tension circuits attracts considerable attention, and is worthy of specific illustration and description.

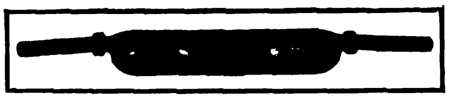
The shield which is being manufactured by the Linemen Protector Company, 201 Whitney Building, Detroit, Mich., is one of the most useful devices which has been developed in recent times. The accompanying illustrations show the protective shield and the method of using it on high-tension circuits. The shield is made of pure Para rubber, no reclaimed rubber being used. The pure rubber is carefully washed and processed so as to eliminate any possibility of impurity either in the form of sand or metal, as before the completed shield leaves the factory it must withstand very high pressures in the molding process, and a puncture test of 30,000 volts, alternating current, under water.





VIEWS SHOWING THE LINEMEN'S PROTECTIVE SHIELD IN USE ON HIGH-TENSION LIVE WIRES.

The main portion of the shield is made of three-eighths-inch rubber, tapering down at those extremities which are least required for insulating value to three-sixteenths of an inch. In order to give the shield sufficient rigidity and to make it tend to hold its original shape and fit closely over the insulators and wires, heavy strips of raw canvas are criss-crossed, and this method of laying up the canvas strips also avoids the possibility of puncture from a tool or from the lineman's spur.



THE LINEMEN'S PROTECTIVE SHIELD.

In using the shield it is hoisted from the ground, weighing complete only seven-and-one-half pounds to eight pounds, and is gripped by means of soft-rubber handles attached to the lowermost outside point of the bifurcated apron. This keeps the wireman's hands from possible contact with either the insulators, tie wires or live circuit.

In order that the shield may be held firmly to the wire a split hard-rubber ring having a helically-inclined half-inch gap, so that it may slip easily over the wire, is fitted over the small ends of the shield, resting snugly against the larger portion of the shield. While this slips on and off easily by a smooth, even movement, any tendency to jerk it off causes it to grip the shield very tightly. This is a great advantage, because at times the lineman will stand on one shield which may be placed over a cross-arm and wire lower than the point at which he is working. Should he slip and the heel of his boot come in contact with the split ring it will immediately check the slipping, and will form a brace for his foot.

The shield is recommended by the manufacturer for use on all live circuits not exceeding 7,500 volts. It is in use, however, on circuits as high as 10,000 volts. In wet weather it is not desirable perhaps to use the shield on circuits carrying voltages higher than 4,600, as in this case the static leakage over a wet shield might give the lineman sufficient shock to throw him off his balance and into contact with an unprotected live wire, or possibly cause him to fall to the street. It is stated that it is a fact that the shields have been used on 4,600-volt, three-phase circuits under all weather conditions, and that with their use it has not been necessary to cut out circuits in order to make taps or effect other repairs.

While the device minimizes the possibility of unintentional contact with other wires on the same pole, there is the chance that the lineman may rely too much upon the protective quality of the shield and subject himself unnecessarily to danger from live wires. Where the shields have been adopted, however—and they have been by a number of large companies in several sections of the country—it has been found that the linemen have accepted them in the same spirit as they have accepted climbing spurs and heavy belts, and other protective devices. It appears that the older and more experienced the lineman is, the more readily does he adopt the protective device; and its utilization appears also to be an indication and a warning on the part of the company that the circuit to be protected is dangerous, and that the lineman, in addition to utilizing the safeguard provided, must also exercise that care which is necessary to eliminate the possibility of danger to himself.

The accompanying illustrations, showing the shield in use, were made from photographs taken during work on live circuits carrying 4,600 volts, three-phase. An affidavit is in the possession of the manufacturer, stating that current was on all three wires shown covered by the shield, and that it was not shut off during the time the pictures were taken or while the work was being done.

Intercommunicating Telephone Systems.

In the December issue of the *Everbest Magazine,* published by the Ewing-Merkle Company, St. Louis, Mo., A. R. Forse, manager of the telephone department, gives some interesting information concerning intercommunicating telephone systems.

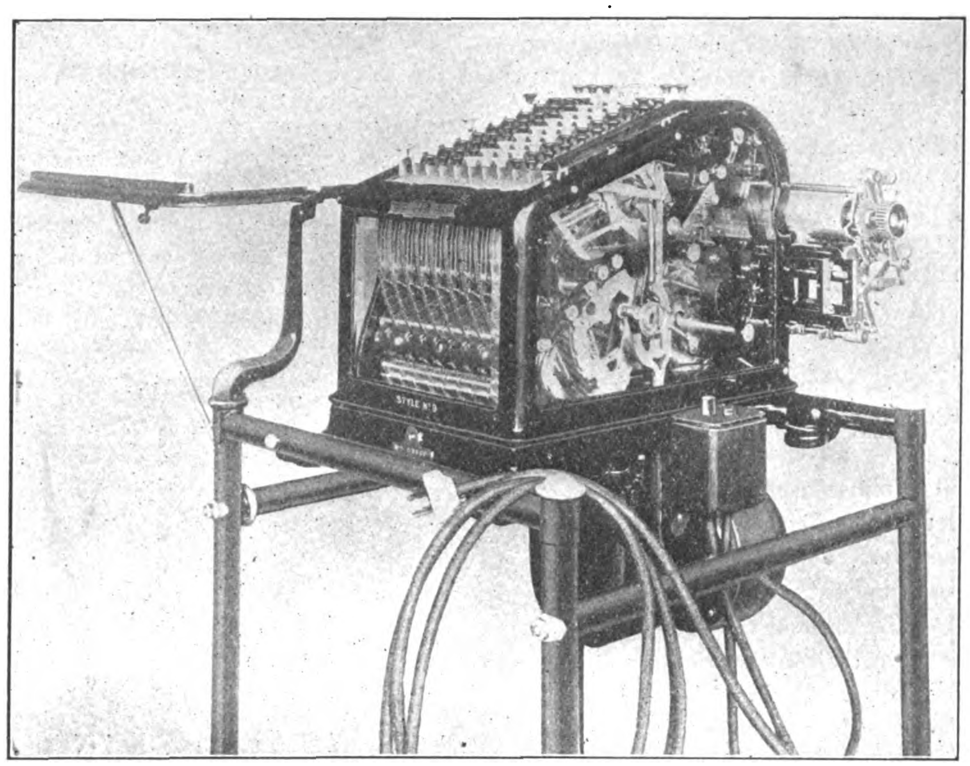
The installation of a good intercommunicating telephone system is somewhat more expensive in first cost than a private branch exchange would be, but the first cost is practically the only cost in the intercommunicating system, with the exception that about every six months there should be a new set of batteries installed, so that the service may be first class in every particular. Junction boxes should always be used wherever a cable is to be spliced. Where it is necessary to cross from one building to another, or through sections of the same building that are damp, weatherproof wire should be used; but where the lines run through ordinarily dry places, annunciator cable having a weatherproof tape and a braid overall may be used. Cable in which each wire has a distinctive color covering is preferable, and saves time in testing. Most of the systems now use four battery wires—two for the ringing batteries, and two for the talking batteries—and one wire for each station installed. Thus, a system having ten telephones would have a cable containing fourteen wires. The battery wires are usually several sizes larger than the others. For systems in which not more than 300 or 400 feet of cable is used, battery wires of No. 18, and line wires of No. 22 are generally used, with slightly heavier wires for longer distances, using four batteries on the talking wires and six on the ringing wires.

An Electric Motor-Driven Adding Machine.

Everyone has experienced the feeling of disgust caused by the expenditure of time and energy in the actual performance of long arithmetical computations necessary to obtain a desired result. Being compelled to devote close attention to a series of operations, which in themselves are extremely simple and require comparatively little intelligence is, to say the least, irksome. Then as the latter feeling increases, the liability to error becomes greater, until there is a definite limit to the amount of such work which may be done by a single computer.

The pertinence of the expression, mechanical computation, is evident when it is considered that this can actually be performed by mechanical computers, or "adding machines"; it has been stated that the number and complexity of the arithmetical operations which can be thus performed are only limited by the mechanical difficulties in the construction of the machine, which increase very rapidly as the number of possible operations is increased. The higher faculties of the human mind can never be replaced by a mechanical contrivance, but in large part the purely calculating power may. Oliver Wendell Holmes remarks that "the calculating power alone should seem to be the least human of qualities, and to have the smallest amount of reason in it, since a machine can be made to do the work of three or four calculators, and better than any one of them."

The ordinary form of adding machine will do adding, subtracting, multiplying and dividing from four to six times as fast as an expert. It is not possible to make errors in the actual performance of the computations, and during operation it does not require the close attention which the human computer must necessarily give his work. By its use, in connection with the card systems and other short cuts devised for especial use with the machine, the efficiency can be much increased. The only mechanical work necessary is the pressing of the keys and the operation of the handle projecting to the right of the case, and the latter has been eliminated in the improved forms by the application of the electric motor.



MOTOR-DRIVEN ADDING MACHINE.

The illustration shows perhaps the most popular adding machine, the Burroughs, equipped with a Westinghouse motor. With this improvement the number is written without any mechanical labor by simply pressing a key on the keyboard of the machine, which throws in a clutch and connects the shaft of the motor with that of the handle. When it is considered that the manipulation of the handle is the only thing in the operation which is tiresome and that this causes a material interruption of the work, it will be seen that the application of the electric motor is a very material advantage. In fact, experiment has shown that the operation is forty per cent faster, with less liability to error caused by setting the incorrect number and less labor on the part of the operator when the machine is thus driven.

The motors used with this adding machine have capacities of one-tenth or one-eighth horsepower, the former being used with a machine of seven figures and the latter with one of nine figures. They run at a speed of about 1,200 revolutions per minute, and are furnished for either direct or alternating current. The cost of the operating energy is insignificant, varying from one to two cents an hour, according to the local rates for electric energy. No special wiring is necessary, the motor can be connected to an ordinary lighting circuit as readily as an incandescent-light bulb. The motor will run continuously without attention, an occasional oiling once in several months being only necessary.

Western Electric Company Completes Paris Switchboard.

The replacement of the destroyed Paris telephone switchboard, as described and illustrated in the issue of November 21, was completed according to specifications November 30 and the $600 daily penalty clause in the contract, for every day over sixty days required in building this switchboard, was thus rendered inoperative.

The Chicago plant of the Western Electric Company started work on the big switchboard October 3, shipped it to New York on October 23, and it arrived in Paris on the steamship La Provence November 6.

This is the second record made within a year by the Western Electric Company for rapid telephone-exchange replacement; the other being that of the Antwerp exchange—the oldest in Europe—for which a 5,000-line equipment was manufactured and installed in thirty days. The Paris contract covered a 10,000-line equipment and, while apparently involving but twice the labor of the other, in reality meant several times more. The fast time made stands as another triumph for American skill and enterprise.

PREVENTING THEFT OF CURRENT.

BY H. W. YOUNG.

Theft of current with the many and varied methods by which it is practiced, presents a most interesting, as well as harassing, problem to central-station

FIG. 1.—SERVICE PROTECTED.

companies, many of whom have perhaps not given the subject the consideration or attention which its seriousness demands.

The larger electric-lighting companies are giving this subject careful thought, and large sums of money have been recovered in some cases, but only by an

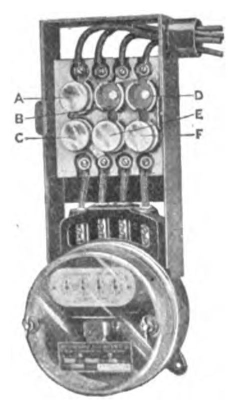


FIG. 2.—TESTING OR INSPECTING SERVICE.

elaborate and expensive spy and detective campaign. That such a system, entailing as it does large expenditures, is justified by the results which have been obtained, many of the companies will testify.

The central-station man, familiar with the fact that the majority of those who will steal current are of the class whose credit involves a deposit before the installation of the service, will appreciate that the list is not, however, entirely confined to this class. A man will hesitate before he will deliberately remove the insulation and make a permanently illegal tap on a service wire, but few will hesitate to connect a flexible cord to an exposed branch block or service switch, when it is necessary to have temporary illumination in some obscure corner, and which will probably prove to be so handy as to remain permanent. Also, but few will hesitate to connect a discontinued service to the branch block when for any reason they wish light, and it is not otherwise instantly available.

A surprisingly large number of connections of this character have been discovered in apartment houses, where meters are removed during the summer months, and the electric-lighting company is not able to connect the service as rapidly as desired.

The average central-station man, with a broad and abiding faith in human nature, will ponder over unaccounted-for current losses, and wonder how much the human equation is a factor in the phenomena of current transmission, particularly so as it has been discovered that the curve of current losses flattens materially in feeders, the service wires of which are carried in conduit directly into the meter, with entrance box and meter connections protected by seals that successfully serve their intended purpose.

The problem is not how to apprehend people who are stealing current and bring them into court, but to remove temptation, increase metered output, and eliminate legal complications that add very greatly to a station's cost of production and frequently engender a hostile feeling in a community which really does not understand the facts of the case.

Appreciating the need of coping with this phase of central-station trouble, the Central Electric Company, Chicago, and the Pettingell-Andrews Company, Boston, have marketed a number of devices designed to cure this evil, one of the best known being the "O. K." connection block illustrated in Figs. 1 and 2.

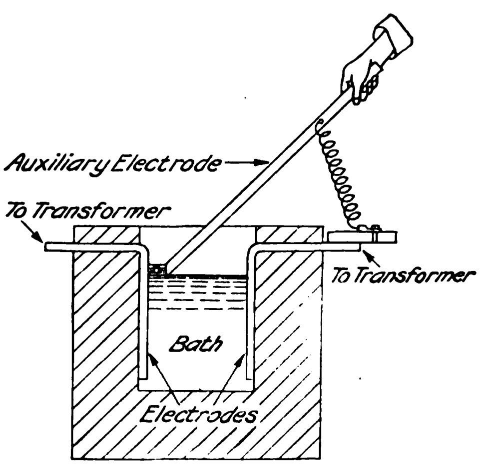
Where it is desirable and practicable to carry the service wires in conduit this connection block offers a means of terminating the conduit at the meter and taking the wires into and out of the meter without leaving any exposed leads or connections. The enclosing box is so made that line and load wires may be brought in on either side as desired. It fits snugly against the meter, protecting one or more of its supporting screws, so that it is impossible to disturb the meter connection or remove the meter from the wall without breaking the seals of the connection block cover.

In the view showing the connection block with the cover removed, the screw plugs designated by various letters are not necessarily fuse plugs, but switch-connecting means, which enable the inspector to make any desired test on the meter without cutting a wire, opening a taped joint, or interrupting the customer's service. By screwing the connection plugs into receptacles B, D, the meter is by-passed and the customer's lights kept burning. Removing the plugs ACEF entirely disconnects the meter from both load and line and permits its removal or replacement without the necessity of a soldered joint or any tool other than a screwdriver.

Any desired commercial or house test can be made by means of this connection block, and its use in laboratory work greatly facilitates meter testing, etc., because of the facility with which any desired connection or combination of connections may be made. This particularly applies to the testing of one or more meters in connection with a standard where it is desirable to remove a meter from its connection without disturbing the others.

A New Electric Furnace for Annealing and Tempering.

To secure the best results in the process of annealing and hardening, it is necessary to have a constant temperature in the furnace. The coal and gas furnaces of today do not entirely fulfill this requirement on account of the large furnace area exposed to the air for radiation.



SECTIONAL VIEW OF ELECTRICAL FURNACE FOR ANNEALING AND TEMPERING.

Again, to obtain the best results, it is often necessary to adjust the temperature of the furnace, and this cannot be done with precision with the gas furnace. Realizing these facts, it is natural that tool producers and manufacturers in general should look forward to the day when a hardening furnace would be designed that might assure them better results in a shorter time than is possible with present methods.

In the new type of electric furnace now being manufactured by the General Electric Company, Schenectady, N. Y., for operation on alternating-current circuits, metallic salts are reduced to a liquid state by means of an electric current. It can be readily seen that as soon as these salts reach a liquid condition, the temperature can be easily regulated by varying the amount of current passing through the bath. By this method of regulation any temperature from 250 to 1,350 degrees Centigrade may be obtained. The temperature will remain uniform throughout the bath except at the surface, where it is slightly lower, due to radiation. This applies, however, only to a depth of 0.6 to 0.75 inch.

Herewith is shown an electric-furnace outfit as it is installed in the die department of the Schenectady works of the General Electric Company. The outfit, as can be seen, consists of the furnace, with its hood suspended from above; the regulating transformer with regulating switch; the switchboard with the necessary ammeter and voltmeter; the incoming line with fuses. The regulating switch is provided with a sufficient number of contact points to give, as stated

ELECTRIC FURNACE FOR ANNEALING AND TEMPERING.

before, almost any desired temperature between the limits of 250 to 1,350 degrees Centigrade.

The furnace, a sectional view of which is also shown, consists of a fire-clay crucible, surrounded by an insulating material, usually of asbestos, which rests in a fire-clay box; all being supported by an enclosing case of iron. Two suitable electrodes, connected to the low-tension side of the transformer, are placed on each side of the crucible, and are in direct contact with the bath at all times.

To start up the furnace an arc is started across the broken flux by means of an auxiliary electrode, and in a very short time the solid mass is in a molten condition. After the bath has reached its proper temperature, that portion of the material to be hardened is placed entirely in the liquid bath, and is allowed to remain there until it attains the same color as the bath, when it is removed and tempered in water or oil, as the case may be.

The bath for hardening or annealing completely fills the crucible, and in the Schenectady factory consists of equal portions of barium chloride and potassium chloride. The ultimate temperature depends on the relative proportions of the two chlorides, the higher the percentage of barium chloride, the higher the temperature may be carried.

In addition to hardening, the furnace may be used for softening tempered steel, the bath being maintained at a temperature of about 250 degrees Centigrade for this work.

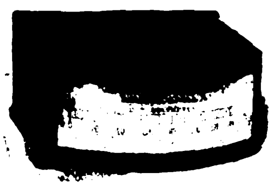
In summing up the advantages of this type of electric furnace, the following may be mentioned: There is no chance for oxidation, for the material while being heated does not come in contact with the air. All parts of the tool are subjected to the same degree of heat at all times, thus preventing any possibility of strains or overheating. Its high efficiency and low cost of operation place it far above the gas furnace. There is practically no danger from fire, as the outer walls of the furnace are never hot; in fact, when the bath has a temperature of 1,300 degrees Centigrade, the hand can be placed on the outside of the furnace without being burned. It is so simple and requires so little care and attention that it can be operated by an ordinary workman. The metallic salts have no effect on the composition of the steel, and the operator never comes in contact with dangerous fumes, as in the cyanide bath.

In the manufacture of machine tools, automobiles, razors, knives, firearms, jewelry, fine instruments, etc., this electric furnace bids fair to replace almost every other type of furnace that is called upon to meet the requirements of accurate tempering, according to the manufacturers, who have made thorough and practical tests of this apparatus.

Keystone Horizontal Edgewise Switchboard Instruments.

The Keystone Electrical Instrument Company, Ninth Street and Montgomery Avenue, Philadelphia, Pa., has placed on the market a new line of horizontal edgewise switchboard instruments. These are made in voltmeters, ammeters and wattmeters, for both direct and alternating-current circuits, and have been designed with particular reference to lighting and power switchboards where space is limited. They are secured to the board by the current-carrying lugs, so that only two holes need be drilled for voltmeters and ammeters, and four holes for wattmeters.

The instruments are neat and pleasing in appearance, and are mounted in plain cases. All cases are finished in dull black, this finish wearing indefinitely and requiring no attention beyond an occasional wiping with a soft cloth to remove dust. The scale openings are large, admitting ample light for reading at a distance. The form and location of the pointer are such that readings can be taken at a considerable angle without introducing appreciable parallax errors.



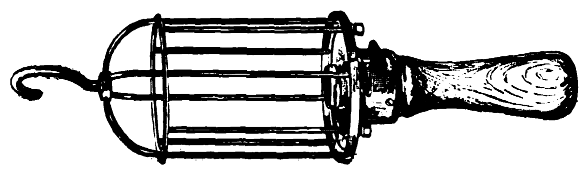
KEYSTONE HORIZONTAL EDGEWISE DIRECT-CURRENT VOLTMETER.

Voltmeters and ammeters for direct current are built on the Deprez-D'Arsonval system; voltmeters and wattmeters for direct and alternating current, on the electrodynamometer system; and voltmeters and ammeters for alternating current on the electromagnetic system. Wattmeters for alternating current are made for either single or polyphase circuits.

"Bulldog" Portable Lamp Guard.

For work requiring the use of an electric lamp in places where the globe is likely to be injured by the light falling or being struck by hard, heavy objects, some protective cage or guard is a necessity. In the design of such a guard it is essential for the comfort of the workmen that the guard metal be insulated from contact with any live parts in the socket.

Illustrated herewith is the "Bulldog" portable lamp guard, which is rigidly made, of Bessemer steel, copper-plated. The socket is provided with a key, and the handle gives perfect insulation. The bushing is large enough to take any size cord, and the guard will contain either a sixteen or thirty-two candlepower lamp.



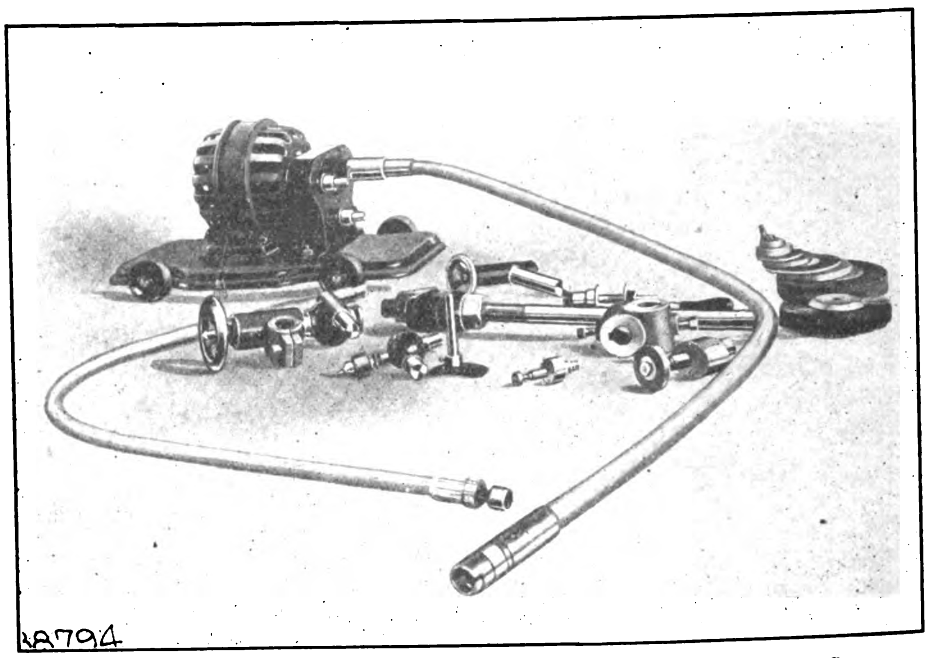
"BULLDOG" PORTABLE LAMP GUARD.

The guard is strong enough for the heaviest usage around engine rooms, machine shops, roundhouses, etc.

The Bulldog portable lamp guard is manufactured by the Crescent Company, 103 West Adams Street, Chicago, Ill.

Small Motor-Driven Emery Wheels, Buffers and Drills.

The illustration shows a handy motor-driven flexible-shaft outfit furnished the United States Government by the Coates Clipper Manufacturing Company, of Worcester, Mass. The equipment consists of a breast drill, drill press, emery wheels and polishers, and is provided with such necessary attachments as a multiplier, clamp, spindle, old-man, etc. The motor is a one-horsepower Westinghouse type CCL alternating-current motor mounted on a portable truck, and fitted with speed-changing head and flexible shaft. The portability makes the appliance convenient for any large work, and the flexible shaft permits the operator to work with ease upon parts otherwise accessible with difficulty.



SMALL MOTOR-DRIVEN EMERY WHEELS, BUFFERS AND DRILLS.

In order to obtain the proper cutting speeds for emery wheels of different diameters, multipliers of the proper ratios are used. The two which can be used to best advantage are those having ratios of eight-and-one-half to one and six-and-one-half to one, respectively; the former for use with three-eighths, one-half and one-inch wheels, and the latter for two and three inch wheels. Larger sizes are used on a clamp spindle, which runs at the speed of the shaft, 1,800 to 2,500 revolutions per minute.

By removing the breastplate on the drill and attaching a combination old-man, drilling up to one-half inch can readily be done. Larger drills up to one-and-one-fourth inches are used in connection with a worm-feed drill press and old-man attachment.

The outfit is so arranged that a heavy or light shaft can be used, according to the requirements of the work. The smaller shaft is fitted with a taper end sleeve for taking small tools, and the larger shaft has a clutch sleeve and grab-dog clutches, so that one tool can be used after another without making any change in the shaft.

Edison Phonograph Manufacture.

Announcement has been made at the works of the National Phonograph Company in West Orange, N. J., that the manufacture of Edison phonographs is in future to be restricted by the company entirely to West Orange, and that the industry will be withdrawn from the London, Paris and Berlin factories.

Current Electrical News

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, NOVEMBER 28.—A very successful interurban electric road has been installed between Schaffhausen and Schleitheim. It uses a type of motor car operating at 750 volts, direct-current, and having a capacity of 200 horsepower, the train being generally made up of a motor car and one or more trailers. The electrical outfit for the line has been supplied by the Oerlikon Company. Passing through a number of localities, such as Beringen and Lohningen, the present line has a total length of eleven miles. It receives current from the municipal electric plant of Schaffhausen, whose transformers supply three-phase current at 10,000 volts. The Siblingen substation, where the three-phase pole-line terminates, contains the rotary groups for supplying direct current for the trolley wire. There are installed in the plant two rotary groups of 200 horsepower each, driven by Oerlikon three-phase motors working upon 380 volts, the secondary potential of the station step-down transformers. Connected with the three-phase motor is a multipole generator of the electric-railway type, which supplies 800 volts, direct current, for the car motors. A storage battery consisting of 390 cells and having a capacity of 200 ampere-hours is mounted in parallel with the generator bars. The motor cars measure fifteen metres between buffers and are mounted on double trucks. Each of the trucks contains two fifty-horsepower motors, making four motors per car.

Among the most recent construction work in the Swiss region may be mentioned the new Bernina electric tramway. The starting point of the line is at Tirano and the route lies along the Poschiavo valley, passing thence by the lake of the same name and Bianco Lake, reaching the mountain region of the Bernina Pass, about which it winds for a considerable distance, offering a fine view of the glaciers of this region. The line then descends to its terminal point at Pontresina. Current for the present line is furnished from the Brusio hydraulic plant, which is fed by the waters of Poschiavo Lake. In the canton of Berne there is a project on foot for the erection of a large hydraulic plant, which is intended to work in parallel with the existing station of Hagneck. For this purpose a dam will be built upon the Doubs stream, near the locality of Souby, at a point where the river is twenty-five metres wide. From the dam there will be run a tunnel flume to the site of the turbine plant at Ocourt. In this way there will be furnished a head of water of forty metres, and the proposed plant will utilize 5,000 horsepower. Of greater size is a proposed plant which is to utilize the power of the Linth River. The rights for such a plant have been already asked from the cantonal government, and, according to the present project, it is to furnish 15,000 horsepower. A tunnel through the Bernardin is one of the most recent projects and will be used to make a railroad connection in this part of the Alps. The enterprise is an extensive one and the project is drawn up by the Buss firm of Switzerland. It is probable that the railroad which runs through the tunnel will be operated electrically.

Messrs. Bellini and Tosi are continuing their experiments in the way of wireless telegraphy by means of directed waves, using for this purpose the main station located at Dieppe and two similar posts at Havre and Barfleur, on the Channel coast of France. By their new method they are quite successful in directing the waves to Barfleur, for instance, without having the same waves affect the station of Havre, which lies nearly in the same line. In this connection I may mention that the work of installing the new wireless station at the Eiffel Tower is making good progress, and it will not be many months before messages will be sent from the plant. A. DE C.

GREAT BRITAIN.

(Special Correspondence.)

LONDON, NOVEMBER 27.—The confusion which had developed in the case of the London electricity supply question has been somewhat disentangled by the result of the proceedings before the Parliamentary Committee, which has now completed its labors, and a certain amount of order has been evolved out of this chaotic condition by the substitution of the London County Council as the one purchasing authority in the year 1831 instead of the different local authorities at different dates.

The interesting experiment now being carried out at Poplar by the local medical officer of health, who makes an electrolytic disinfectant for distribution among the inhabitants, has been reported upon by the bacteriologist to the Local Government Board. This report, which has been asked for in consequence of certain criticisms upon the system, is entirely in its favor, and states that one ounce of the electrolytic fluid to about one gallon of water will kill cholera and typhoid germs in two-and-one-half minutes.

Mr. W. M. Mordey, as the president of the Institution of Electrical Engineers, in a recent address dealt with the alleged backwardness of Great Britain in the electrical industry compared with the rest of the world, and gave figures to show that compared with Germany the consumption of electrical energy is greater here. The present industrial depression he attributed purely to home reasons, and mainly to the fact that users of electrical machinery purchase too much from abroad.

The Great Western Railway Company, which was the first to adopt a system of audible signaling on its locomotives, with a view to abolishing the semaphore system, is now to install this system upon a section of its main line. The system signals are in character essentially electrical and were described in these columns some months ago.

Efforts at running electric cabs and electric omnibuses are apparently destined to meet with more or less unsatisfactory results in London. The Electromobile Company, which promised at one time to establish a very lucrative business in the West End in hiring out electrically driven cars of various descriptions, has suffered a loss of about $7,500 on the past year's trading. The Electrobus Company is also meeting some difficulty in raising its new capital through the public, while a prospectus for placing electric taxicabs on the streets of London did not meet such response as to warrant the directors going to allotment.

An action is being taken in the British courts by the Johannesburg Corporation against the contractors for the famous gas-engine plant there for damages to the extent of $2,000,000, which sum, however, includes the balance of the cost of the plant, which is claimed back. The defense is that the failure of the plant to come up to specification was the unsatisfactory coal used in it. G.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, DECEMBER 5.—The Brazilian Electro-Steel and Smelting Company of Toronto has been incorporated with a capital stock of $10,000,000. The provisional directors are those who usually appear in connection with the announcement of the incorporation of Mackenzie & Mann projects.

As regards the introduction of electric lighting by Canadian railways, both the Canadian Pacific and Grand Trunk railway companies are now carrying out duration trials on some of their cars. These cars have already covered a total mileage of over 1,000,000 miles without one report against them, and it is expected that similar installations will be gradually made until all the railway cars in the Dominion are thus equipped.

The sum of $1,500,000 from Chicago was deposited in a bank at Hamilton, Ont., this week to be used by the Independent Telephone Company. This company is already established at Toronto with a charter covering rights to operate out of that city, and within two weeks construction work will be commenced between Montreal and Toronto. The company is already formed, and interested Chicago people are now in Toronto, one of the party being a member of the Chicago firm of Marshall Field & Company. With this project is associated Eugene M. Beals of New York, who has sole rights for the "Telepost" system of telegraphing. W.

WESTERN CANADA.

(Special Correspondence.)

WINNIPEG, DECEMBER 5.—The electric light and power commissioners of Edmonton, Alb., have discovered that more power is urgently needed by the city. The matter will be taken up by the City Council and arrangements made for the enlargement of the municipal plant. Commissioner McNaughton may be addressed in regard to this matter.

Several important by-laws will be voted on by the ratepayers at the coming municipal elections at Fort William, Ont. The sum of $18,000 is required for extensions and improvements to the municipal telephone system; $10,000 for the extensions to the electric lighting system; $5,000 for the installation of a fire-alarm system, and $170,000 for extensions, double-tracking, etc., of the street-railway system recently acquired from Port Arthur. Address Mayor Murphy, Fort William, Ont.

By a large majority the ratepayers of McLeod, Alb., have voted in favor of spending $55,000 for improvements and extensions to the municipal electric-lighting system. Address E. F. Brown.

Despite the fact Edmonton, Alb., has a new telephone system, there is already a shortage in the supply of instruments, the demand for connections having greatly exceeded the provision made for subscribers. The Council will at once arrange for the purchase of additional equipment. Address Superintendent Cummings.

At Calgary, Alb., a company being formed has applied for a charter to build an electric railway system from that city to Millarville, a distance of twenty-nine miles. So far the names of the incorporators have not been made known. E. L. Richardson, Calgary, can give particulars.

The stringing of the wires to the Silver King mine, near Nelson, B. C., by the West Kootenay Power Company, has been completed. The intention of the owners of this mine is to use electricity entirely in the future.

Superintendent McCauley of Port Arthur, Ont., who formerly had charge of the municipal street-railway system, has been appointed superintendent of the municipal electric-light, power and telephone systems in Port Arthur.

The Kootenay Telephone Company, with head office at Cranbrook, B. C., has announced its intention of building a long-distance line from Corbin to McGillvray, B. C., in connection with the development promised by the Corbin Coal Company of Spokane, Wash. The company is also arranging for the construction of a number of lines in Canada in that part of the country due north of Spokane as well as a long-distance line through the Crow's Nest Pass country to connect with the government system in the province of Alberta. R.

OBITUARY.

MR. FRANK MILLER, manager for the Southern Bell Telephone Company, died at Nashville, Tenn., November 29. His home was at Le Sourdsville, O. H.

MRS. MARY J. NATE, who died December 2, at the age of seventy-two years, was the mother of J. J. Nate, the well-known representative of the Stromberg-Carlson Telephone Manufacturing Company.

A. V. SCHROEDER, general manager of the Winona Railway and Light Company, Winona, Minn., died of typhoid fever at Winona the latter part of November. Mr. Schroeder was formerly electrical engineer for the Illinois Traction Company, and prior to that was electrical superintendent of the Springfield (Ill.) Light, Heat and Power Company. He was a prominent figure in the organization of the Minnesota Electrical Association.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

BRYAN, TEX.—The Bryan Telephone Company has increased its capital stock to $14,000.

YANKTON, S. D.—The Yankton Telephone Company will erect a new central office building. C.

ESSEX, IA.—The Farmers' Telephone Company has been organized with a capital stock of $15,000.

PARK, KAN.—The Park Telephone Company has been incorporated with a capital stock of $10,000.

BALSAM LAKE, WIS.—The McKinley Telephone Company has been incorporated. C. J. Porter is secretary.

BELFIELD, N. D.—Ed. O'Connor and others have incorporated an independent telephone company at Belfield.

UNIONTOWN, WASH.—The Uniontown Telephone Company has been incorporated with a capital stock of $5,000.

BARTLEY, NEB.—The Bartley Mutual Telephone Company has been incorporated with a capital stock of $12,000.

LEBANON, WIS.—The Lebanon Telephone Company has been incorporated with a capital stock of $10,000.

CHISHOLM, MINN.—The Mesaba Telephone Company is about to move its exchange office at Chisholm into larger quarters. A larger board will be installed. C.

WILLMAR, MINN.—The Tri-State Telephone and Telegraph Company has secured larger quarters at Willmar and will install day and night operation of the toll service. C.

MARSHALLTOWN, IOWA—The Farmers and Merchants' Telephone Company of Marshalltown, Iowa, has been incorporated with a capital stock of $250,000. The officers are: B. F. Cummings, president; E. H. Martin, vice-president; P. C. Holdoegel, secretary; J. P. Cooper, treasurer. C.

LADORA, IOWA—The Farmers' Mutual Telephone Company of Ladora, Iowa, was incorporated with the following officers: W. L. Morse, president; Fred Guehrn, vice-president; M. W. Kelting, secretary; H. C. Gates, treasurer; E. H. Matteson, J. W. Bean and Geo. W. Rumple, directors. C.

CULBERTSON, MONT.—The Dakota Western Telephone Company of Culbertson has been incorporated by H. C. McCartney and T. F. Marshall of Oaks, N. D., and J. J. De Laney of Streeter, N. D. The company is capitalized for $200,000. The line will extend from Palermo, N. D., to Havre, Mont. C.

LA PORTE, IND.—The South Bend Home Telephone Company is asking the La Porte City Council for a franchise to permit it to install ten toll stations in La Porte. This action is due to the fact, as alleged, that the La Porte Telephone Company has refused to make arrangements with the South Bend Home Telephone Company for an exchange of service. S.

RICHMOND, IND.—The working agreement between the Central Union and the Richmond Home telephone companies, by which the long-distance service of the former was provided to patrons, has been discontinued. This action was taken on the Ohio court's order enjoining the Central Union from alleged interference with independent companies in Ohio and Indiana. As a result the Central Union can no longer give long distance service to the patrons of the Home company unless they go to the Central Union Company's office. S.

MINNEAPOLIS, MINN.—The attorney-general of Minnesota has given notice to the effect that the Northwestern Telephone Company cannot continue to sell reduced-rate telephone coupons without violating the laws of Minnesota. The company asked the attorney-general if the selling of coupons good for ten to twenty-five dollars' worth of talk at a reduction of ten to twenty-five per cent from the usual rate were lawful. Following the decisions of the United States Supreme Court and Interstate Commerce decisions, G. W. Peterson, who wrote the opinion, says that the sale of the coupons at a discount favors the man with $10 to invest in long-distance talk all at once and discriminates against others.

PERSONAL MENTION.

MR. G. W. ARMSTRONG, Chicago manager of the Excello Arc Lamp Company, is making an extended trip through the South, and writes from New Orleans that he is finding business in fine condition. The southern people are in prosperous shape, crops are good, and "Excello lamps are seen everywhere."

MR. BERNARD E. SUNNY, president of the Chicago Telephone Company and vice-president of the American Telephone and Telegraph Company, has been elected president of the Cleveland Memorial Association, the object of which is to erect a suitable monument to the memory of the late Grover Cleveland.

MR. JOHN C. DOLPH has retired from the Standard Varnish Works, New York city, and will engage in the same line in an independent connection. Mr. Dolph has spent the last twelve years in a study of insulating varnish processes, and has been very successful in establishing and building up the insulator department of the Standard Varnish Works.

"HURRY-UP" YOST, Michigan University's famous football coach, has been selected general manager of the Great Falls River and Power Company, chartered to develop the power of Great Falls and to build an electric short line from Chattanooga to Nashville. The Michigan leader is to take the place of the late C. H. Fisk, who died in McMinnville recently.

MR. R. C. CAMPBELL, district manager for the Philadelphia office of the Adams-Bagnall Electric Company, of Cleveland, Ohio, has recently returned from an inspection tour abroad and has opened new offices in the Land Title Building, Philadelphia, where any communications or inquiries concerning tungsten incandescent lamps, open or enclosed arcs, for operation under all conditions and on all circuits, or any problems involving the field of illuminating engineering, will receive his prompt attention.

EDUCATIONAL.

POLYTECHNIC INSTITUTE OF BROOKLYN—The Polytechnic Institute of Brooklyn, according to the annual report of its president, Fred W. Atkinson, has a total enrollment of 179 students, of whom fifty-six are in the department of electrical engineering. Professor Samuel Sheldon reports on the marked improvement attained in the electrical course and adds that new exercises are being arranged which will require more extended work on the part of the students.

UNIVERSITY OF ILLINOIS INSPECTION TRIP—The University of Illinois departments of electrical and railway electrical engineering visited Chicago November 21 for an inspection trip through a number of electrical manufacturing and power-generating plants of the city. The electrical engineering students made an extended visit to Croton Dam, Mich., visiting the hydroelectric generating station of the Grand Rapids-Muskegon Power Company's 110,000-volt transmission line into Grand Rapids.

NEW PUBLICATIONS.

LIST OF ELECTRICAL FITTINGS—The October list of electrical fittings that have been examined and approved by the Underwriters' National Electric Association for use under the rules and requirements of the National Board of Fire Underwriters for the installation of electric wiring and apparatus has been issued. This list is revised semi-annually.

THE WESTINGHOUSE DIARY FOR 1909—The 1909 edition of the Westinghouse Diary is ready for distribution. This is the fifth edition of the diary, and although this reference book has been of great value to engineers in previous years, the present edition is an improvement over anything that has been published before. The information in connection with high-pressure steam turbines, condensers, low-pressure steam turbines, mechanical stokers, mercury-vapor lamps, meter testing, storage batteries, single-phase railway systems, tungsten lamps, turbo pumps and blowers, and Westinghouse Nernst lamps, is particularly complete and of great value.

PROPOSALS.

POST OFFICE BUILDINGS AT PARIS, ILL., AND JOHNSON CITY, TENN.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until January 6 for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Offices at Paris, Ill., and Johnson City, Tenn., in accordance with specifications which may be obtained from the custodians of the sites, or at the office of the Supervising Architect.

ELECTRICAL SECURITIES.

Last week's developments in the stock markets showed confused and erratic trading and irregular price movements. Artificial manipulation was in evidence, and this included activity in low-priced issues. The financial community, however, holds to the belief that the larger interests are still committed to higher prices. The approach of the end of the year and the usual January reinvestment demand should bolster up public confidence, and it is expected that these events will make for better market conditions. There has been no noteworthy change in the slow improvement in industry in general. Comparisons now being made with last year's period of depression may be misleading, and for some time it is evident that reports of gross earnings should be analyzed very carefully.

Dividends have been declared upon the following electrical securities: Twin City Rapid Transit Company; regular quarterly dividend of one-and-three-fourths per cent on the preferred stock, payable January 2 to stock of record December 15. Butte Electric and Power Company; regular quarterly dividend of one-and-one-half per cent on the common stock, payable January 2 to stock of record December 20. Interborough Rapid Transit Company; regular quarterly dividend of two-and-one-fourth per cent on the capital stock of the company, payable January 2 to stock of record December 19. Chicago City Railway Company; regular quarterly dividend of one-and-one-half per cent, payable December 30 to stock of record December 8. United Traction and Electric Company; regular quarterly dividend of one-and-one-fourth per cent, payable January 2. Seattle Electric Company; a dividend of $2.75 a share on the common stock, payable January 15 to stock of record at the close of business January 1. Indianapolis Street Railway Company; a dividend of three per cent, payable January 1 to stock of record December 23. St. Joseph Railway, Light and Power Company; a quarterly dividend of one-and-one-fourth per cent on the preferred stock, payable January 1 to stock of record December 15. United Traction and Electric Company of New Jersey; quarterly dividend of one-and-one-fourth per cent, payable January 2. Wilkesbarre Gas and Electric Company; quarterly dividend of one per cent, payable January 2 to stock of record December 17.

ELECTRICAL SECURITIES FOR THE WEEK ENDED DECEMBER 5.

New York:	*Closing.*
Allis-Chalmers common	15⅛
Allis-Chalmers preferred	48⅞
Brooklyn Rapid Transit	55½
American Telephone and Telegraph Company	123¾
General Electric	157
Interborough-Metropolitan common	14½
Interborough-Metropolitan preferred	35½
Kings County Electric	127
Mackay Companies (Postal Telegraph and Cable) common	75
Mackay Companies (Postal Telegraph and Cable) preferred	70
Manhattan Elevated	149
Metropolitan Street Railway	25
New York and New Jersey Telephone	114
Western Union	69½
Westinghouse Manufacturing Company	89½
Boston:	*Closing.*
Edison Electric Illuminating	250
Massachusetts Electric	58½
New England Telephone	124½
Western Telephone and Telegraph pref	75
Philadelphia:	*Closing.*
Electric Company of America	10¼
Electric Storage Battery common	42½
Electric Storage Battery preferred	42½
Philadelphia Electric	11¼
Philadelphia Rapid Transit	22
United Gas Improvement	92½
Chicago:	*Closing.*
Chicago Telephone	129
Commonwealth Edison	106⅜
Metropolitan Elevated preferred	48
National Carbon common	85
National Carbon preferred	112

ELECTRIC LIGHTING.

(Special Correspondence.)

PRESCOTT, WIS.—The Prescott Light and Power Company has been incorporated with a capital stock of $30,000.

HARRISON, N. J.—The Strang Electric Company has been incorporated in New Jersey with a capital stock of $25,000.

STEVENSVILLE, MONT.—G. W. Messer and Mr. Featherstone have applied for an electric-lighting franchise for Stevensville. C.

MURRAY, IOWA—A vote will be taken on December 15 at Murray on the question of granting a franchise to Mr. Murray for an electric-light plant. C.

GRIDLEY, CAL.—The City Clerk of Gridley is advertising for bids for furnishing and constructing an electric-lighting plant and distributing system for the city. A.

POSEYVILLE, IND.—The directors of the Poseyville Light and Power Company have decided to extend its transmission line to Cynthiana, a distance of fourteen miles. S.

SLATEDALE, PA.—The Slatedale Electric Light, Heat and Power Company is to be incorporated with a capital stock of $10,000. Wilson Rex is president of the company.

OLNEY, ILL.—The power plant of the Olney Electric Light and Power Company was completely destroyed by fire with a loss of $30,000, of which $17,000 was covered by insurance.

EVANSVILLE, IND.—Plans have been ordered by the Evansville Gas and Electric Light Company for the improvement and enlargement of its plant and the installation of some new equipment. S.

TWIN BRIDGES, MONT.—It is reported that Twin Bridges will be supplied with electric light from the power line which the Madison River Power Company will build from Renova to Sheridan. C.

SPRINGFIELD, ILL.—The Consumers' Electric Company, of Springfield, has been incorporated, with a capital stock of $1,000, to furnish light, heat and power. James A. Hull heads the company.

SANTA BARBARA, CAL.—The Water Commissioners of Santa Barbara have awarded to the Reynolds Electrical Company a contract for cable work and the installation of transformers amounting to $2,550. A.

NORCROSS, GA.—Norcross has voted for bonds, thirty to one, for electric lights. The Mayor and Council ordered the election for the purpose of voting upon the question of issuing bonds to the amount of $5,000.

WILMINGTON, DEL.—The Columbia Power, Light and Railways Company has been incorporated with a capital of $1,200,000 by W. H. Sprousler, Bloomfield, Pa.; M. P. Reed, Philadelphia, and C. L. Ward, Wilmington.

TIPTON, IND.—The Indiana Gas and Electric Light Company has applied for a franchise for a central plant, to be located at Tipton, agreeing to furnish both gas and electricity at a greatly reduced rate from that now charged. S.

RACINE, WIS.—Joseph Horlick, Jr., has undertaken the development of waterpower at the Rapids Dam, near Racine. He is under contract to furnish electricity for nearby plants and towns, and work is to be commenced immediately.

BOSTON, MASS.—The Gas Commission has approved of an issue of $15,000 additional stock by the Marion Gas Company, to be offered to stockholders at $100 per share, the proceeds to be used in the construction of an electric light and power plant.

CALISTOGA, CAL.—The plant, franchise and other property of the Calistoga Electric Light and Power Company at Calistoga has been sold under execution by the sheriff for the extremely small amount of $2,000. The buyer was William Spiers of Lakeport, Cal. A.

SABINAL, TEX.—The electric light and power company is now at work erecting poles and wires on the streets, and it is expected that the plant will be in operation within a few days. The company has been granted a franchise by the town for twenty years.

SAN JOSE, CAL.—R. W. Hersey of San Jose, promoter of the National Park Electric Company, and a party of engineers are now in Tuolumne County inspecting the site of the proposed plant. Mr. Hersey announces that work on the plant will be begun next spring. A.

LINTON, IND.—The City Council at its last meeting took steps to improve and increase the capacity of the electric-light plant. Those opposed to municipal ownership insist upon the sale of the plant, but the Council has decided otherwise and will improve the plant. S.

SAN FRANCISCO, CAL.—It is given out that a new electric power company to be known as the United States Electric Light and Power Company and to have an authorized capital stock of $40,000,000 will file articles of incorporation in San Francisco within a few days. A.

ESCANABA, MICH.—The Escanaba Power Company has been launched by O. L. Hule, formerly manager of the local traction company at Marinette, Wis., to construct a second power dam, capable of developing 2,500 horsepower, across the Escanaba River at Gross, Mich.

EUGENE, ORE.—The City Council of Eugene has decided on the construction of a power plant on the McKenzie River, about fifteen miles from the city. The power developed will be used chiefly for the operation of pumps for the recently-acquired water plant of the municipality. A.

ALBANY, N. Y.—The Central Station Operating Company, with a capital of $25,000, has been incorporated, to furnish gas and electric light in all the cities and villages in the state. The directors are William H. Sheehan, Edward F. McAviney and Frank L. Smith, of New York city.

ANDERSON, IND.—The Sefton Manufacturing Company of Anderson has decided to enlarge its local plant which, when completed, will cover nearly seven acres. The plant will be equipped with electric power throughout. Ex-Governor W. T. Durbin is vice-president and manager. S.

LOS ANGELES, CAL.—The San Joaquin Light and Power Company of Los Angeles, which has a plant under way on the Middle Tule River in Tulare County, is reported to have secured the site for its proposed dam on the Tule River by the purchase of the entire property on which the site was located. A.

AGNEWS, CAL.—The Board of Managers of the Agnews State Hospital at Agnews, Cal., is advertising for bids for the furnishing and erection of a power plant and conduit system to include boilers, engine, generators, switchboard, conduit pipe, wire and wiring. Bids will be received until December 16. A.

CAMAS, WASH.—Two applications for franchises for electric lighting have been presented to the Camas City Council. A steam plant is proposed by Kelley Loe, who applied for a fifty-year franchise, while G. S. Smith of Washougal contemplates building a system to supply both towns with power from the Washougal River.

CHICAGO, ILL.—It has been definitely announced that the Commonwealth Edison Company has acquired the property and franchises of the Cosmopolitan Electric Company. The latter was recently granted a building permit for a power house costing $280,000, to replace its present plant at Canal and Grove streets and the south branch of the Chicago River.

PORTLAND, ORE.—F. S. Morris, of Morris Bros., Portland, has begun preliminary work for the construction of a power plant on the Clackamas River, near Portland. It is given out that the plant will have a capacity of 15,000 horsepower and will cost in the neighborhood of $500,000. The work includes the building of a dam 400 feet long and forty feet high. A.

SEATTLE, WASH.—The Pacific Coast Light and Power Company of Seattle, Wash., has begun condemnation proceedings for the purpose of securing water rights on White River which are supposed to be the property of the Muckleshoot Indians. The company plans to convey water from White River to a point on Stuck River, where the power house will be located. A.

TACOMA, WASH.—The City Council of Tacoma has called an election for December 16 to vote on the question of the construction of a municipal electric power and lighting plant of 20,000 horsepower on the Upper Nisqually River at a cost of about $2,000,000. On the same date the issue of bonds to the amount of $300,000 for the preliminary expenses for rights, etc., will be voted on. A.

EASTON, PA.—The Easton Gas and Electric Company has a project on foot that is bound to result in benefit to the city and community. By the erection of a sign the name and location of Easton is to be burned into the minds of travelers on the various railroads passing through the city. The people of the city are asked to do their share, and a slogan is to be selected and suggested by the people.

BELLINGHAM, WASH.—Howard E. Grant, manager at Bellingham, Wash., for Stone & Webster of Boston, announces that it has been decided to double the capacity of the power plant on the Nooksaak River, controlled by Stone & Webster, the cost of the improvement to be about $250,000. When the changes are completed the power plant will be made the distributing point for the company's interurban railway lines. A.

PORTLAND, ORE.—President Josselyn, of the Portland Railway, Light and Power Company, has approved of the order for underground conduits for the company's system in the business section of the city. Work will commence at once. When completed it will cost in the neighborhood of $1,250,000. Orders have also been given for the installation of new machinery at the Alder and Seventh streets substation at a cost of $150,000. A.

JOLIET, ILL.—The Illinois Steel Company has entered into a contract with the Sanitary District of Chicago to use 1,200 horsepower of electrical energy from the latter's hydroelectric plant at Lockport, Ill. A special transmission line about three miles long will be built from this plant to the steel works. This will be fed directly from the generator buses at 6,600 volts and will be distinct from the 45,000-volt transmission line to Chicago.

LA CROSSE, WIS.—Governor Johnson of Minnesota and Governor Davidson of Wisconsin have been invited to attend the ceremonies marking the formal opening of the works of the La Crosse Water Power Company about December 15. The dam is 50 feet high, 50 feet wide at the base and 495 feet long, damming the Black River into a reservoir lake in its rear. This lake is five-and-one-half miles long and in some places two-and-one-half miles wide. When the water is over the dam there is a storage reserve of 479,160,000 cubic feet.

LEXINGTON, N. C.—The Fries Power Company has closed a contract with the Southern Power Company, the great water-power concern below Charlotte, on the Catawba, whereby this company will enter Winston and furnish 1,500 horsepower of electricity. The transmission lines will be built through Lexington, High Point and Greensboro, these towns, including Thomasville, having the opportunity of securing electric power, also. The Southern Power Company has already built lines and is furnishing power to Charlotte, Mooresville, Statesville, Newton and various other communities.

MERRILL, WIS.—Current has been turned on from the recently completed hydroelectric power plant at Grandfather Falls. The dam is 700 feet long and 70 feet in height. At the right end is the power house, which is 44 feet square and 23 feet high. In this is installed one 1,400-kilowatt generator with its exciter. Other flumes have been constructed to receive additional units to the amount of 3,700 kilowatts when necessary. The power is transmitted twelve miles to the city over high-tension transmission wires, and is used at the mills of the Grandfather Falls, and for lighting purposes at Grandfather.

NORTH YAKIMA, WASH.—Another big electric-power project, where 4,000 to 5,000 horsepower can be developed from the Naches River flow, is planned for the vicinity of North Yakima. Local capitalists have already procured a site for a new power house and the right-of-way for the canal to it, assuring a drop of sixty feet to the power wheel. The power estimated is at the lowest stage of the river. There are now four big power projects under construction near North Yakima, that of the Northwest Light and Power Company, the Yakima Valley Transportation Company's canal through the Moxee to Union Gap, and the East Selah project in the Yakima River Canyon, besides the new one.

OAKLAND, CAL.—The Great Western Power Company of San Francisco has completed the installation of the first unit of its power plant on the Feather River as well as the cementing of the three-and-one-half-mile tunnel which will convey water to the power house. December 10 was set as the date for starting the plant. The initial production will be 20,000 horsepower of electric energy. It is expected that the company's transmission line to Oakland on San Francisco Bay will be completed about that time. The company has filed deeds for a right-of-way through the lands of the People's Water Company in Alameda County, Cal., and will erect its line over the property at once. A.

COLORADO SPRINGS, COLO.—The controlling interest in the Empire Water and Power Company was recently sold to George Bullock, of New York, president of the Colorado Springs Electric Company. Mr. Bullock announced that development to the extent of $500,000 will be prosecuted within the next twelve months. The company owns valuable water rights on the north slope of Pike's Peak and has plans already made for the building of three large reservoirs with necessary pipe lines and an electric power plant in Manitou that will develop 3,000 horsepower, which will be used in supplying power to the large mills and other manufacturing concerns in the Pike's Peak region.

SALT LAKE CITY, UTAH—The application for water power for the largest electric producing plant in Utah has been filed with the state engineer by the Grand Canyon Power Company, Incorporated. The company asks for 2,000 feet of water per second from the Green River, which will be used in running a plant capable of producing 38,000 horsepower. The fees paid for the water rights are $2,000. The plan of the company is to place an immense dam in the Green River 200 feet below its junction with the Coal Creek in Emery County. This will back the water up in Green River for twenty miles. Near the junction of Coal Creek with Green River a diverting channel will be constructed. It will be twenty-four feet wide, ten feet deep and 9,000 feet long.

BELLOWS FALLS, VT.—The Cavendish Gorge hydroelectric generating plant of the Claremont Electric Company is now practically in commission and supplying electricity for a variety of purposes. The dam is of concrete, fifty-four feet high and 107 feet wide along the crest or rollway. The thickness below the water line is thirty-eight feet. There are two gates and a forty-eight-inch waste-water pipe. The gate leading into the fore-bay is nineteen feet below water surface. From the forebay an eight-foot tunnel extends through 200 feet of rock, connecting with a steel penstock six feet in diameter and 1,100 feet long, that conveys the water to the turbines in the power house. In the brick and concrete power house are three Pelton wheels, direct-connected to an equal number of Fort Wayne generators of 500 kilowatts capacity.

SAN FRANCISCO, CAL.—Several large appropriations of water for electric power purposes in California have been made during the last few days. Most of these are in the northern part of California. Among these are: The appropriation of 300,000 inches from the Sacramento River at Tron Canyon by Paul Stoll; the appropriation of 8,000 inches from Deer Creek, near Chico, by William Elliott; 11,000 inches from Battle Creek by H. A. Tedford and W. W. Wheeler. In central California, J. W. McLaughlin and C. K. Kirby have appropriated 300,000 inches of water from the San Joaquin River to be diverted in Fresno County. The Mountain Development Company of Tacoma, Wash., has appropriated 2,000 cubic feet of water from the south bank of White River, near Tacoma, to be stored and used for electric power purposes. The latter company has just been incorporated with a capital stock of $200,000 by B. P. Simonds, Robert M. Davis and A. J. Firmin. A.

ELECTRIC RAILWAYS.

(Special Correspondence.)

MISSOULA, MONT.—W. A. Clark and others have been granted a fifty-year franchise for an electric line. P.

GRAND FORKS, N. D.—The Grand Forks Street Railway Company is to be incorporated with a capital of $150,000. P.

GRUNDY CENTER, IOWA—A right-of-way has been granted at Grundy Center to the proposed electric road from Waterloo to Perry. C.

SIOUX CITY, IOWA—The Sioux City and Spirit Lake Interurban has petitioned for franchises in Spirit Lake, Hartley and Le Mars, Iowa. C.

BUXTON, IOWA—An interurban railway is projected by Byllesby & Company of Chicago, from Ottumwa to Buxton, passing through Eddyville. C.

JACKSON, MINN.—It is proposed to build an electric line from Jackson to Spirit Lake, Iowa, to connect the Sioux City and Spirit Lake road with the Dan Patch Air Line. C.

ELGIN, ILL.—The De Kalb Midland Railway Company has been formed to construct and operate an electric railway from De Kalb to Sandwich, Ill. The capital stock is $150,000 and the incorporators are John W. McQueen, Herbert J. Burdick and John F. Pearce.

L'ANSE, MICH.—The new hydroelectric power plant at L'Anse has been started successfully. This generating station is one of the few waterpower plants in the northern peninsula of Michigan and was constructed after a new steam plant had already been built and discarded.

BERNE, IND.—The stockholders of the Bluffton, Berne & Celina Company, recently organized to construct a traction line between the cities above named, will file articles of incorporation during the coming week. Bids will be received in a short time for the construction of the road. S.

SAN FRANCISCO, CAL.—The delay in the return of President Patrick Calhoun of the United Railroads of San Francisco to California has led to a number of rumors of a possible sale of the company to E. H. Harriman or to interests allied with Mr. Harriman. All knowledge of such a move is denied by the company's representatives here. A.

GARY, IND.—The construction of a street railway connecting the cities of Whiting, Indiana Harbor and Gary is the object of the franchise now being asked of the City Council of East Chicago. The capitalist behind the project is Louis N. Erb, of Chicago, who with other Chicago capitalists recently procured a franchise to enter the city of Whiting. S.

CHICAGO, ILL.—Receivers J. B. Forgan and John M. Roach of the Consolidated Traction Company were given leave of court on December 2 to borrow $200,000 for use in rehabilitation work on the Cicero & Proviso branch of the Consolidated lines. The receivers were authorized to pledge the receipts of the road until 1910 as security for the money to be borrowed.

INDIANAPOLIS, IND.—J. W. Wood of Evansville, senior member of the Indiana Railroad Commission, who has been elected chairman of the Commission, just returned from a meeting of railroad commissioners held in Chicago and reports that the commissioners from Illinois, Michigan and Minnesota decided to adopt the Indiana plan of separating grade crossings of railroads. S.

SOUTH BEND, IND.—The Chicago, Lake Shore & South Bend, the traction line between South Bend and Chicago, which is now in operation between South Bend and South Chicago, has been officially changed in name to the South Shore Line. The company has ten cars in operation between South Bend and Hammond, eleven to Michigan City and twenty-nine to Hammond and Gary. S.

SOUTH BEND, IND.—Under the authority of the board of public works, the South Bend police stopped the Chicago, South Bend & Northern Indiana Traction Company from stretching an overhead feed-wire in the business district of the city. The wire was being stretched on the trolley poles in violation of an ordinance providing that all wires in the business district must be placed underground. The board has also instructed the city attorney to bring proceedings against any person or corporation violating any provision of the ordinance governing wires in the underground district. S.

DETROIT, MICH.—The franchise of the new Windsor Tunnel & Lake Erie Electric Railway Company is now before the City Council of Detroit. The company has agreed to issue workingmen's tickets at eight for a quarter during four hours of the day, with five-cent fares at all other times. The promoters of the road will apply immediately to the Government for a charter of incorporation.

GOSHEN, IND.—Harry L. Weber, consulting engineer in the employ of the Ohio & Indiana Traction Company, and an expert in interurban railway engineering, with a company of assistants, arrived to survey a line between Goshen and Kendallville. Mr. Weber comes in the interest of Boston capitalists, who are proposing to construct the line which is supposed to be the beginning of an interurban line from Chicago to New York. S.

INDIANAPOLIS, IND.—A contract for the construction of a $4,700,000 interurban traction line to connect the cities of Des Moines and Sioux City, Iowa, has been awarded to the American Engineering Company of Indianapolis. The line will be about 196 miles long and will be a part of the triangular system that is being constructed to connect Des Moines, Sioux City, Omaha and Council Bluffs. Chas. N. Wilson, president of the construction company, says that the line will ultimately be a connecting link between Ohio, Indiana and the West. S.

TERRE HAUTE, IND.—The United States Express Company has opened offices in Terre Haute to operate over the four branches of the Terre Haute, Indianapolis & Eastern Traction Company, to Paris, Ill., Sullivan, Clinton and Indianapolis and eastward. The traction company has been doing a semi-express business in connection with its freight business, but did not collect or deliver packages as will now be done by the United States company. It is understood that the deal covers all the lines of what is known as the McGowan syndicate. S.

SAN FRANCISCO, CAL.—Charles N. Black, vice-president and general manager of the United Railroads of San Francisco, announces that eight carloads of power machinery are now due in the city. This will be installed at once and will go far to repair the company's system and put it in shape to resume a full service on its lines. A recent accident to a 6,000-horsepower frequency-changer did considerable damage to the system, rendering it unable to handle some of the power which it had been taking from the City Electric Company. Some of the machinery rented from the Pacific Gas and Improvement Company has also been out of order, but it is expected that this will soon be remedied. A.

SAN FRANCISCO, CAL.—Vice-President and General Manager E. E. Calvin, of the Southern Pacific Company, denies specifically the report that the company has secured control of the Great Western Power Company or of any other power company. He says: "The Southern Pacific Company has bought no power company and owns no sites of its own in the Sierras. We are not planning to operate our suburban trains by hydroelectric plants, but are going ahead with our steam power plant in Oakland. We have cheap oil of our own for use in developing power and do not anticipate that any of the power companies with hydroelectric plants will be able to supply us with power cheaper than we will be able to generate it in our Oakland plant. If any company offers to do so we shall accept the offer and hold our Oakland plant as a reserve plant. A considerable part of the machinery for our Oakland plant is already on the way and more is being manufactured. The trolley wire and feed wire is already on hand. The suburban railway lines in Alameda, Berkeley and Oakland will be converted into trolley lines at once in the order named. The line south from San Francisco will be a third-rail line. The matter of using electricity for the operation of our transcontinental lines over the Sierra Nevada Mountains is for the distant future." A.

INDUSTRIAL ITEMS.

THE SOUTHERN ELECTRICAL AND INDUSTRIAL EXPOSITION has been incorporated at Louisville, Ky. The officers are: F. W. Keisker, president; J. V. Beckmann and F. C. Nunemacher, vice-presidents, and A. T. Macdonald, secretary.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, 184 Lake Street, Chicago, Ill., has ready for distribution some interesting information in booklet and pamphlet form concerning Christmas-tree outfits. This literature will be sent to those interested upon request.

THE BRILL CAR WORKS, Philadelphia, Pa., suffered damage by conflagration on Sunday, November 29, variously estimated from $100,000 to $250,000, pending the company's official estimate of the loss. It is believed that the damage will not interfere seriously with any of the company's contracts.

THE CHICAGO MICA COMPANY, Valparaiso, Ind., announces that Judge Anderson, in the United States Circuit Court, District of Indiana, on December 4, at Indianapolis, refused the plea of the Mica Insulator Company for a temporary injunction to enjoin the Chicago Mica Company from manufacturing mica insulating plates.

THE STEEL ROLL MACHINE COMPANY, 254 East Madison Street, Chicago, manufacturer of laundry equipment, calls attention to the waste involved in throwing away soiled printers' cleaning rags, which, it advises, should be washed in a power washing machine of its manufacture. The rags are washed and rinsed thoroughly without attention.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., devotes the November issue of its monthly house organ *Paistery* to describing and illustrating its National Electrical Code standard pipe taplets adapted for a variety of uses. The pipe taplet is attached to the conduit by pipe threads, located inside the sleeve. A set-screw method of adjustment enables the work to be lined up perfectly.

THE WESTERN ELECTRIC COMPANY, Chicago, in a little booklet entitled "Pointers on Power" describes in an attractive way a number of the applications of its line of alternating-current induction motors. The variety of uses illustrated includes the employment of these motors in driving centrifugal pumps, sheet-metal machinery, turn-table tractors, conveyers, dough mixers, wood-working machinery and exhaust fans.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., in bulletin No. 4627, describes its curve-drawing instruments for alternating and direct-current circuits. These instruments, though in commercial use for several years, have been recently improved by the General Electric Company, and the illustrations and descriptions contained in the bulletin are of interest. The bulletin contains, also, connections, dimensions and other data.

THE GREGORY ELECTRIC COMPANY, Chicago, dealer in electrical apparatus and machinery, has issued a new bargain sheet showing its complete stock. The company is offering exceptional bargains in alternating-current motors, which will doubtless prove attractive to a great many possible buyers. The company is well equipped for the buying and selling of second-hand machinery and is one of the largest dealers in this line. It will be glad to send its latest bargain sheet to interested parties.

THE ELECTRIC MOTOR AND EQUIPMENT COMPANY, Newark, N. J., announces that it has succeeded to the business of the American Chemical Company, formerly conducted by H. C. Swann at 79 Cortlandt Street, New York city. The latter company manufactured the well-known "Faultless" lamp coloring and "Faultless" weatherproof lamp coloring. These colorings, which have been in the market for eight years, are furnished in eighteen colors and shades, or any desired blend to order.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a new line of circulars especially devoted to articles intended for holiday gifts, such as electric-heating devices, Christmas-tree outfits, electric curling-irons, etc. A new folder describes the "Never Break" electric lamp guards and approved electrical fittings. This circular consists of forty pages of descriptive matter, supplemented by interesting information taken from the reports of the Electrical Bureau and National Board of Fire Underwriters. Copies will be sent upon request.

THE GAS CANNON COMPANY, South Bethlehem, Pa., is distributing an interesting circular calling attention to the flintlock model of the gas cannon. This cannon works on the principle of the ordinary gas engine. Gas is allowed to flow into the gun and mix with the air. The mixture is ignited, producing an absolutely harmless explosion. The cork or wooden projectile is not dangerous, and a heavy metal projectile cannot be thrown by the gun at all. There is no other element of danger, because the tongue of flame from the gun will not set fire even to tissue paper or burn the skin.

THE HOYT ELECTRICAL INSTRUMENT WORKS, Penacook, N. H., announces that it has opened an office at 161 Summer Street, Boston, Mass., to take care of its New England trade. The demand for Hoyt instruments from New England centers has shown such a steady and consistent increase since they were first offered a year ago that it was felt the interests of the company's patrons could best be served in this way. The office will be in charge of H. F. Kellogg, a pioneer in the electrical field, and well known in automobile circles. A complete stock of instruments will be carried at all times.

THE CARLYLE-JOHNSON MACHINE COMPANY, Hartford, Conn., has a new catalogue descriptive of the Johnson friction clutch. This clutch has but few parts and is very compact. A body fastened to the shaft carries a split ring in which are inserted a pair of levers. A curve-shaped wedge, which is made part of a shipper sleeve, forces the levers apart, expanding the ring, bringing its outer surface into frictional contact with the inner surface of the friction cup, the hub of which is made to suit requirements. The leverage is so compounded that it requires but little pressure to operate the clutch.

THE HARVARD ELECTRIC COMPANY, 66 West Van Buren Street, Chicago, and 136 Liberty Street, New York, manufacturer of steel brackets, conduit boxes, sectional switch boxes, fuse wire, electrical specialties, etc., announces that since recovering from the August fire which nearly destroyed the Harvard plant, the factory has been working overtime, the total of the October orders being greater than those of any two months during the 1908 season. Allen L. Haase, sales manager of the company, recently returned from a trip through the South and reports exceptionally bright prospects in all the cities he visited.

THE MINNEAPOLIS ELECTRIC AND CONSTRUCTION COMPANY of Minneapolis, Minn., which, for a number of years, has placed on the market a wire-measuring machine which reels wire into a coil and shows the number of feet, is meeting with excellent success. This reel, the manufacturer states, is now used in almost every state in the Union. The company recently received an order from the United States Government for an electric wire meter to be used for measuring signal wire in the Navy Yard, Seattle, Wash. The same device is also used by the United States Government in Manila. The Otis Elevator Company, Minneapolis, made a test on one of the company's large size meters, measuring seven-eighths-inch steel cable, which proved very satisfactory.

C. H. CHALMERS, vice-president of the Electric Machinery Company, Minneapolis, reports a satisfactory business and states that the outlook for the coming year is encouraging. The company has recently booked a number of new orders, among them being one from the Acme Cement Plaster Company, Acme, Texas, secured through the Wesco Supply Company of St. Louis, for one 180-kilowatt revolving-field alternator. The Electric Machinery Company is also installing two 300-kilowatt machines for the Peerless Electric Company, Warren, O., making four machines in all. Two seventy-five-kilowatt engine-type generators, one thirty-kilowatt motor-driven and one twenty-kilowatt balancing sets are being shipped to the Southern Pacific Railway at San Francisco. This order was secured through the company's Pacific agents, the Standard Electrical Works.

THE PETTINGELL-ANDREWS COMPANY, Boston, for December presents the first issue of its new house organ, entitled "Juice." Between striking covers are well-printed pages describing and illustrating "O. K." connection blocks, "Opalux" reflectors, "P-M" remote-control switches, "New Wrinkle" sockets, and other specialties. The leading article, relative to devices designed to prevent the theft of current from unauthorized taps outside the meter, is accompanied by thirty views and diagrams of connection blocks, showing the variety of connections that can be made with these blocks for purposes of applying test instruments, without interrupting the continuity of the consumer's service. "Juice" wil be regularly mailed to central stations, street railways, electrical engineers, architects, contractors, dealers and isolated manufacturing plants using electricity.

THE WHEELER CONDENSER AND ENGINEERING COMPANY, Carteret, N. J., has just published "The Wheeler-Edwards Air Pump," an elaborate thirty-two-page treatise which explains the peculiar action of the Wheeler-Edwards pump in handling both air and water. It is shown how the absence of foot and bucket valves, and an exceedingly small clearance, results in the attainment of a high vacuum, otherwise to be had only by means of separate dry vacuum pumps, hot well pumps and air coolers. Various types of Wheeler-Edwards pumps are shown, as well as a number of large steam-turbine installations in which these pumps are used. The latter half of the book is made up of the discussions of the principles of air pumps, tables of mixed vapors, a complete and original table of saturated water vapor from 60 to 180 degrees F., etc. The final section gives practical instructions for the handling of pumps of this character. This booklet should be valuable to anyone interested in vacuum machinery.

NEW MANUFACTURING COMPANIES.

DULUTH, MINN.—The Duluth Electrical Company of Duluth, with a capital stock of $25,000, has been incorporated by J. W. Day, M. J. Day and H. J. Rich. C.

BROOKLYN, N. Y.—The Bell Arc Light Company, of Brooklyn, has been organized with a capital of $100,000. The directors are: Charles A. Campbell, Henry W. Van Allen and Monroe May, all of New York.

SCHENECTADY, N. Y.—The Tirrill Manufacturing Company has been incorporated with a capital stock of $100,000, to manufacture electrical appliances and machinery. The members of the company are Allen A. Tirrill, Everett E. Lucas, Franklin W. McClellan, Schenectady.

NEW YORK, N. Y.—The Jaeger Tungsten Company of Manhattan has been incorporated to manufacture Tungsten lamps, electrical and illuminating appliances, etc., with a capital of $30,000. The incorporators are W. C. Lillehold, Brooklyn; C. S. Pinkney, H. J. Robinson and J. Wilzing, New York city.

ENGINEERING SOCIETIES.

ARMOUR INSTITUTE BRANCH, A. I. E. E.—At the meeting of the Armour Institute Branch, American Institute of Electrical Engineers, held in Chapin Hall on December 3, an interesting paper on "Alternating-Current Single-Phase Commutator Motors" was presented by Tracy W. Simpson. All the commercial forms of these motors were analyzed and their characteristics pointed out. On January 7, 1909, Arthur P. Strong will present a paper on "Economic Considerations in the Design of Multi-Office Trunk Telephone Systems;" this paper was originally announced for December 17, but was postponed to the first meeting in 1909 on account of conflict with Dr. Steinmetz's lecture to be given on that date.

Directory of Electrical and Allied Engineering and Scientific Societies.

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AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, Walker Electric Company, Twenty-third and Noble streets, Philadelphia, Pa. Next meeting, January, 1909.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Cosmos Club, Washington, D. C. Annual meeting, Baltimore, Md., December 28-January 2.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Dr. J. W. Richards, Bethlehem, Pa.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, 352 Willis Avenue, New York, N. Y.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Dr. Richard Moldenke, Watchung, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN INSTITUTE OF MINING ENGINEERS. Secretary, Rossiter W. Raymond, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th Street, New York, N. Y.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN-RAY SOCIETY. Secretary, Dr. G. C. Johnson, 514 Bijou Building, Pittsburg, Pa. Annual meeting, New York, N. Y., December 28-30.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Forty-seventh Street, New York, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, A. P. Folwell, 239 West Thirty-ninth Street, New York, N. Y.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, H. E. Weeks, secretary and treasurer Tri-City Railway Company, Davenport, Iowa.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION. Secretary, B. B. Davis, claim agent Columbus Railway and Light Company, Columbus, Ohio.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, J. W. Corning, electrical engineer Boston Elevated Railway Company, Boston, Mass.

AMERICAN STREET AND INTERURBAN RAILWAY TRANSPORTATION AND TRAFFIC ASSOCIATION.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION. Secretary, George B. Keegan, 2321 Park Row Building, New York, N. Y.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, J. E. Cowles, superintendent of lighting Hot Springs Light and Railway Company, Hot Springs, Ark.

ARKANSAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

ASSOCIATION OF CAR-LIGHTING ENGINEERS. Secretary, G. B. Colegrove, Illinois Central Railroad, Chicago, Ill.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, D. L. Huntington, second vice-president and manager Washington Water Power Company, Spokane, Wash.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington Street, Newton, Mass.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Wisconsin Central Railway, Milwaukee, Wis.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION. Secretary, L. E. W. Pioda, Oak and Broderick Streets, San Francisco, Cal.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Canada.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Acton Burrows, 33 Melinda Street, Toronto, Ontario.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, A. L. Neereamer, Traction Terminal Building, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. C. Lawler, Colorado Springs, Colo.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, F. W. Poole, Bridgeport, Conn.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, George William Russell, Jr., 500 Fifth Avenue, New York, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine Street, St. Louis, Mo.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago, Ill.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA, LIMITED. Secretary, William R. Stanley, Royal Insurance Building, Montreal, Canada.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, Cal., first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York, N. Y. Board of directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau Street, New York, N. Y.

ENGINEERS' CLUB OF PHILADELPHIA. Secretary H. G. Perring, 1317 Spruce Street, Philadelphia, Pa.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt Street, New York, N. Y.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. A. Camp, Henry, Ill.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Van Rensselaer Lansingh, Engineering Societies Building, 33 West Thirty-ninth Street, New York, N. Y.

INDEPENDENT TELEPHONE ASSOCIATION OF TEXAS AND LOUISIANA. Secretary, C. A. Shock, Sherman, Tex.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Allen J. Paylow, Rockport, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ward, Grand Rapids, Mich. Secretary's office, Monadnock Building, Chicago, Ill.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Iowa.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Iowa.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. G. Turpine, Henderson, Ky.

MAINE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, M. E. Crow, Houlton, Me.

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MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

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MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, George W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago, Ill.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, John F. Gilchrist, Commonwealth Edison Company, Chicago, Ill.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb.

NEBRASKA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. E. Mattison, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 60 State Street, Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass. Meetings held on fourth Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 West Thirty-ninth Street, New York, N. Y.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Temporary secretary, J. D. Crary, Aberdeen, Wash.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, R. M. Kimball, Kenosha, Wis. Annual meeting, Milwaukee, Wis., January, 1909.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, O. O. Welsheimer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Ballard, Cleveland, Ohio.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

OLD TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, Frank J. Scherrer, New York, N. Y.

ORDER OF THE REJUVENATED SONS OF JOVE. Mercury, C. B. Roulet, Dallas, Tex.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. S. Smith, Towanda, Pa.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa. Next annual meeting, Louisville, Ky., October 12-14, 1909.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, J. A. Myler, Jr., 608 Juanita Building, Dallas, Tex.

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TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, G. M. Goddard, 55 Kilby Street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 382 Ohio Street, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION. Secretary, Clement C. Smith, president Columbia Construction Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

ALABAMA LIGHTING AND TRACTION ASSOCIATION. Temporary secretary, F. K. Jackson, Mobile, Ala.

DATES AHEAD.

American Roentgen-Ray Society. Annual meeting, New York city, December 28-30.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

American Association for the Advancement of Science. Annual meeting, Baltimore, Md., January, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) December 1, 1908.

905,130. MACHINE FOR CRIMPING ELECTRIC RESISTANCE-WIRES. James I. Ayer, Cambridge, Mass., assignor to Simplex Electric Heating Company, Boston, Mass. Filed December 6, 1906. Two loop forming devices are arranged to lay the loops alternately in opposite directions.

905,131. ELECTROMAGNETIC STOP MECHANISM FOR SHUTTLE-LOOMS. Daniel Bacon, New York, N. Y. Filed February 8, 1907. An electrically-operated clutch governs the movements of the driving shaft of the loom.

905,136. ALTERNATING-CURRENT MAGNET. Thomas E. Barnum, Milwaukee, Wis., assignor to Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Filed April 15, 1905. There is an iron shroud surrounding the coil with an air-gap so proportioned that the self-induction of the coil will permit the passage of sufficient current to attract the armature, but when this is attracted only sufficient current can pass to maintain the armature in position.

905,141. INSULATOR. Lawrence L. Bogue, East Orwell, Ohio. Filed May 28, 1907. An elongated cylindrical body has continuous U-shaped grooves intersecting at its rounded ends.

905,159. ELECTRIC HEATER. Austin C. Dunham, Hartford, Conn. Filed April 16, 1907. An electric radiator comprises a corrugated receptacle with a central casing dividing it into communicating chambers with an electric-heating coil in the bottom portion.

905,176. DEVICE FOR SUSPENDING BATTERY-CRADLES. Emil Gruenfeldt, Cleveland, Ohio, assignor to The Baker Motor Vehicle Company, Cleveland, Ohio. Filed January 23, 1908. A series of independent hangers for suspending the storage battery in an electric vehicle.

905,229. ELECTRIC CALL-BELL. Christian Reinker and William Reinker, Lakewood, Ohio. Filed April 27, 1908. A separate magnetically-controlled device is adapted to limit the vibratory movement of the hammer to a buzzing sound.

905,230. ELECTRICAL CONDUCTOR FOR DYNAMOS. Walter J. Richards, Milwaukee, Wis., assignor to National Electric Company, Milwaukee, Wis. Filed August 15, 1904. A pigtail carbon brush.

905,266. SIGNAL APPARATUS. Leonidas G. Woolley, Lima, Ohio, assignor to John C. Riley, Lima, Ohio. Filed August 31, 1906. A magneto-electric signaling system includes a main-line testing mechanism having a magneto with an overbalancing weight.

905,308. AUTOMATIC RAILROAD SIGNAL. William H. Harris, Stark, Mont. Filed December 16, 1907. Electrically-operated block-signal system.

905,312. HEADLIGHT. Theron L. Hiles, Chicago, Ill. Filed July 23, 1908. An electric lamp is located in a parabolic reflector composed of glass silvered on its outer surface.

905,326. ELECTRICAL TEMPERATURE READER AND RECORDER. George E. Kirk, Toledo, Ohio, assignor to William A. Baker, Toledo, Ohio. Filed June 26, 1907. Contains an indicating instrument and a temperature-measuring instrument capable of producing variation in a resistance.

905,327. ELECTRIC SIGNALING SYSTEM. Edward E. Kleinschmidt, New York, N. Y. Filed August 7, 1907. An alternating-current system for a direct-current railway has a transformer in each block.

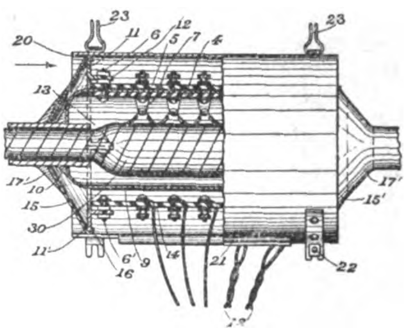
905,347. CABLE TERMINAL. James E. McMeen, Galesburg, Ill. Filed May 21, 1906. A sealed sleeve contains a set of insulated terminals; a second set of terminal posts is supported by the flanges of the sleeve, and a cover is clamped upon the flanges, forming a housing for both sets of terminals.

905,349. SEAL FOR ELECTRIC WIRES. Orrie W. Neal, Burton W. Shaw and Harry J. Howarth, Portland, Me. Filed August 15, 1908. A seal for the ends of insulated wires consists of a two-part casing adapted to inclose the bare ends.

905,351. TROLLEY RETRIEVER. Clarence Norland, Los Angeles, Cal. Filed March 7, 1907. A casing contains a reel and a slack-adjusting spring connected therewith.

905,361. METHOD OF PRODUCING AND UTILIZING OZONE. Henry N. Potter, New Rochelle, N. Y., assignor to Cooper-Hewitt Electric Company, New York, N. Y. Filed January 6, 1904. The method consists in passing current between the electrodes inside a container previous to ozonizing radiation.

905,364. FLOOR BOX AND RECEPTACLE. Nelson H. Raymond, Trumansburg, N. Y., assignor to Alice C. Patterson, New York, N. Y. Filed July 7, 1908. A socket is mounted on a saddle in the receptacle.



905,347.—CABLE TERMINAL.

905,370. DELIVERY APPARATUS FOR DELIVERING MAIL, PARCELS, OR THE LIKE. Shelton H. Roby, Dublin, Ga. Filed January 9, 1908. A suspended carrier system has means for energizing the track wires and connections for leading the current to and from the motor of the carrier.

905,378. FIRE AND TEMPERATURE ALARM OR INDICATOR. George L. Smith, Aberdeen, Scotland. Filed May 22, 1908. A pneumatically controlled electric fire and trouble alarm.

905,402. METHOD OF REMOVING CARBON FROM METALLIC FILAMENTS. Werner von Bolton, Charlottenburg, Germany, assignor to Siemens & Halske, A. G., Berlin, Germany. Filed June 2, 1908. The method consists in highly electrically heating the film containing the carbon in an atmosphere of acetic acid vapors.

905,414. METALLIC INSULATOR PIN. Charles G. Ette, St. Louis, Mo., assignor to Ette Investment Company, St. Louis, Mo. Filed December 24, 1907. Consists of two sections that are provided on their longitudinal edges with interlocking teeth.

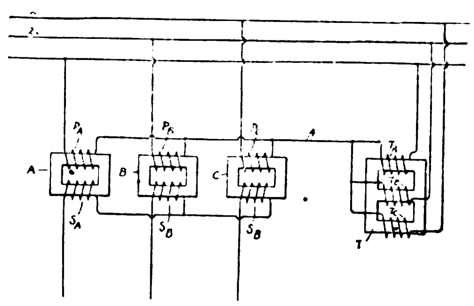
905,458. GLOBE CLEANER FOR ARC LAMPS. Robert H. Read, Schenectady, N. Y., assignor to General Electric Company. Filed October 25, 1906. In combination with the inner globe are electromagnetic means for rotating it and one or more stationary wipers inside the globe.

905,459. FLAT-IRON STOVE. Edwin W. Rice, Jr., Schenectady, N. Y., assignor to General Electric Company. Filed May 11, 1908. A flat-iron stand comprises an upwarding projecting support for an iron and contact terminals adjacent thereto.

905,468. ELECTRIC SIGN. John P. Shearer, Nyack, N. Y. Filed April 16, 1908. A casing has panels mounted in it and a bar carrying the lamp support.

905,478. INCANDESCENT LAMP. Alfred Swan, New York, N. Y., assignor to General Electric Company. Filed June 7, 1905. A portion of the leading-in wire is curled up in a cavity in the web.

905,483. ELECTRIC-LIGHT-BULB SHIELD. Benjamin R. Williams, English, Ark. Filed March 18, 1908. Each of a pair of shields adapted to enclose the bulb is provided with a neck fitting the neck of the socket, and a binding-band encircles the necks of the shields.



905,509.—THREE-PHASE DISTRIBUTION SYSTEM.

905,495. ELECTRORESPONSIVE DEVICE. Edward A. Buckman, Chicago, Ill., assignor of one-half to Harry L. Felio, Chicago, Ill. Filed July 1, 1907. An electromagnet comprises a spirally-advancing laminated core, laminated pole pieces and a coil wound on the core.

905,497. TELEGRAPH TYPEWRITER. George A. Cardwell, New York, N. Y., assignor to American Telegraph Typewriter Company, New York, N. Y. Filed March 18, 1907. Consists of a number of main and secondary circuits and selectable magnets responsive to a characteristic kind of impulse.

905,503. NON-EXPLOSIVE FUSE. Frank B. Cook, Chicago, Ill. Filed May 3, 1906. An enclosed fuse is filled and sealed so as to exclude all air therefrom.

905,508. CONTROL OF SEPARATELY EXCITED GENERATORS PROVIDED WITH AUXILIARY POLES. Lionel Fleischmann and Georg Stern, Berlin, Germany, assignors to General Electric Company. Filed March 11, 1908. The generator has an auxiliary series field and means for "killing" this when the main field circuit is broken.

905,509. SYSTEM OF DISTRIBUTION. Lionel Fleischmann, Berlin, Germany, assignor to General Electric Company. Filed April 10, 1908. A three-phase system has three single-phase transformers Y-connected and a three-phase Y-connected reactance, with its neutral point connected to the neutral point of the single-phase transformers.

905,512. DYNAMO-ELECTRIC MACHINE. Charles M. Green, Lynn, Mass., assignor to General Electric Company. Filed August 12, 1903. The armature has a shield formed of a strip of woven fabric cut on the bias and means for gathering the edges of the strip to cause it to closely embrace the armature.

905,513. SIGNAL SYSTEM. John L. Hall, Schenectady, N. Y., assignor to General Electric Company. Filed January 30, 1908. A number of receiving devices are provided with magnet windings.

905,514 and 905,515. ARC LAMP. Cromwell A. B. Halvorson, Jr., Lynn, Mass., assignor to General Electric Company. Filed October 31, 1906, and April 6, 1907. There are means for operating the negative electrode to cause it to strike the positive one. The second patent describes the clutch mechanism.

905,520. FEED MECHANISM. Bengt M. W. Hanson and Frederick W. Post, Hartford, Conn., assignors to Pratt & Whitney Company, Hartford. Conn. Filed April 12, 1907. An electric circuit has a member provided with means for limiting the action of the feed mechanism.

905,537. RECEIVER ARRANGEMENT FOR WIRELESS TELEGRAPHY. Gerhard Jahr, Berlin, Germany. Filed June 12, 1907. Comprises a coil, a receiver, adjustable terminals therefor, a lever connected with one of the terminals and adapted to contact the other terminal under the action of electric waves.

905,554. INSULATED CONDUCTOR. Joseph I. Mitchell, Schenectady, N. Y., assignor to General Electric Company. Filed September 14, 1903. The conductor for use in making edgewise-wound coils consists of a flat strip and a flat strip of insulating material adjacent to one side.

905,557. ARC-LIGHT ELECTRODE. Berthold Monasch, Berlin, Germany, assignor to General Electric Company. Filed May 16, 1906. Composed of one or more metallic compounds mixed with several per cent of silicon carbide.

905,572. METHOD OF STRIKING VOLTAIC ARCS. Albert J. Petersson, Alby, Sweden. Filed November 3, 1905. The method consists in leading gases through a furnace chamber, striking arcs between the electrodes and moving the arcs by means of magnetic action to electrodes of other circuits of higher intensity.

905,588. ELECTRIC CONTROLLER. Ralph R. Root, Cleveland, Ohio. Filed February 8, 1906. A resistance controller there are provided a pair of carbon pencils and solenoids for moving one pencil so as to increase the distance between them and thereby produce resistance.

905,589. SYSTEM FOR CONTROLLING MOTORS. David E. Ross, Brookston, Ind. Filed May 18, 1907. A pneumatically-operated controller for traction motors.

905,594. DEVICE FOR LOCATING A MOLTEN DISTRIBUTING FUSE. Ferdinand Schultz, Münster, Germany. Filed February 15, 1907. The fuse on melting opens an electric connection between the feeder and pilot wires, and indicates its location by a voltmeter at the central station.

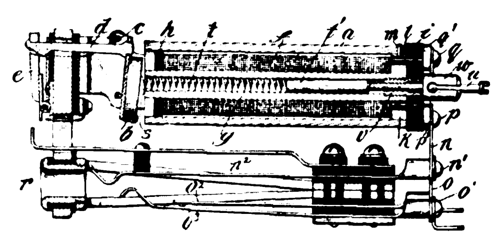
905,597. ELECTRIC FLUID HEATER. James S. Smyser, Harwich, Mass., assignor to General Electric Company. Filed April 4, 1908. Comprises a fluid receptacle and a pair of electrodes therein, each composed of parallel-spaced plates connected at one end.

905,599. NEGATIVE-POLE ACCUMULATOR ELECTRODE. Edward Sokal, Chicago, Ill. Filed August 22, 1907. Consists of a perforated envelope completely filled with active material containing a small percentage of lead dust.

905,619. TELEPHONE-EXCHANGE APPARATUS. Ernest E. Yaxley, Chicago, Ill., assignor to Monarch Telephone Manufacturing Company, Chicago, Ill. Filed September 26, 1905. A combined magneto drop and spring jack.

905,621. ALTERNATING-CURRENT HIGH-FREQUENCY GENERATOR. Ernest F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. Filed February 6, 1905. An inductor-type alternator has two rotating discs tapering toward their center and carrying projections on the inner sides of the peripheries.

905,625. EXPLOSION ENGINE. Elmer Apperson, Kokomo, Ind. Filed July 3, 1906. A pair of spark plugs extends into the cylinder, one being connected to a magneto and the other to a battery.



905,619.—TELEPHONE DROP AND JACK.

905,628. TELEGRAPHIC REPEATING APPARATUS. William E. Athearn, New York, N. Y., assignor to American Telephone and Telegraph Company. Filed April 29, 1908. The circuit has at each of two stations a current-reversing transmitter and a polarized relay.

905,666. ELECTRODE. Albert G. Davis, Schenectady, N. Y., assignor to General Electric Company. Filed July 29, 1904. In an apparatus for electrical treatment of gases there are electrodes containing magnetite and means for establishing an arc between them.

905,675. BRUSH HOLDER. Hermann F. T. Erben, Schenectady, N. Y., assignor to General Electric Company. Filed October 17, 1903. A pivoted frame to which the brush is rigidly secured is provided with a spring having an adjustable spiral portion and reversely curved portion.

905,697. MOTOR-CONTROL SYSTEM FOR ELECTRIC VEHICLES. Max R. Hanna, Schenectady, N. Y., assignor to General Electric Company. Filed March 16, 1908. There are a number of electrically-controlled switches for connecting and regulating two pairs of motors and a master controller governing the controlling switches.

905,703. INCANDESCENT ELECTRIC LAMP. Herman J. Jaeger, New York, N. Y. Filed November 4, 1907. Construction of a multiple metallic-filament lamp is described.

905,713. SELF-REGULATING ELECTRICALLY-PROPELLED VEHICLE WITH LIMITED VARIATIONS IN INTENSITY. Louis Krieger, Paris, France. Filed January 10, 1906. A generator arranged to deliver constant watts has an exciter.

905,734. AUTOMATIC SELF-STARTER. Charles H. Miller, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Filed April 10, 1905. An electromagnetically operated starter for electric motors.

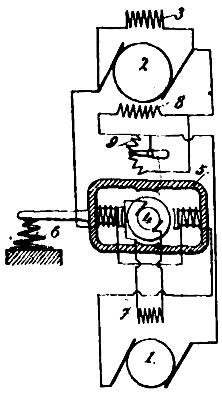
905,746. OPERATING DIRECT-CURRENT GENERATORS IN MULTIPLE. Frank W. Peek, Jr., Schenectady, N. Y., assignor to General Electric Company. Filed April 8, 1908. There is a voltage regulator for each generator containing a main-control magnet having a differential winding.

905,752. POWER-GENERATING SYSTEM. Edmond Rosenberg and Edgar W. Mix, Paris, France, assignors to General Electric Company. Filed April 23, 1907. There are in combination an electric generator, a turbine driving the same, a flywheel located in a chamber and a condenser which creates a vacuum in the chamber to decrease rotation losses of the flywheel.

905,761. SEALING-CAP FOR ELECTRICAL APPARATUS. Joseph G. Swallow, Brooklyn, N. Y., assignor of one-half to Frank W. Smith, New York, N. Y. Filed March 6, 1908. A reversible perforated cap is provided with an opening for the appliance.

905,773. GROUNDING CLAMP FOR ELECTRIC WIRES. Wheeler H. Vibber, New London, Conn., assignor of one-half to the Gillette-Vibber Company, New London, Conn. Filed April 11, 1908. A wrought-metal strap is bent to a circular form and has two projections which are perforated for the reception of the binding-screw.

905,781. TELEPHONE RECEIVER. Nathaniel Baldwin, Heber, Utah, assignor of one-half to William Witt, Heber, Utah. Filed January 29, 1908. A magneto telephone has a permanent magnet, an armature and means for causing both poles of the magnet to act on each side of the armature.



905,713.—SELF-REGULATING GENERATOR.

905,782. ELECTROMAGNETIC SWITCH. Thomas E. Barnum, Milwaukee, Wis., assignor to Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Original application filed April 15, 1905. Divided and this application filed July 5, 1906. This is a modification of No. 905,136.

905,784. MOUNTING FOR TROLLEY HEADS. Joseph J. Bennett, Pittsfield, Mass., assignor of one-half to Loando B. Estes, North Adams, Mass. Filed August 6, 1906. There is an arm integral with the base piece and adapted to be mounted in the upper end of the trolley pole.

905,785. ELECTROLYTIC SOLUTION FOR ZINC PLATING. Celestino Bianco, New York, N. Y. Filed July 16, 1907. Contains sulphates of zinc and iron and acetate of sodium.

905,790. MOTOR CONTROLLER. Albert H. Buckelew, Newark, N. J. Filed February 21, 1905. The pilot motor actuates the controller step by step and a pair of directional switches controls the pilot motor without stopping the main motor in going from one position to another.

905,792. SNAP SWITCH. Frank S. Capello, Schenectady, N. Y., assignor to General Electric Company. Filed October 8, 1907. In combination with the spindle are catch-plates having a slot and an actuator engaging the slot and adapted to slide transversely of the spindle.

905,797. ALTERNATING-CURRENT CLUTCH. Albert G. Davis, Schenectady, N. Y., assignor to General Electric Company. Filed March 27, 1908. A magnetic clutch has two movable members, one with a laminated core and a winding thereon and the other with a short-circuited conductor in inductive relation to the winding.

905,800. ARC LAMP. John T. H. Dempster, Schenectady, N. Y., assignor to General Electric Company. Filed February 29, 1904. Renewed April 7, 1906. Comprises a non-consuming electrode, a consuming electrode co-operating therewith and means for heating the former to thereby heat the latter electrode.

905,805. DYNAMO-ELECTRIC MACHINE. Samuel S. Forster, Schenectady, N. Y., assignor to General Electric Company. Filed July 20, 1905. The teeth of a laminated armature core are provided with U-shaped stiffening members.

905,812. ELECTRICAL CONNECTOR. Preston E. Gilling, Camden, N. J., assignor to Novelty Electric Company, Philadelphia, Pa. Filed March 20, 1906. Comprises a piece of tubing with a section flattened and bent into a loop to form a clamp having a terminal with a socket.

905,814. DYNAMO-ELECTRIC MACHINE. Charles M. Green, Lynn, Mass., assignor to General Electric Company. Original application filed August 12, 1903. Divided and this application filed November 8, 1904. The pole shoe is formed of iron laminated perpendicularly to the plane of revolution of the armature.

905,815. APPARATUS FOR THE MAGNETIC SEPARATION OF ORE. Gustaf Gröndal, Djursholm, Sweden. Filed June 25, 1907. A set of magnets is arranged above the overflow between the vessels.

905,816. CLOCK. Augustus L. Hahl, Chicago, Ill., assignor to Hahl Automatic Clock Company, Chicago, Ill. Filed September 26, 1903. An electromagnet is energized at predetermined intervals thereby actuating the rack bar and winding the spring.

905,817. DYNAMO-ELECTRIC MACHINE. Fred B. Howell, Schenectady, N. Y., assignor to General Electric Company. Filed April 17, 1908. A pole piece comprises laminations and fastening bolts therefor extending all the way through the pole piece.

905,819. AUTOMATIC CARRIER SYSTEM. Carl W. Larson, Schenectady, N. Y., assignor to General Electric Company. Filed January 2, 1906. An automatically-controlled and electrically-driven cable moves the car.

905,824. ELECTRIC EXHIBITOR. Bert H. Winters, Annapolis, Md. Filed December 17, 1907. A casing with a sight opening contains a drum revolved by an electromagnet and an electric-lighting arrangement.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired December 8, 1908:

464,490. ELECTRIC RAILWAY SIGNAL. C. E. Buzzell, Leaf River, Ill.

464,505. CONDUIT CONDUCTOR FOR ELECTRIC RAILWAYS. W. H. Knight, New York, N. Y.

464,510. AUTOMATIC FIRE-ALARM TELEGRAPH. M. Martin, Malden, Mass.

464,513. ELECTRIC FARE-RECORDING SYSTEM. B. S. Molyneaux, Minneapolis, Minn.

464,540. TIME-REGISTERING DEVICE FOR ELECTRICAL CURRENTS. W. D. Wilder and W. Cobb, Jr., Brockton, Mass.

464,547. ARMATURE WINDING FOR DYNAMO-ELECTRIC MACHINES. C. R. Arnold, Philadelphia, Pa.

464,557. ELECTRIC RAILWAY SYSTEM. L. O. Dion, Natick, Mass.

464,643. PROTECTOR FOR TELEPHONES. J. L. W. Zietlow, Aberdeen, S. D.

464,665. SECONDARY BATTERY. I. L. Roberts, Brooklyn, N. Y.

464,666. ELECTROMAGNETIC MOTOR. N. Tesla, New York, N. Y.

464,667. ELECTRICAL CONDENSER. N. Tesla, New York, N. Y.

464,676. ELECTRODE FOR SECONDARY BATTERIES. W. Morrison, Des Moines, Iowa.

464,677. ELECTRICAL TRANSFORMER. A. Poleschko, St. Petersburg, Russia.

464,682. ELECTRIC ARC LAMP. A. G. Waterhouse, Hartford, Conn.

464,683. ELECTRIC METER. A. G. Waterhouse, Hartford, Conn.

464,780. TROLLEY FOR ELECTRIC RAILWAYS. J. W. Schlosser, Washington, D. C.

464,822. SYSTEM OF DISTRIBUTING ELECTRICITY. T. A. Edison, Menlo Park, N. J.

464,897. TELEGRAPH KEY. L. F. Robare, Au Sable Forks, N. Y.

ELECTRICAL REVIEW
AND
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CONTENTS.

UNREASONABLE FRANCHISE EXACTIONS.

Very often the city fathers, in drawing up an ordinance for the regulation of the relations of the municipality and a corporation exercising a quasi-public function, are eager to impose exactions which will make it imperative for the company desiring a franchise to treat all people applying for service exactly alike. This has led to considerable loss on the part of the telephone companies, and the reason for it is not hard to see if any close analysis is made of the possibility of irresponsible persons demanding and securing service for which they are unable to pay.

The electric-lighting company usually brings its feeders to a point either outside or just inside of a residence or factory building, and the gas company is responsible only so far as its street mains and house connections are concerned. The telephone company, on the other hand, takes care of its own street distribution and carries its wiring scheme through the building to its own instrument, which it leaves ready for service upon the premises of the subscriber.

In discussing the subject of credit co-operation among manufacturers, and the necessity for a close analysis of the credit of those asking for service from a quasi-public corporation, a prominent telephone man, speaking before an electrical gathering recently, stated that under its ordinance, his company was expected to give service to everybody who demanded it. At one time during the present year there were something like 3,800 requests for nickel-telephone service. A credit department was established, and these 3,800 requests were dumped into this department, and in a short time 2,500 of them were returned as being unable to pass muster for apparent ability to pay their bills. The installation of wiring and the telephone instrument for these subscribers would have occasioned a very great investment upon the part of the telephone company, so it was decided to address a brief letter to these apparently irresponsible ones, with the request that they post a deposit of $9 with the telephone company as a guarantee of good faith, with the understanding that if the bills were properly met for a period of one year, they would have returned to them the sum of $10, which would, of course, include their original payment and interest thereupon. Out of 2,500 possible subscribers thus addressed only 400 either put up the deposit of $9 or secured a guarantee from parties such as the telephone company could deem reliable. As a further indication of the irresponsibility of large numbers of people who will exact a service, even though unable to pay for it, out of another 2,500 subscribers who actually did receive service, 300 fell down the first month, 400 the second month and something like 600 the third month.

CENTRAL-STATION LOCATION OUTSIDE CITIES.

Within the past two or three years the location of central stations outside the immediate centres of distribution which they serve has become sufficiently frequent to justify comment. While local conditions are obviously responsible for this departure from former practice in cases that have been given thorough engineering study, the tendency is none the less marked. Usually the problem has been solved in connection with the re-location of a plant at a time when the growth of the old station demands a large addition in capacity, with provision for a number of years' expansion. The progress lately made in the field of high-voltage transmission justifies taking a wider view of the power supply question for any given community than was possible in the old days when the ideal of the plant designer was to locate his machinery as close to the centre of distribution as real estate restrictions and water supply would permit.

There are more advantages in locating a plant at some distance from an urban centre than are always appreciated, in view of the general tendency of central stations in the majority of communities to adopt 2,300 volts as the standard of service. The increasing cost of real estate, the rapid growth of the power business and the expansion of lighting loads, the tendency of city taxation to mount upward, the development of adjacent territory and property, the difficulty and great cost of purchasing land for extension, smoke restrictions, crusades against noise, restrictions against coaling at the most convenient hours, and the pressure of commerce against the station walls, all point the way toward a location of the plant ultimately on a site less cramped, following the course of many industrial establishments in their re-location in the suburban sections of large municipalities, with new equipment and better opportunities for development along the best lines.

The location of a station on a piece of land in a small town adjacent to the city mainly supplied enables the company to design the plant according to its own ideas, without interference from over-zealous municipal regulations. At moderate cost, usually, sufficient land can be obtained to provide for many years' growth along whatever lines engineering development dictates, and the operation of the new station can be vastly facilitated by the low cost of space on the new property. It is a great mistake for a company building a new station on a suburban or rural site, to crowd the apparatus as though operation were to be carried on in a congested city district, and yet one of the latest examples of a transplanted station illustrates a case of this kind. In the instance in mind, the old steam plant in the centre of the city became inadequate in both capacity and economy of power production, and a new station with the latest turbine equipment was built by the company in an adjoining town, to supply all power through the original plant location as a distributing substation. Unfortunately the new station is so crowded that passage through the building is devious and difficult, the handling of machinery parts is less flexible than is desirable, and the operation of the station is clearly hindered by the cramping of equipment. The location of the plant on land so cheap that the expansion of the next twenty-five years, if not of the next half-century, is provided for by the area purchased, ought to have predicated a station of ample design, even at some relatively small increase in first cost of building, piping and wiring runs.

The more remote site similarly affords larger and less costly coal-storage facilities. If the plant is located beside a railroad track or on a navigable stream, the cost of coal per ton may be considerably reduced through lessened expense in handling, avoidance of teaming, ease of installing telpher systems or electric traveling grab-bucket equipments of moderate cost which might be precluded entirely in the more constricted site of the old station. The cost of water for boiler feed may be considerably reduced also, by a location outside the city. In not a few cases the housing of the station employees may be solved in a much better way than is possible in the city proper, although the provision of hours of labor that will allow a certain amount of relaxation is a very important factor in retaining the services of desirable men when a plant is moved to some out-of-the-way suburban point.

The only objection of serious character against these locations of the newer central stations is the question of service reliability and cost of transmission. The integrity of the transmission to the substations or distributing centres must be absolutely established. At the moderate voltages usually required in these central-station services, with distances rarely exceeding a dozen miles or so, there is little excuse for the failure to maintain continuous service. A 13,200-volt transmission offers no difficulty to an experienced engineer in these days, and where 2,300 or 6,600 volts are adequate, interruptions should be few and far between. When the service of a good-sized city depends upon a plant located outside the centre of population, it may pay to install at least two lines in the interest of service continuity. The cost of transmission, including fixed charges, needs to be carefully figured in planning the location of a station in a suburban territory, together with the probable development of loads in the vicinity of the plant. Where the cost of power production is high at the old plant on account of obsolete or depreciated equipment, unfavorable operating conditions, or excessive taxes, a line of moderate length is not likely to interpose a transmission cost unfavorable to the location of the new plant outside. An important point to make certain of before beginning construction is the rate of taxation or possible exemptions to be secured the company through its location in a given suburb. The small town can afford to make it an object to the lighting company to locate in it, generally speaking, for even a moderate rate of taxation on a plant of, say, 5,000 kilowatt rating, means a revenue of large proportions from the point of view of town administration. If concessions of this kind can be secured, the lighting company will generally be able to repay them by bringing increased business of various kinds to the town, giving it new life industrially through cheap power, increasing in and out freight and express business, helping the postal receipts and bringing business to certain retail merchants through the visits of officials to the community in connection with the plant affairs, and by improving the standards of street illumination.

THE GAS APPLIANCE EXPOSITION.

One of the recent events of considerable interest to manufacturers of electrical appliances and to central-station men was the Gas Appliance Exposition, held under the auspices of the National Commercial Gas Association, and the American Gas Institute, in Chicago. The exhibit was remarkably complete, and attracted a great deal of attention. The gas men received and deserved a considerable meed of praise for the extent to which this industrial indication of the magnitude of the gas industry was handled, and, as one of the prominent gas men put it: "The gas men are wondering why they didn't do this thing long ago, now that they have found out that they really could do it."

One thing was noticeable, and this must bring a good deal of satisfaction to the designer of electrical fixtures and the central-station man: The chandeliers which attracted the greatest amount of attention, and which, per se, were most usable and likable, both from an æsthetic and utilitarian standpoint, were fashioned absolutely in imitation of electric fixtures and appliances. One fixture, however, an excuse for the design of which it is hard to find, was a gas arc using inverted gas mantles and an alabaster round globe; in carrying out the imitation of the arc lamp even the casing which the manufacturers of electric arcs must use in order to protect and conceal the works of the lamp has been conscientiously copied.

Electrical ignition systems seem not to be very popular, for not one was noticed at this very extensive exposition of gas appliances. Pilot-lighting systems operated by compressed air and by electromagnetic control, and also pyro-electric spontaneous igniters, were in evidence. At the present time a combination pneumatic-pilot-lighting system appears to be the most dependable, as was pointed out in one of the papers dealing with the improvements in gas-ignition devices read at the recent convention of the Illuminating Engineering Society.

Another feature which attracted much notice from the electrical men in attendance at the exposition was the fact that in almost every case where motive power was required, small electric motors were used, where it would appear there was an excellent chance for the exploitation of small gas engines, if any were available.

THE ELECTRICAL INDUSTRY IN GREAT BRITAIN.

Some five years ago a council of ponderous intellects passed a resolution declaring, in so many words, that although the engineers of Great Britain had contributed largely to the wealth and standing of the nation and the world, technical education and recognition of technical worth appeared to be backward. This was all occasioned through the passage by the British Parliamentary committees of certain stultifying restrictions and regulations which, it was feared, would make impossible the development of new inventions and their application to electrical undertakings in Great Britain.

Certainly, the unwise, though well-meant, restrictions imposed by governmental policy in Great Britain would appear to retard many applications; as, witness the borrowed developments which have recently been applied to the solution of both lighting and traction problems.

Mr. W. M. Mordey, in his presidential address before the Institution of Electrical Engineers, of Great Britain, quite recently, took this topic as the subject for some characteristic remarks. After careful compilation and considerable research, based upon the assumption that the value of any utility should be measured by the amount by which each unit of the population is served by such utility, Mr. Mordey finds that in no direction is the electrical engineering profession backward in England; in fact, it is ahead, and well ahead. He does not wish it to appear, however, that there are not restrictions and hindrances to the British engineer employing many valuable inventions which should reasonably and logically be developed in Great Britain. But the fact remains, says this doughty champion, that the aspersions which have been cast upon British engineering progress, and which have originated, unfortunately, in England itself, have no real foundation.

WATER RESOURCES INVESTIGATION.

The annual report of the director of the United States Geological Survey emphasizes the wisdom of determining the extent and character of the water resources of the country. Prominent engineers have long advocated the extension of government investigations of water resources, and it is a well-known fact that the work in the United States is not commensurate with that done in many European countries. If the United States were to provide for the prosecution of water resources investigations on a scale of thoroughness equal to that of Switzerland, for example, it would appropriate $11,000,000 annually, a sum 110 times greater than the present annual appropriation for similar work in this country.

Aside from the development of power, which would be a contemporary advantage, together with irrigation, increased facility for inland-waterway navigation, and the canalization of streams not now available for water transportation, the saving of waste caused by floods would be considerable. It is estimated that the annual damage caused by floods in the United States must be at least $100,000,000, and it is stated that in many parts of the country the proper expenditure of an amount equal to one year's flood loss would prevent further floods. In other parts of the country the cost would probably equal the losses of two or more years, but in every locality prevention could be accomplished by an expenditure equivalent to the losses from the floods of a few years.

Whatever means may be finally adopted to prevent the devastation by floods and to conserve the power resources and the possibilities of waterway transportation, the data must be gathered largely by government surveyors. It is quite necessary, then, that the Geological Survey, or whatever department of the Government may undertake this work, be aided by such appropriations as will enable the speedy and thorough compilation of the data now so ardently desired by constructing and contracting engineers.

The Mexican Light and Power Company.

A controversy has arisen over the Mexican Light and Power Company, certain directors of the Bank of Montreal being arrayed on one side, and Dr. F. S. Pearson, of New York, with certain Montreal and London associates, on the other.

The company was formed under the corporation laws of the Dominion of Canada, in 1902, by Dr. Pearson, to develop waterpowers on the Necaxa River, ninety miles from the city of Mexico. The bonds outstanding amount to $12,000,000, and there is $13,000,000 stock. A very successful power demand has been built up, and current has been satisfactorily transmitted to a number of mining camps and to the City of Mexico, where the company controls the electric-lighting facilities.

Some time ago Dr. Pearson succeeded in securing control of the Mexican Tramways Company, and later sought to arrive at equitable terms for the acquisition by the tramways company of the Mexican Light and Power Company. Some of the directors of the company, headed by President E. S. Clousten, managing director of the Bank of Montreal, opposed Dr. Pearson's proposals.

A special meeting will be held in Montreal on December 30 to consider a lease of the Mexican Light and Power Company to the Mexican Tramways Company, Dr. Pearson and his associates representing more than the twenty-five per cent of the stock which is necessary to issue a call for a special meeting.

The tramway company seeks a lease of the Mexican Light and Power Company on the basis of the payment of fixed charges, seven per cent on the preferred stock, and four per cent on the common stock. The directors of the light and power company say that the earnings of that company are now at the rate of seven per cent on the common stock, and that the earnings of the tramways company are at the rate of less than two-and-one-half per cent on that company's $6,000,000 of stock.

Formal Opening of Patapsco River Plant

On November 28 the Patapsco River plant of the Patapsco Electric and Manufacturing Company, Baltimore, Md., was opened with formal ceremonies. The Patapsco River plant, it will be recalled, was constructed about a year ago, and in the technical journals at that time was given particular attention, as the development is unique in combining in one structure both power house and dam, the turbo-generators being located within the concrete abutment.

The plant has now been running for some time, but owing to numerous changes which were found necessary, especially the rebuilding of the power tunnel to make it air and water tight against floods, continuous operation did not begin until three months ago. The formal public opening was held after all was assured to be in complete working order. Five hundred visitors were present November 28 upon the invitation of the power company and witnessed the starting up of the plant by the young daughter of Victor G. Bloede, president of the company. Following the ceremonies, a luncheon, cooked by electricity derived from the waterpower, was served to the guests.

The completed plant cost $175,000. The dam and power house creates a head of twenty-six feet, and contains two 300-kilowatt alternators, generating at the transmission potential of 11,000 volts for distribution to Ilchester, Ellicott City, Catonsville and Southwest Baltimore.

Electrical Engineers Entertained by the National Commercial Gas Association.

In connection with the Gas Appliance Exposition, which was conducted, under the auspices of the National Commercial Gas Association and the American Gas Institute, from December 7 to December 12, at the First Regiment Armory, Chicago, Ill., a spirit of the greatest cordiality was effected by reason of the co-operation of the Chicago Section of the Illuminating Engineering Society and the officers and members of the National Commercial Gas Association.

On the evening of Thursday, December 10, the Chicago Section of the Illuminating Engineering Society was entertained at a banquet at the Auditorium Hotel, tendered by the National association, and later in the evening the Section was the guest of the Gas Appliance Exposition, being welcomed by A. Cressy Morrison, who made a brief address commendatory of the activity of electrical engineers in bringing to the fore the advantages of better illumination.

Mr. Morrison brought to the attention of the illuminating engineers some interesting figures concerning the extent of the gas industry. The investment in the United States today amounts to $1,600,000,000. Gas is supplied to 38,500,000 consumers, and of this number there is one gas meter to every seven people. The output for the year at the present time is about 200,000,000,000 cubic feet.

Indiana Public Utilities Bill.

At the second annual convention of the Indiana Manufacturers' and Shippers' Association, held at Indianapolis, Ind., on December 10 and 11, the principal business was the consideration of a public utilities bill to be introduced in the next session of the Legislature. A number of public-utilities men were present.

The bill advocated by the association is sweeping in its provisions, and seeks to include waterworks, telephone and telegraph, electric light and power, and transportation companies of every description, and is patterned largely after the Wisconsin law. Exception was taken to the advisability of framing such a bill for Indiana, and it was contended that transportation utilities have already been brought well under state control. A legislative committee was appointed to prepare a bill providing for a public-utilities commission, and present it to the Legislature for passage. The following men were chosen: C. C. Perry, Indianapolis Light and Heat Company; L. C. Boyd, Indianapolis Water Company; C. H. Graf, Indianapolis Gas Company; T. P. Sylvan, Central Union Telephone Company; Charles H. Norton, Indianapolis Telephone Company; J. R. Zartman, secretary of the Indiana Manufacturers' and Shippers' Association; C. M. Kimbrough, Muncie, a bridge manufacturer; M. D. Wilson, Madison, cotton-mill owner; and C. C. Foster, lumber dealer. S. S.

Wireless Conference Bill in the French Chamber.

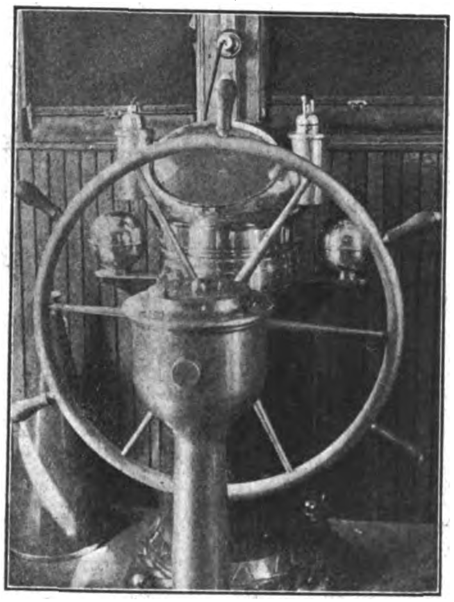
A bill for putting in force the decisions of the Berlin Wireless Telegraphy Conference of November, 1906, as embodied in an international convention, has been laid before the French Chamber. The conference has fixed wave-lengths, one of 300 metres, the other of 600 metres, for the transmission of public messages by the wireless current. All stations must be able to produce and to receive one, at all events, of these two wave-lengths. All public correspondence must be restricted to one of these wave-lengths. A coast station, however, can use other wave-lengths for long-distance communications, or for messages other than those transmitted by the public, provided that these wave-lengths are not under 600 metres and are not more than 1,600 metres. Stations on board ship must use the 300-metre wave-length. They are permitted, however, to use other wave-lengths as well, provided that these are under 600 metres. —*Nature (London), December 4.*

The Lighting and Power Arrangements and Other Uses of Electricity in a Modern Steamship.

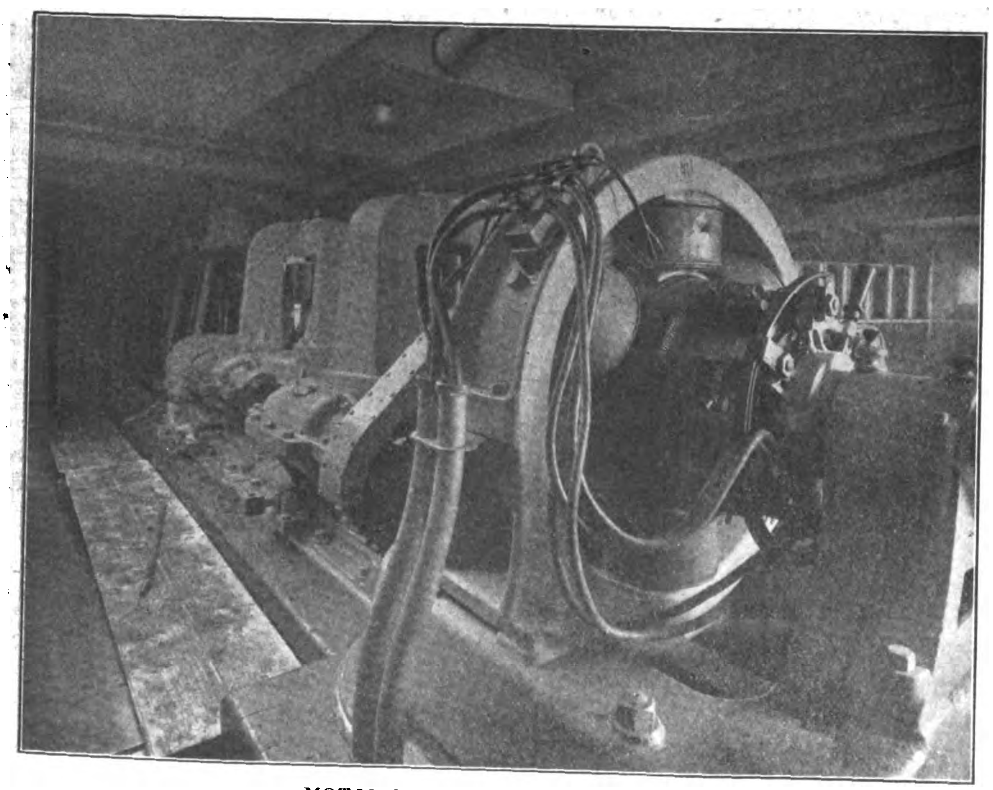
By Louis P. Zimmerman.

About the illumination, the lighting system and the size of the electrical equipment of a modern steamship, the average engineer knows very little. The giant steamship Minnesota which has been operated for some years between Seattle, Wash., and Oriental ports by the Great Northern Steamship Company, presents a very interesting problem in interior lighting adapted to the peculiar and special needs of a steamship. On shipboard every part of the equipment, particularly the generating units and the switchboards, is crowded into as small a space as possible, and at times this space is totally inadequate for the proper handling of the apparatus. This crowding is necessary, for a ship is a compact unit and every inch of space counts; hence the engineer is not allowed spacious quarters for the machines which form the electrical system.

The Minnesota is a combined passenger and freight-carrying vessel, 630 feet in length, 73.6 feet in beam and fifty-six feet deep from the keel to the saloon deck amidships. There are five complete decks in the ship proper and three more in the ship house, giving a total depth of eighty-eight feet from the upper navigating bridge to the keel. These decks are named from the bottom up: orlop, lower, 'tween, main and upper which is the weather deck. In the ship house are the promenade, bridge and boat decks with the navigating bridge above all. There are accommodations for 318 cabin passengers, 1,500 troop or steerage passengers and a crew of 230 men.



STEERING WHEEL, PILOT HOUSE.



MOTOR-DRIVEN STEERING GEAR.

The total deadweight capacity is 23,000 tons of 2,240 pounds in addition to the weight of the stores and supplies, while a cubical capacity of 28,000 tons of forty cubic feet each is available for the storage of light cargo. The ship has complete double bottoms, each capable of floating the ship in event of damage and between which sufficient water ballast can be carried to obtain the desired stability in case of light loading. A longitudinal steel bulkhead extends the entire length from keel to main deck dividing the ship into two separate water-tight sections, and twelve transverse thwartship bulkheads give twenty-six water-tight compartments.

The 15,000-horsepower power plant driving the two twenty-foot twin screws and the 450-kilowatt lighting plant on board, would require a good-sized building and foundations of great depth and solidity on land, but here they are crowded together in the lower part of the hull supported on beams and almost regarded as a necessary incumbrance.

The boilers, sixteen in number, are of the Niclausse water-tube type, with a total heating surface of 39,264 square feet. The furnaces are coal-burning and have a storage bunker capacity of 4,000 tons with a reserve of 2,000 additional tons. The engines are in two complete units on the two sides of the vertical bulkhead. Each unit consists of three vertical, inverted, direct-connected, triple-expansion, Midvale Steel Company's marine engines with cylinder diameters of twenty-nine, fifty-one and eighty-nine inches and a common stroke of fifty-seven inches, designed to develop 4,800 horsepower per cylinder, running at seventy-eight revolutions per minute, with a steam pressure of 230 pounds. All the cylinders are jacketed with steel galvanized lagging and provided with a continuous circulation of live steam.

Two three-blade, true screw propellers with a pitch of twenty-two feet nine inches are driven separately through two shafts each 232 feet long. This immense power of the engines and propeller is transmitted to the frame of the ship through a cast-iron thrust shaft and bearing, eighteen-and-one-eighth inches in diameter and fourteen-feet-four-inches long, with nine collars two-and-one-half inches wide and twenty-seven-and-five-eighths inches in diametei, running in an oil bath.

Next is the electrical plant and its many applications on board ship. Something over 450 kilowatts are developed for light and power in the little plant located in the forward part of the engine room on a platform at the level of the orlop deck extending across the width of the ship, three units being on each side of the bulkhead. Six single-acting, inverted, vertical, compound automatic Westinghouse engines direct-connected to six six-pole, direct-current, 110-volt generators, running at 300 revolutions per minute, generate the electricity needed. Each unit is closely surrounded by a protective iron railing and all connections are carefully insulated to avoid possible contact. The floor around the pedestals of the machines is of gridiron grates and steam pipes pass around and over the units leaving barely room for a man to pass through. Two switchboards, one for each set of three units, are located on the two sides of the dividing bulkhead and are provided with the necessary instruments, simply and compactly arranged. Power is distributed from these main boards on eleven lighting and seven power circuits to various smaller boards in other parts of the ship. The three-wire system is used throughout for power and light. The total installed motor capacity is 1,566 horsepower.

A brief mention of the various uses of power in the ship is almost necessary to get an idea of the extent of its use.

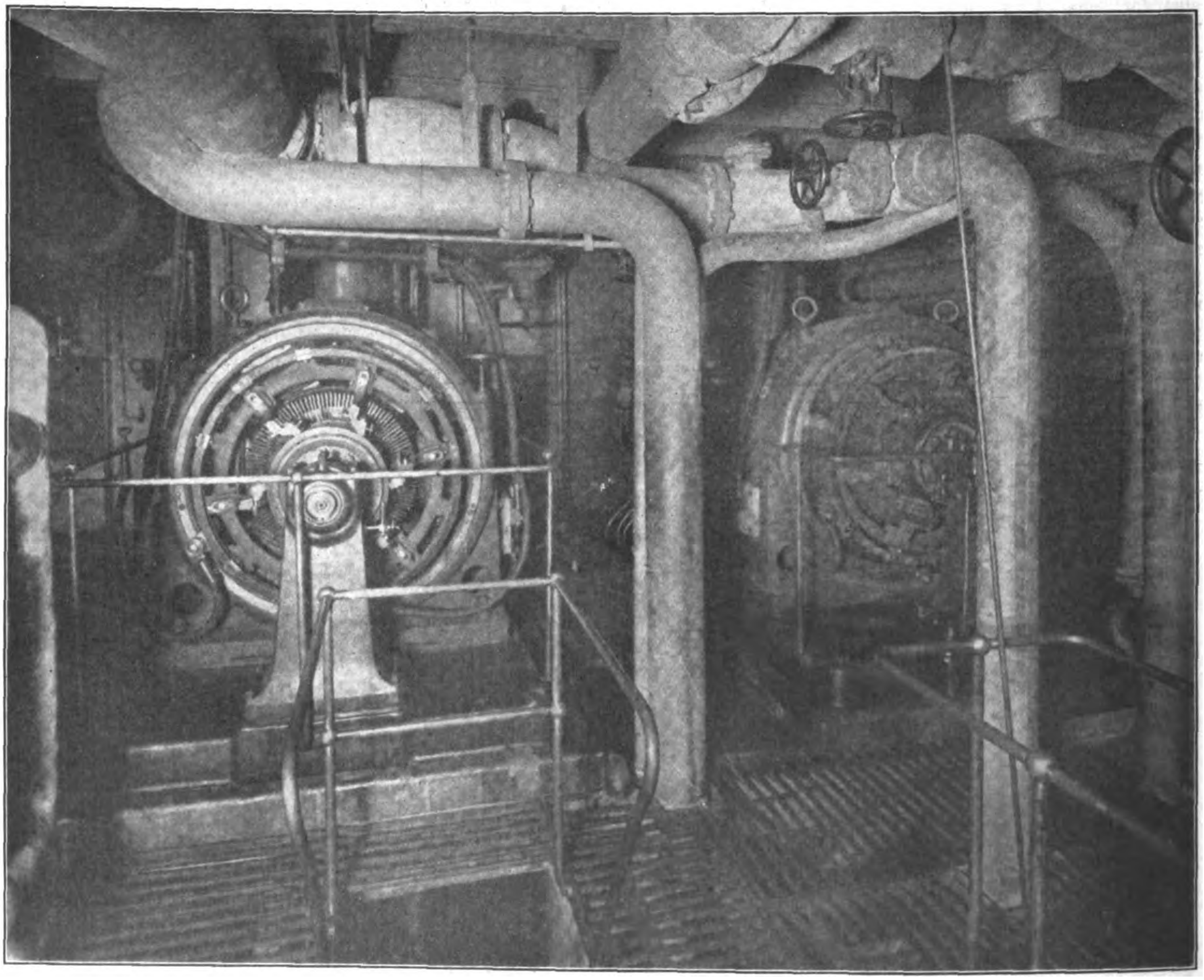
The ventilation consists of a fresh-air supply and exhaust system. Fresh air taken in over the heating coils is delivered to the staterooms and saloons, seventy-two Westinghouse motor-driven exhaust fans being used in the entire ventilating system.

The steering gear is in duplicate, steam and electrically driven; the electrically-driven being used for landings and emergencies and the steam for regular work, both sources of power being directly connected to the steering quadrant.

The refrigerating plant consists of two brine refrigerating machines, two air coolers, an ice-making machine, and water cooler for filtering drinking water. Two seventy-five-horsepower motors are direct-connected to the two thirty-ton marine ammonia compressors.

Electrically-operated winches are installed throughout. There are in all thirty-eight cargo winches geared directly to General Electric series-wound, armored motors fitted with railway-type controllers, as follows: Twenty-six twenty-five-horsepower, capacity of 3,000 pounds; eight 40-horsepower of 5,000 pounds; one 7,000 pounds; two 10,000 pounds and one 14,000 pounds.

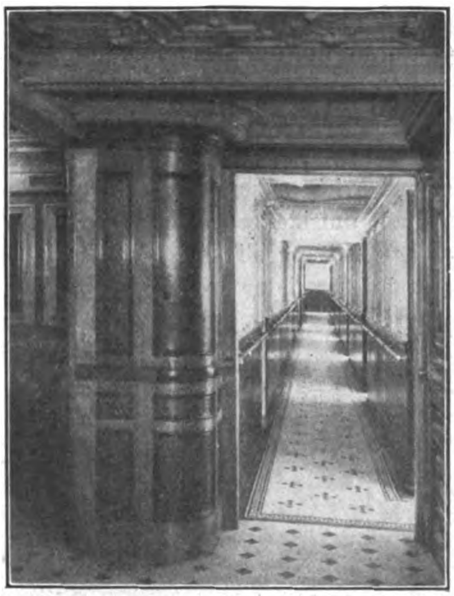
Interior communication in the Minnesota is the same as in a first-class hotel, being complete with telephone system, call-bells, fire-alarms, electric whistle con-



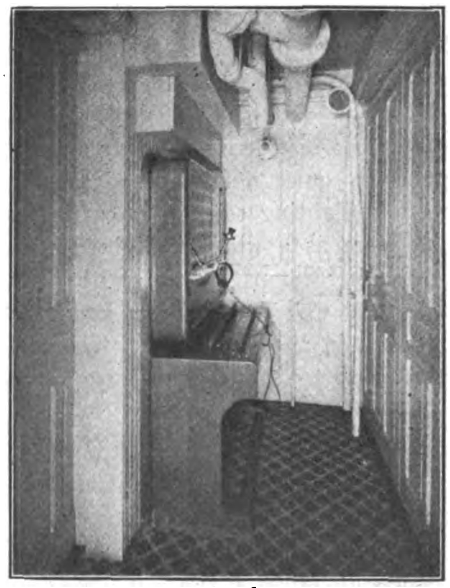
WESTINGHOUSE GENERATOR, FOR POWER AND LIGHTING SERVICE.

trol, electric cooking and electrically operated dumb waiters.

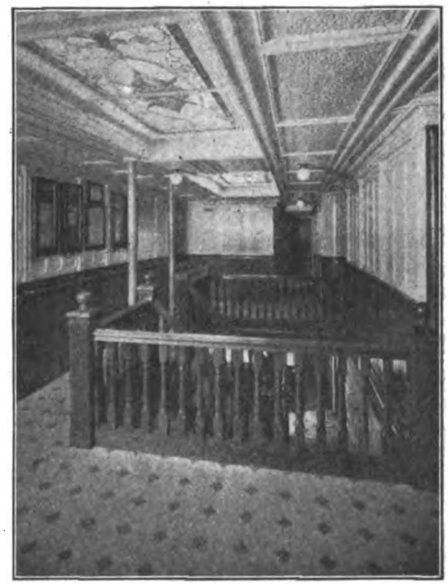
Passenger accommodations on board are entirely dependent for heating on electric heaters, there being apparently nothing else to satisfactorily take their place.



CABIN HALLWAY, PROMENADE DECK.



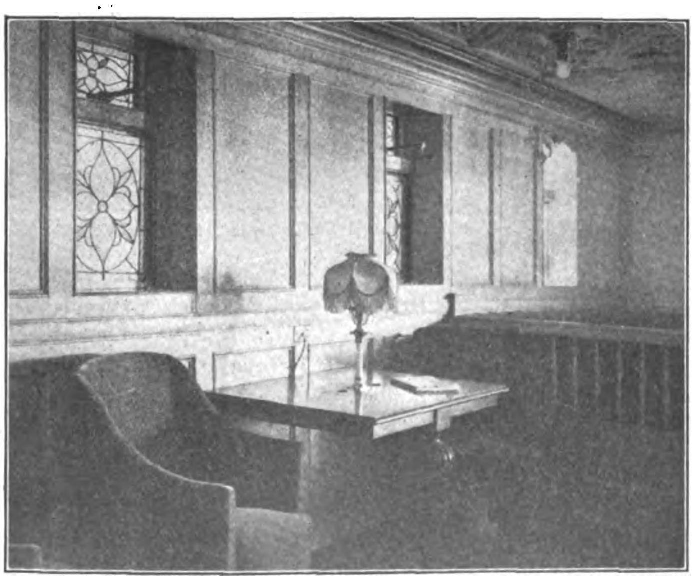
CENTRAL TELEPHONE STATION.



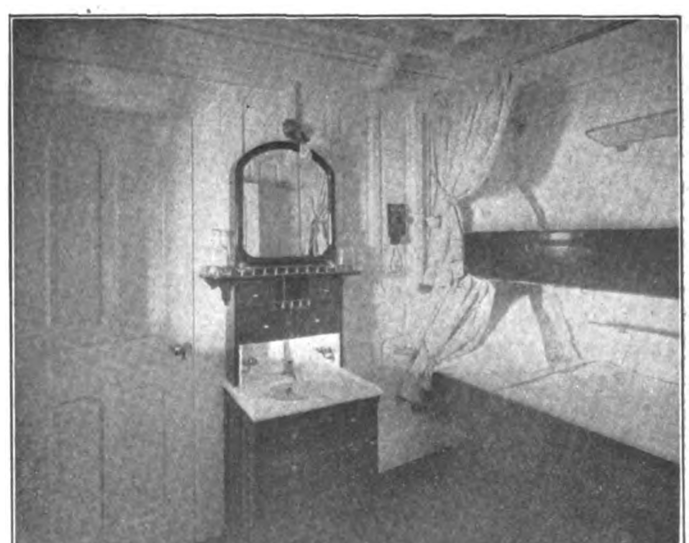
MAIN STAIRCASE, BRIDGE DECK.

Electric heaters are an unprecedented departure from ordinary heating practice, but are superior on shipboard to steam radiators because they occupy less room, are more easily regulated and not liable to tip over. One electric heater is found in each stateroom.

Modern vessels demand the use of electricity for lighting. The incandescent



DESK IN LADIES' MUSIC ROOM—PORTABLE LAMP AND PENDENT INCANDESCENTS.



STATEROOM, PROMENADE DECK—NOTE TELEPHONE, MIRROR AND BERTH LIGHTS.

lamp is no small factor in bringing out the harmonious effects of the interior furnishing of the Minnesota. Luxurious finishings and superb furnishings would appear like dismal caverns were it not for the art of the electrical engineer in illuminating and beautifying the interior. In the staterooms, saloons, library, smoking room and passenger quarters, special ornamental fixtures are installed, and the design and finish of these fixtures harmonize with the interior furnishings.

In the steerage, engine rooms, firerooms, cargo holds, on the decks and all other places where there is any moisture or exposure to weather, fixtures with a steam tight globe and heavy protection guard are installed.

The Minnesota is equipped with a twenty-four-inch General Electric searchlight on the pilot house which projects a beam of light of sufficient density to render plainly visible on a dark, clear night a light-colored object ten feet by twenty feet at a distance of about 5,000 yards. A searchlight is a necessity on board ship, and its importance and usefulness are demonstrated in picking up buoys in channels, signaling between ships at sea and in making landings in the dark.

All parts of the Minnesota are open to the public and the quarters occupied by the officers are luxuriantly finished. The pilot house is finished in wainscoting of dark stained cherry with an upper paneling of quartered oak. The chart room and captain's sitting room are done in cherry and oak with dark upholstery.

The public are interested mainly in the passenger accommodations, and these will now be described in detail. The main dining saloon in the forward end of the mainhouse on the upper deck extends the full width of the house. The walls are finished in dark, rich mahogany side paneling with rectangular windows in the front and side of the saloon, fitted with mahogany sliding shutters and stained glass panes topped with Adams-Westlake ventilators. The ceiling design is stucco work of cream and gold; the ceiling and beam cappings are staff paneling; the electric fixtures and exhaust vents are in alternate panels. The furniture is all mahogany, finished in old gold and draperies. There is a seating capacity for 190. The whole scheme of lighting the dining saloon is to give it a rich, pleasant appearance to set off the white dishes and tables, the silverware and the various viands. This plan is followed out in the dark, rich mahogany background and furniture, and the dark carpet on the floor. The tables are illuminated by lamps covered with frosted globes which give a diffused light on the tables, the ceiling and the faces of the diners, producing an abundance of light, but entirely eliminating any glare or direct exposure to bare lamps. The forty lamps in the ceiling arranged in alternate rows, give a rich, full coloring to the entire room.

From the saloon a grand double staircase of mahogany with a curved baluster leads to the social hall and the staterooms on the promenade deck. This hall is built around the double staircase leading to the dining saloon and up to the upper deck. Special twisted posts and a pleasing curve make the banister fit in well with the symmetry of the room. Directly above the staircase is a stained-glass skylight surrounded by white scroll work and rectangular capped beams between which are six ceiling lamps covered with large frosted globes set deep into an ornamental rosette, illuminating the hall evenly and satisfactorily, but not nearly as intensely as the dining saloon.

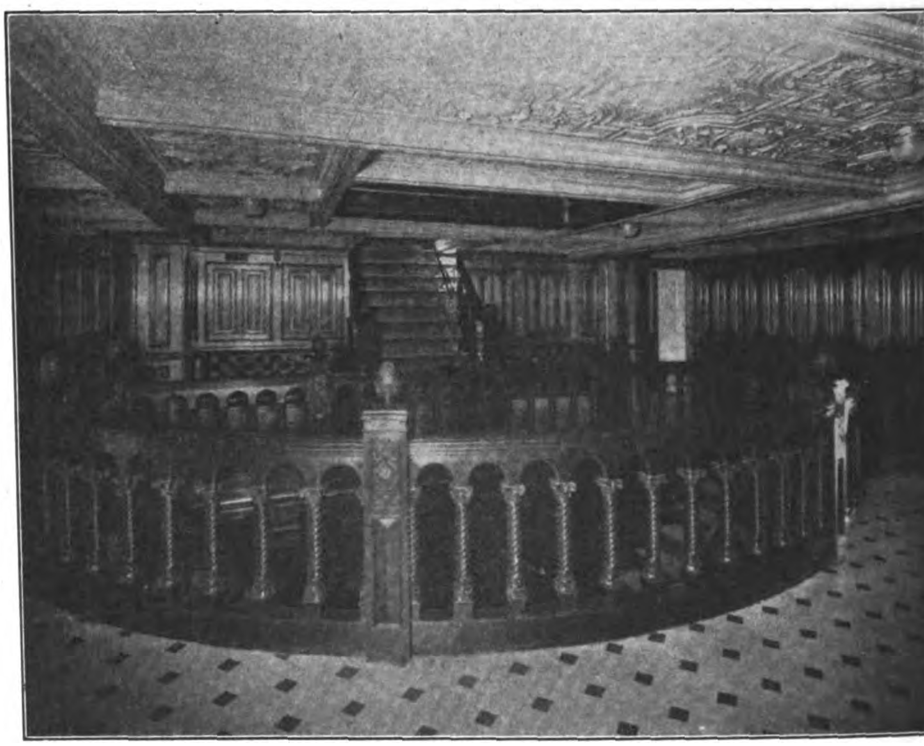
Above the saloon and off from this hall on the starboard side of the promenade deck, is the ladies' parlor and music room, which is the most comfortable and inviting part of the whole ship. The furniture, the writing tables and the grand piano give the room a desirable homelike appearance. The color scheme is sky-blue and silver, the walls are paneled with bird's-eye maple and the ceiling is of tinted staff finished throughout in light gold furnishings. A light olive-green upholstery, light draperies and stained-glass windows all suggest cheer and comfort. All tables have drop lamps with heavy ornamental shades throwing the light directly on the table for reading or writing. In the ceiling some eight-candlepower bare lamps, set in long slender rosettes, give a gentle white light to the room as a whole, but are not sufficient in number or power to cause annoyance or distress to the eyes. There are no pronounced shades or colors, all being a uniform, cozy, harmonious silver and white.

In the adjoining library is an entirely different style, all the paneling being of dark oak, and all the tables and furniture of dark upholstered leather. The color scheme is buff and gold artistically worked out in stucco conveying a sense of grandeur, quiet and impressiveness. A two-fold lighting scheme is carried out. The room as a whole is lighted with a few ceiling lamps covered with frosted globes, set well down with a long rosette arranged in the centers of octagonal designs between the transverse ceiling beams. Bare lamps, set two and two, on either side of the central columns, just above the tables, provide light for reading. While sufficient, the illumination is hardly the best for a library, being too high and too much diffused.

The smoking room, on the after-end of the bridge deck, has panelings of Flemish oak, natural finish, and rosewood wainscoting, harmonizing with the rosewood furniture, upholstered in red leather. In the center of the ceiling, which is worked out in stucco and light oak, paneled and capped, is a large raised skylight of colored glass. Directly above the glass is a fan to draw off the smoke. All the lamps are bare, placed in the ceiling, and of sufficient number to well light the interior, which reflects on the reddish colored furniture, and gives that brilliant, festive effect common to smoking apartments.

The long halls leading through the ship are fairly well and sufficiently lighted with lamps enclosed in frosted-glass globes set in the ceilings, spaced about twenty-five feet apart. The lower halls are uniformly dark, the upper part white, and all are provided with a convenient handrail.

The staterooms are finished in white enamel, with mahogany and oak fittings. All are outside rooms, provided with a window, sliding blinds, stained glass and a hinged ventilator open at the top. Each room is electrically lighted with two bare lamps. Electric reading lamps, placed above each berth, under the control of the occupant, are so arranged that it will not disturb the other berth. All the second and third class rooms are well lighted by artificial light, but some, of course, are inside rooms, and daylight is impossible to get.



SOCIAL HALL AND MAIN STAIRCASE—PROMENADE DECK—HEMISPHERES AND INCANDESCENT LAMPS.

On deck, and below in the engine rooms, the boiler rooms and the holds, bare incandescents are arranged for special work wherever needed.

As a whole, the lighting is better planned and carried out with more care than in a majority of offices and residences. The 1,300 lamps distributed over eight decks of the immense ship give, roughly, one lamp per 150 square feet, and sufficient and satisfactory illumination in all parts.

NEW YORK SECTION, ILLUMINATING ENGINEERING SOCIETY.

DR. STEINMETZ ON "LIGHT AND ILLUMINATION."

The meeting of the New York Section of the Illuminating Engineering Society, held in the Engineering Societies Building on December 11, was very well attended, as might have been expected, owing to the fact that the speaker of the evening was Dr. C. P. Steinmetz.

When the section chairman, W. W. Freeman, called the meeting to order some seventy-five members were present and, from the attention given the speaker, it may be said that they not only enjoyed, but also profited by the lecture. Dr. Steinmetz selected a very broad topic, "Illumination and Illuminating Engineering," and treated it in like manner. He stated that the physiological aspects of the subject were much more important than the physical ones, owing principally to the effect upon the eye of both direct and reflected light and the lack of it in many ways.

Calculations.—As far as calculations were concerned, the importance of using the lumen as the unit of efficiency, as well as flux, was brought out, as, owing to the varying characteristics of our sources and also because the tube lamps, such as the Moore and Cooper Hewitt, have no candlepower values which are of any importance. Besides, the lumen has a definite relation to the intensity on the illuminated plane, or, in other words, the flux density.

Although we may determine accurately, by means of illuminometers, the intensity in foot-candles or flux density, this physical quantity will not be of great value unless we have fulfilled the physiological requirements.

That there are many factors in illumination problems which bear directly upon the use of our eyes, was very forcibly presented by the speaker. For instance, high intrinsic brilliancy will lower the visual sensibility, even though the lamps are not directly in the field of vision; either too high or too low flux density causes considerable strain. Complete uniformity is also undesirable, as the eye will have no opportunity to rest. On the other hand, the change from high to low intensity must be within comparatively small limits, for although the eye can withstand great changes in this respect, they must not be rapid ones. We can see fairly well at night under a full moon, when the flux density will be but a fraction of one foot-candle, and also under full sunlight at noon, when the flux density will be several thousand times that amount, but we cannot go from a dim room into clear sunlight without decided eye strains.

Color.—As far as color was concerned, Dr. Steinmetz did not refer to the effect of ultra-violet rays, but it is obvious that this troublesome feature will be eliminated when we use shades which cut down the intrinsic brilliancy.

When light sources of various colors are desired, this can be accomplished by means of colored shades, and in this connection he called attention to the fact that color differences vary rapidly under various intensities.

Shadows.—Probably the most interesting feature of the lecture was the importance, clearly shown, of the use of shadows, and it would seem as if the crux of the matter was in the success with which this feature was carried out. In very few cases no shadows are desirable, a drafting board being one of them; but in the majority of cases we need shadows without sharp edges, and this can be accomplished by means of a combination of diffused and direct lighting.

In domestic lighting, the diffusion can usually be obtained by means of reflection from walls and ceilings. The fact that we require at least some of the light within the line of vision, can be readily demonstrated by a visit to an auditorium where only indirect lighting is employed. Dr. Steinmetz summarized the defects in our present systems as follows:

1. Improper combinations of high and low flux density.
2. Sources of high intrinsic brilliancy in the field of vision.
3. Improper combinations of direct and indirect lighting.
4. Not enough shadows.
5. Shadows with very sharp edges.

He seemed to think that many of the difficulties could be overcome if we studied the effects of daylight in the various rooms of a house.

Street Lighting.—Dr. Steinmetz stated that uniform intensity was the chief desideratum, but on account of economy it would necessarily have to be of low intensity. In order to obtain these results the light source, if placed within twenty feet of the ground, should give its maximum intensity about ten degrees below the horizontal and to be as near white as possible in color, owing to the poor refraction from roads and buildings. The objection to this method was that shadows from an object are very long and therefore objectionable, as the appearance of the object is distorted. Another objection is that a source such as he described would be of too high intrinsic brilliancy, and if diffusing globes were used the light near the horizontal would be considerably reduced. Therefore the solution of the matter was to place the lamps forty or fifty feet high and use enough of them to obtain uniform illumination.

In answer to a question he stated that the system in Detroit had not been successful, as it was altogether too pretentious and not enough lamps had been used.

In answer to the many criticisms which have been made of the lighting in this country as compared with Europe, he stated that the conditions here are entirely different, and cited as an example the fact that the city of Schenectady with only 70,000 population covers the same area as the city in Germany where he was born, which has a population of 450,000.

Dr. Steinmetz called attention to the fact that, although we could not afford to light our streets by placing the units very high as suggested, we could afford to do it in exposition work, and he hoped that general illumination would be provided in this manner at one of the expositions to be held in the future.

At the January meeting two papers on street lighting will be presented, one by W. C. Allen, electrical engineer for the District of Columbia, and one by S. S. Rhodes, of the New York Edison Company.

Enlarged Power for Interstate Commerce Commission.

An entering wedge to enlarging the jurisdiction of the Interstate Commerce Commission is contained in a bill introduced in the Senate by Senator Burkett of Nebraska. It places the telephone companies, electric-light companies, and the gas companies in the District of Columbia under control of the Commission.

As telephone companies do an interstate business, should the bill become law, such telephone companies may also be placed under jurisdiction of the Commission.

Rome has appropriated about $4,000,000 for an electric plant, the generating apparatus for which will be placed twenty-two-and-one-half miles distant.

The New York, New Haven & Hartford Railroad Electrification.

Two-Hundred-and-Thirty-second Meeting of the American Institute of Electrical Engineers, New York, December 11.

The two - hundred - and - thirty-second meeting of the American Institute of Electrical Engineers was held in the Engineering Societies Building, New York city, on Friday evening, December 11. Secretary Ralph W. Pope announced that eighty-eight associates had been elected to membership and that John Knowlton Robinson, of New York and South America, had been transferred to full membership.

President Louis A. Ferguson called the meeting to order and introduced W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad, who presented the paper of the evening, an abstract of which follows:

THE LOG OF THE NEW HAVEN ELECTRIFICATION.

BY W. S. MURRAY.

Unlike steam traction, where the number of links in the delay chain is but one, electric traction has its delay chain composed of three links; namely, the power house, line, and locomotive. A failure in any one of these links may produce train delay or delays.

In the conception of the form of power house, line, and locomotive to be used in the New Haven system, ignorance and lack of experience led those pertinently interested in its success to believe that while the chain of power generation, and its transmission and utilization for traction, was of a new character, that its links, however, were made up of principles long recognized and reliable. They were right in this conclusion, except that it did not include certain phenomena which could not have been anticipated, due to the combination of these old principles in the form of this new chain.

THE SERIOUS FAULTS.

Power House.—The electric power supply for the New Haven road is derived from four 11,000-volt steam turbine generators, three of which have an electric capacity of 3,750 kilovolt-amperes single-phase; the fourth unit consisting of a 6,000 kilovolt-ampere, three-phase generator, which can also supply single-phase current to the system.

Although the generators as originally designed were made exceptionally strong, and particular attention paid to their insulation, due to the necessity of grounding one phase, it was found that the utilization of so much single-phase current from a three-phase star-wound generator produced a stray magnetic field completely out of the path of normal lamination. As a result it was impossible to develop for continued operation more than sixty-six per cent of the normal rating of the generators. Overloads of any character produced abnormally rapid heating, making such operation dangerous, although the generators were guaranteed to carry 50 per cent overload for two hours, and 100 per cent overload for two minutes in order to meet the sudden drafts of currents required for a schedule such as exists on the New Haven road. The generators are today operating in the power house, fulfilling the guarantees mentioned previously.

Line Insulation.—Of the effect of steam locomotive discharges upon insulators, there was no initiative by which to be guided, and it became necessary to decide upon the factors of insulation that would be required. It was quickly noted that the greatest number of insulator failures occurred wherever the insulation was subject to the direct blast of the steam locomotive. To correct the difficulty, therefore, it was found necessary to double up on anchor insulators. The intermediate messenger insulators proved adequate and it was not found necessary to increase the impregnated stick insulation between trolley wires at curves, but wood stick insulators had to be added in series with the molded material insulator between the pull-off wire and pull-off post. The original insulators on the anchor-bridge switches were made of molded material and for them was substituted porcelain. It was not necessary to change the feeder insulators on the catenary bridge struts. While very little trouble has been experienced with the form of insulation used for supporting the feeders under highway bridges, it is anticipated that trouble will follow if this is not changed. The present form consists of the corrugated spool-type insulator, for which there will be substituted a regular porcelain double-petticoat insulator.

Today, instead of line failures being the rule, they have become the exception.

Circuit-breakers.—The momentary energy involved in a short-circuit produced upon a line fed by high power, high-speed turbines is very great. Under the sub-title "Power House" it was stated that the generators were operating under their guaranteed capacities. Internal heating, due to stray magnetic field, was the cause of the generators failing to meet their designed capacity. This heating was completely cured by the simple addition of a short-circuited winding surrounding the rotating member of the generator, similar to that used in the well-known squirrel-cage type of induction-motor rotors. It is interesting to note here, however, that while the heating is entirely eliminated by this short-circuited winding, its effect on the occasion of a short-circuit is to allow more current to flow.

The failure of circuit-breakers, either in the power house or on the line, naturally produced train delays of large or small magnitude. It was difficult to believe that these large circuit-breakers were incapable of taking care of the short-circuits, and some time was wasted in thinking this way. Therefore, we reluctantly but surely arrived at the conclusion that the conditions would have to be changed.

The remedy was simple. Instead of feeding the main line with a direct transmission straight from the power house bus-bars to the trolleys directly opposite the power house, the current was fed into the line over feeders connected to it at Port Chester and Stamford. For the feeder resistance, above described, there has since been substituted impedance coils installed in the leads of the generators.

Trolley Wire.—An examination of the hard-drawn copper trolley wire throughout its length proved that even after only a few months' operation upon it, its cross-section had been so materially reduced as to point to its short life with a continuance of operation upon it. Especially was this true in the vicinity of the many low highway bridges where the trolley wire approaches the bridge on a two per cent gradient. This fault and dilemma were indeed serious. The cause of the difficulty was perfectly apparent; namely, the hard spots in the line which existed at the hanger points.

Many suggestions were offered. None of them, however, offered the speedy installation that was paramount. Mr. McHenry, vice-president of the New York, New Haven & Hartford Railroad Company, made the suggestion that an auxiliary wire be suspended from the present copper wire by clips at its midpoint between the hangers, and followed up the suggestion that this auxiliary wire be made of steel, of the same cross-section as the 0000 grooved hard-drawn copper above it. It took two weeks for the manufacturer to draw two miles of this wire. It was installed immediately upon its receipt on the main line between Port Chester and Harrison. On the night of its completed erection a special seven-car train with two locomotives was operated upon it for several hours. Previously to the installation of the steel wire there had been installed a section of hard alloyed wire suspended in a manner similar to that of the steel. It is undeniably true that hard alloyed wire would, from a purely operative point of view, be the better of the two, and yet the commercial aspect, which would naturally include its cost, had to be considered, particularly in reference to so large an immediate order as one involving 100 miles of single-phase electric trackage. Again it is important to note that the steel, besides having the advantage of being a cheaper, harder, and stiffer wire, also possesses a lower coefficient of expansion and higher elastic limit, especially valuable characteristics for the service desired. The auxiliary wire construction on the main line, as described, prevails throughout the whole system, except at the approaches of and under a few very low highway bridges, where the contact system consists of two wires strung in the same horizontal plane.

The New Haven trains have been operating now on the auxiliary wire for several months, and absolutely no kinking has been noted at the hanger points, with the attendant result of a smooth and almost sparkless overhead contact.

Locomotives.—There were originally purchased thirty-five locomotives, which was considered an adequate number to take care of the New Haven passenger service. These locomotives, considered *per se,* were rated on a half-unit basis. That is to say, the half unit was designed to handle about seventy-five per cent of our trains, the remaining twenty-five per cent to be handled by two units. Only a short experience in commerical operation revealed two important facts. The first one of a very encouraging nature, the second, decidedly otherwise. The first was the proof that the two main parts of the locomotive, namely, the transformer and motors, had sufficient capacity to more than handle the manufacturer's guarantees. The second was the discovery that many of the auxiliary electrical and mechanical parts of the locomotive equipment were not of equivalent capacity. It was simultaneously apparent that more locomotives would be required to provide for an increase of train service and the reduction of time schedule, and an order was promptly placed for six additional ones; before accepting their design, however, a careful survey was made of all the component parts of the locomotives at hand, in order to determine the changes necessary to be incorporated in the six new engines. To accomplish this it was found necessary to make a number of electrical and mechanical changes.

The most important electrical changes made were in the switch-groups and brush-holders of the motors. The former lacked carrying capacity and the latter sufficient insulation. To these shortcomings were due the greatest number of our first train delays. The most important mechanical changes necessary were the reinforcement of the truck bolsters and installation of pony wheels, respectively, for locomotive with and without pony wheels.

With the exception of the installation of pony trucks, the six new electric locomotives arrived within five months of the date of their order. To be noted here is the marked value of the spring type of armature and field suspension begun with the New Haven locomotive motors, thus making flexible the entire motor suspension.

It seems to be the time and place, here, to draw attention to a point in design concerning the New Haven locomotives that has been so persistently misrepresented by those who seem to have been ignorant of the facts. The specifications upon which the locomotive units were purchased, as stated hereafter, were that each unit would handle a normal trailing load of 200 tons. The writer, by careful measurement of the weights of all the trains (trailing loads) in the New Haven service, found that they averaged 212 tons. It seemed good engineering that if seventy-five per cent of the service could be handled by locomotives rated upon a basis of 200 tons trailing load, that that would be the correct locomotive unit size; using two units for the remaining twenty-five per cent of the trains. Today, three years after this decision, we find that seventy-three per cent of our trains can be handled with single units, twenty-seven per cent requiring two units. The percentage is slightly different from the original, as the service is slightly heavier.

THE MINOR FAULTS.

Generator Burn-outs.—Previously to the rearrangement of the feeders or the installation of the choke-coils in the power station, the short-circuits that were experienced on the line naturally had a deleterious effect on the generators. The prodigious rush of current naturally produced severe strains in the armature windings, strains whose mechanical intensity was made manifest by the movements of the coils. Therefore, during this period of violent short-circuits, frequently the generator coils were grounded and burned out. Since the rearrangement of feeders or the installation of choke-coils, the violent short-circuits have disappeared and with them the damaging effects on the generators.

Hard Spots in Line.—The original main-line section-break consisted of a rectangular impregnated wood frame suspended under the anchor bridges. The trolley wires were carried on opposite sides of this rectangle lapping, of course, a sufficient distance in the center so as to permit a short period of simultaneous contact of the shoe with both trolleys, thus preserving continuity of current to the locomotive in passing from one section to another. It was found that these rectangular section breaks were prone to get out of shape, introducing a very rough spot in the line, its effect being, on the passage of the shoe, to draw long arcs which frequently extended themselves to ground. Our new section break, containing all the flexibility obtained by the auxiliary wire, has been constructed by simply staggering the messenger insulators of each trolley sixteen inches, thus permitting the anchor-bridge trolley wires of the same track to pass at this distance. Each trolley wire is dead-ended to a wood impregnated stick insulator, supported by the messenger of its opposite section. By this arrangement practically all inertia is taken out of the section break and a sparkless passage between sections is obtained.

Signal Wires.—The catenary bridge struts carrying the cross-arms for the by-pass or feeder wires, likewise carry the cross-arms upon which are installed the signal wires. The voltage placed on these signal wires is entirely distinct from the propulsion voltage, it being 2,200 volts and sixty cycles. The proximity of the wires of these two systems has been the cause of short-circuits between them, resulting in double failures. It would seem that as the signal system should be so completely separated from the propulsion system, it should be installed on an entirely separate pole line. If, however, right-of-way conditions make it absolutely necessary that the supporting structures of the catenary system should support also the signal wires, then the two circuits should be made as distinctive as possible, the propulsion system having its wires on the cross-arms on the railroad side of the struts, the signal wires being installed on the opposite.

Locomotive Current Collectors.—An efficient pantagraph shoe has proved itself a very difficult problem. The present cost is about 0.06 of a cent a locomotive-mile. We have made various experiments with aluminum, phono, copper, and steel rigid and spring-supported pantagraph shoes. While this feature does not present a serious aspect, it is none the less a most interesting study. Shoe life is also seriously affected by the amount of soot deposited by the locomotives upon the overhead wire. While we have obtained mileages varying between 600 and 1,500 miles per shoe with various types used, other roads of lesser speed and not subject to the effect of locomotive stack discharges, have obtained as high as 25,000 shoe-miles.

THE LOG OF OPERATION.

Electric Passenger Service.—So great was the demand for electric service that in July, 1907, long before we were ready, as the records of our operation have proved, the first commercial service was begun between New Rochelle and the Grand Central Station. With all speed possible the electrification was pushed eastward and local service was established from Port Chester in August, 1907. Local service from Stamford followed in October, and finally, on July 1, 1908, all through and local passenger trains were under electric schedule between Stamford and the Grand Central Station.

Individual and Collective Train-minute Delays in Electric Zone, Due to Failures in Power House, Line, and Locomotive.—The segregation of these failures based upon train-minute delays offers a quick and interesting comparison. It is to be noted that the last two months indicate a great improvement over the two preceding ones. From the chart have been taken the train-minute delays that have amounted to over 300 minutes per diem, which are treated separately in the following paragraph. It is interesting in reviewing the "cause of delay" to note that ninety per cent of the causes are of an inconsequent nature, and might be reasonably expected when considered in the light of an initiative service.

Serious Failures in System Causing Over 300-minute Delays.—A description of the cause of one applies to all of them, except those of July 16 and October 19. In every instance, excepting the two dates mentioned, the tie-up was due to simultaneous failure of several circuit-breakers, due to a short-circuit, thus temporarily disorganizing the distributing system, preventing the electrification of trolley wires.

On July 16, the White Mountain Express left the rails just east of Greenwich station, tying up both east-bound tracks, and causing excessive train-minute delays. Except for the electric rail bonds which suffered destruction, no other electrical apparatus was disturbed. One of the electric locomotives attached to this train was immediately returned to service, the other following it the next day after light repairs were made to its pilot and third-rail shoe mechanism.

On October 19, although the impedance coils in the generator station were in action, a ground occurring on the bus-bars of the anchor bridge directly outside of the power station, in combination with a defective circuit-breaker, produced a short-circuit which destroyed the operating mechanism of the breaker in question. This unfortunately occurred at a time when temporary connections had been made between the power house and line; on this account a serious delay was experienced in restoring the voltage to the line.

It is interesting to note that since the complete inauguration of electric service, the serious failures in the system have been reduced from five to one.

The Capacity of the Electric Locomotive.—The capacity of the electric locomotives was based upon their ability to handle a trailing load of 200 tons in local service with stops averaging those that exist between stations between New York and New Haven. As a matter of fact, the station stops between Stamford and New York average very much greater than between New Haven and New York, and as very quick turns are made at both termini, the service may be said to be more severe under these conditions than under the guaranteed conditions of purchase.

Comparative Steam and Electric Engine Mileage.—In obtaining an average for all electric locomotives of 212 miles, it is to be remembered that this was made for all classes of service, express, express-local, and local, and further that the mileages were made over three short terminal runs; namely, Stamford, Port Chester, and New Rochelle to New York, the distances being approximately thirty-four, twenty-six, and seventeen miles, respectively. Several engines made eight runs, two of them nine, and one ten. It is difficult to get an exact comparison for steam locomotive mileages. All of the electric engines are confined to one division, while the steam locomotives do interdivision service. However, using the records of the 1906 steam service for Labor Day and considering steam locomotives doing mileage in and out of the present electric zone, out of 117 locomotives the following record is to be noted: Ten made over 300 miles; twenty made between 200 and 300 miles; twenty-one made between 150 and 200 miles; thirty-four made between 100 and 150 miles; thirty-two made under 100 miles.

Thus with division limits double that of the present electric division, and with the additional advantage of interdivision runs, the electric mileage for this concrete case averaged thirty-four per cent better than the steam mileage.

THE ELECTRIFICATION IN ITS RELATION TO MATTERS OTHER THAN TRACTION.

Telegraph and Telephone.—Single-phase electrification affects telegraph and telephone systems whose wires lie parallel with and in close proximity to the railroad. The corrective for this disturbance has proved to be simple and not costly. Briefly described, it consists of compensating transformers whose secondaries are a part of the telegraph and telephone wires and whose primaries receive their voltage from pilot wires strung on the same cross-arms as those bearing the telegraph and telephone wires, and thus having impressed upon them the same voltage, by electromagnetic induction, as the telegraph and telephone wires. The transformer secondary voltage is approximately equal and opposite to the induced voltage on the telegraph and telephone wires and thus constantly compensates for it throughout all ranges of induction due to the single-phase wires.

Public Safety.—As no fatality to the traveling public has happened by reason of the high-voltage wires since the system has been in operation, this would indicate the safety involved in its construction. The catenary form of construction as applied to the suspension of the trolley wire virtually eliminates all danger of these wires falling. On the other hand, the feeder or by-pass wires are not suspended by messengers, and although the 300-foot spans used in this construction are not uncommon, it has been considered a wiser policy to reinforce all such spans which are above passenger platform stations. It may be of interest to state also that the scheme of reinforcement is not to cradle or place supplementary wires in connection with this span, but simply use a steel wire with a large factor of safety reinforced by copper for conductivity conductor and supported from the struts by insulators. The resistance to ground of this construction will be far in excess of the ordinary insulator used in the open construction with the steel wire connected to it in such a manner as to make impossible the burning of this wire in two in the case of the insulator breaking down.

Foreign Wires.—All electrifications are subject to foreign wire crossings. As in the case of suspension of high-voltage wires over passenger platforms, instead of using supplementary catenaries or cradles, the safer (and incidentally the cheaper) method of crossing is to use at the crossing heavier (and possibly guyed) poles, better insulation, and larger wires than are commercially necessary in the other parts of the foreign transmission line. High factors of safety with economy are obtained following this policy.

COMMENTARY.

Lightning Protection.—An ideal arrangement of catenary construction in relation to lightning protection would be to have the overhead messenger system grounded, and from it suspended by insulators a secondary catenary system, to which in turn would be attached the contact wires. Even in the New Haven case, where the overhead messenger system is not grounded, lightning has given but slight trouble. This is probably due to the very great number of grounded steel trusses and struts projecting above the electrified wires.

Grounds.—Structures supporting high-voltage insulators should be grounded. Particularly is this true of structures foreign to the railroad company, such as highway bridges. This arrangement insures a prompt response of the circuit-breaker apparatus, and carries out the good practice universally applicable, that the material supporting the insulator be grounded. This principle has application in wood-car construction. Positive grounds between Pintsch gas pipes and both car trucks should be made to avoid any arcs being drawn under the car body.

Many of our catenary bridges, of both the intermediate and anchor type, serve to support signals. Signal men have been entirely free from coming in contact with the high-tension wires, by the simple provision of grounded close-mesh screens interposed between the signal platforms and the high-voltage wires. The value of two grounds can be rated considerably higher than twice that of one.

Tell-tales.—Tell-tales in connection with an overhead system offer a peculiarly difficult problem. It is quite apparent that the pantagraph current-collecting device would get into either electrical or mechanical difficulties with the present form of tell-tales. We have experimented at some length in trying to produce an electrical horn that would be automatically sounded by an approaching train. There is nothing particularly difficult in getting the automatic action or in producing a noise. The superiority of the tell-tale over the horn, however, is that no matter how much noise the freight train is making, the tell-tale always notifies, while in the case of the horn should the freight train be making more noise than it, the notification is lost. A horn if used for this service should be a large one.

Train Lighting and Heating.—On account of the necessity of wiring for electric heating and lighting some 2,500 coaches, it seems reasonable to retain the present method and apparatus of heating and lighting the trains in the electric zone. To accomplish this it was only necessary to supply each electric locomotive with a small steam boiler used solely for train heating. The Pintsch gas system has been retained intact. Later, when the service is sufficiently extensive, all trains will be heated and lighted by electricity. All multiple-unit cars are to be heated and lighted by electricity.

Fatalities.—As has been pointed out, we have had several fatal accidents, due to men coming in contact with electrified wires. We are none the less concerned that in every instance they were men employed by the company. In each instance the accident was due to carelessness or violation of instructions, and most of the accidents occurred during the period of construction. The operating period has provided a less number of these unfortunate events, and the records today now seem to indicate that the future will be free from this most regrettable feature.

Cross-catenary Versus Bridge-bents.—The excellent results of a year's experience with cross-catenary construction in our Port Chester yard, where as many as ten tracks are spanned, is tempting encouragement for its application to main-line work.

Single Versus Double-catenary Construction.—Lack of operating data led the engineers of the New Haven road to take no chances with the overhead construction, and the double catenary was considered the safest.

Single-phase Operation.—The New Haven system provides that the volt manufactured in and leaving the doors of the power house, is the same physical volt that knocks at the doors of the locomotives. Thus the line is the single link that unites the power house and the locomotives. All such adjuncts as step-down transformers, synchronous converters, storage-batteries, and low-voltage distributing systems with their necessary attendant complement of help is dispensed with. The Cos Cob power house has the usual number of men for a station of its output, and the locomotives are operated by the electric locomotive engineer with the customary assistant present for emergency. This crew holds good for single or double-unit trains. An emergency repair train is the guardian of the line, attending to all matters pertaining to its repair and maintenance. Including the night and day crews of the emergency train the number of men employed to maintain the distribution system is nineteen. This covers about 100 miles of single track, including yards.

Conclusion.—In connection with the New Haven electrification I wish to speak of the privilege of association with E. H. McHenry and Calvert Townley. Upon Mr. Townley devolved the responsibility of decision as to the form of electrification selected. Neither the object nor the scope of this paper can include a description of the analytical course of procedure preparatory to the conclusion that the New Haven road would adopt the single-phase form of electrification. Suffice it to say that Mr. Townley's conviction to accept this responsibility was sufficiently strong to lay the foundation of this work. To E. H. McHenry, whose serious illness had prevented his filling the office of vice-president in charge of matters pertaining to engineering, fell upon accession to that office the responsibility of ratification or disagreement with the policy as set forth by Mr. Townley. That ratification is better written in the details of the electric zone itself, as in each department of power house, line, and locomotive may be seen the betterments due to his suggestion. To him is due the credit of the practical issue of this electrification.

This paper would, indeed, be incomplete did I not refer to the splendid courage and indomitable pluck of our contractors, who through a fire of criticism and business depression perseveringly stuck to their belief in the principles they were advocating. They can now have the satisfaction of viewing something begun and something finished; for while there may be many improvements to accrue to the alternating-current, single-phase system, the trunk-line principles have by them been laid and demonstrated.

After the reading of the paper Mr. Murray emphasized his belief in the single-phase, alternating-current system, and stated that it was with a good deal of pleasure that he saw among those present a number of noted engineers, who would undoubtedly contribute to the information available on this subject.

Mr. Ferguson said that the Institute owed to Mr. Murray an appreciation of the work he had done in thus frankly coming forward and stating the actual experience which he had had in the construction and operation of this untried and important undertaking. He called upon Calvert Townley, vice-president of the New York, New Haven & Hartford Railroad, who stated that he was strongly impressed by the radical way in which Mr. Murray had treated the subject. The nature and magnitude of the project under discussion emphasized the radical departure in Mr. Murray's methods. It was seldom that a man felt so sure that the beauties of the work which he had been doing would be so apparent that he could afford to call attention to only those points wherein he had failed initially, notwithstanding the fact that the ultimate working out had been eminently successful. Mr. Townley believed that now, five months after the complete substitution of electricity for steam, and while some of the improvements still have to be completed, the system has been demonstrated to be successful and well adapted to the service for which it was designed. It is an interesting fact that at the present time the electric service is less subject to delays and interruptions than was the steam service which it has replaced. The one radical thing that was done wrongly in the New Haven electrification, and which was really at the bottom of the major part of the difficulties that have been encountered, is that the electrification was not begun soon enough. Had more time been allowed for attention to minor details of equipment, and could work that had to be done under great pressure have taken its normal course, many of the troubles which can be traced to these facts would never have existed, and many of the defects which have caused delays to service would have been detected and remedied during the trying-out period instead of in practical service.

Mr. Townley took emphatic exception to Mr. Murray's expression that the company was not proud of the record made. Mr. Murray might say this in a spirit of great modesty, but Mr. Townley did not believe that any such statement was necessary. The company had reason to be, and was, proud of everything that had been done.

Mr. Townley endorsed what Mr. Murray had said in his paper concerning the Westinghouse Electric and Manufacturing Company, which was the contractor. This company's tireless, resourceful, prompt and cheerful co-operation with the engineers throughout the entire progress of the installation had contributed the essential features of its successful development, and the company was rightfully entitled to a full and frank acknowledgment. The keystone of the system was the locomotive. Without the single-phase, alternating-current motor the whole plan would become impossible.

In the locomotive a large part of the changes made were mechanical—not only mechanical changes to mechanical features, but also mechanical changes to electrical features. With the principal elements of the locomotive design, namely, the large gearless, twenty-five-cycle motors, there had been no trouble; their performance as to torque, commutation and capacity having been most gratifying. A feature of the locomotive design which Mr. Murray had passed over rather briefly was the flexible drive, whereby the armature of the gearless motor is wholly supported on and exerts its driving power through a set of spiral eccentric springs. Trackmen have frequently been appalled because electric locomotives are so much harder on track than steam locomotives of even greater weight, and it has now come to be a generally accepted conclusion that this is due to increased impact, because the armature dead weight is supported without cushion rigidly on the axle. The impact due to this additional dead weight is astounding. In the New Haven locomotives the method of mounting the armatures, obtaining the cushioned effect, exerting the full driving power of the motors, and compensating for the so-called varying torque thereof has been successfully accomplished. The results in improved track maintenance cannot fail to be of far-reaching consequence.

W. J. Wilgus raised the question as to what extent the engineer was morally justified in seeking renown by a brilliant dash into untried ways at the expense of travelers who pay their fare with the expectation of reaching their destination as nearly on time as the most practicable state of the art of transportation will permit. It seemed to him that experimental application of electrical apparatus to untried conditions belongs to unimportant localities, where the results of failure would not be burdensome, and that only the most reliable, well-tried methods should be used where the results of failure might be embarrassing.

B. G. Lamme said that he had been more or less intimately connected with the problems in the New Haven electrification. There were two parts of the system to which he had given a great deal of personal attention. These were the design of the alternating-current generators in the power house and the design of the main motors on the locomotive. The popular opinion, even among engineers, when the decision as to the use of single-phase, alternating current was first announced was that the greatest trouble would be found in developing the large gearless single-phase motors, and that the designing of the generators would be comparatively easy. The record made by the gearless motors, particularly for commutator wear, and the demonstration of the absolute value and longevity of the preventive leads were remarkable. At the present rate of wear on the commutators of the locomotives now in service it would appear that there was at least fifteen to twenty years' life in each one of them, and there had been relatively little sparking, even when developing two or two-and-one-half times full-load torque.

In the designing of the generators it was discovered that although the reaction which caused the difficulty was known, it had not been tried out to an extent which developed its most harmful effects.

Mr. Lamme described the phenomena which occasioned the pulsating armature reaction, and said that when the first rotor was built the structure was laminated as completely as mechanical conditions would permit. Upon testing the first machine it was found that there was local heating with heavy load sufficient to create hot spots which practically broke down the insulation. After trying several remedies it was decided to attempt to eliminate all pulsating reactions from the armature by putting a short-circuit winding on the rotor of such value that a large current could flow in it with but little loss. In order to maintain this condition indefinitely without overheating, it was necessary only to put enough copper on the armature so that the C^2R losses under the short-circuit condition were within the temperature capacity of the windings. A complete cage winding was placed on one of the rotors of the New Haven generators. This rotor had not been designed originally for this purpose and it was therefore difficult to adopt the most suitable proportions in this winding. The operation in practice, however, showed that the remedy was a practicable one. With the new rotors designed for the application of heavy cage windings all trouble disappeared. The fourth machine installed, which has a 4,260-kilovolt-ampere, single-phase rating, has a solid steel core, in the surface of which the copper-cage winding is embedded. As the service was increased and the whole electric service established, it became evident that there was a serious condition existing in the system which was indicated by extremely violent shocks to everything in case of a short-circuit. It had been calculated that the machines would give possibly six or seven times full-load current on the first rush in the case of a dead short-circuit, this dying down to possibly two or three times normal full-load current. Oscillograph tests indicated, however, that under certain conditions each machine could give at the moment of short-circuit almost 5,000 amperes on one phase, the normal full-load current being 340. With three machines in parallel this would therefore mean that approximately 15,000 amperes could be delivered momentarily. The oscillograph tests also showed that this short-circuit current would be maintained at almost its maximum value for a very considerable period, due to the cage winding on the rotors of the generators. Apparently this current at the first rush is not appreciably greater than on the machine before the dampers were added, but without the dampers the field was more quickly killed, so that apparently the breakers did not open until the current had fallen somewhat. With the heavy cage winding on the field structure, however, secondary currents were set up in this winding, tending to maintain the field strength, and thus the current rush was maintained at almost full value for possibly twenty to thirty alternations.

The experience with the windings of the generators indicated that they were being subjected to enormous forces in the end windings. As the machines could give about fifteen times full-load current momentarily on short-circuit, the force acting on these end windings would be 225 times normal, and in this case these forces were so great that it became a serious problem to devise a type of bracing on the end windings sufficiently rigid to withstand such a force. In the endeavor to support these windings against movement, probably the most complete system of bracing ever applied to alternating-current generators was developed and used on these machines; yet in spite of this there was evidence of movement at times.

It was decided to limit this short-circuit current to the value originally intended, namely, about six times full load. This was done by an unsaturated choke coil or impedance coil on the trolley side of each machine, which coil takes up a comparatively small voltage under normal operation, but in case of a short-circuit the electromotive force generated in it is sufficient to limit the current rush to less than half the value it would attain without this coil. With the installation of the choke coils the shocks on the machine were greatly reduced, so much so that further trouble from this source is not feared. An interesting point in connection with the use of the cage windings is that the apparent regulation of the system has been improved.

L. B. Stillwell said that the engineering world was fortunate in the fact that the New York Central Railroad and the New Haven Company had not adopted the same electric system. Such an opportunity to compare the possibilities and limitations of the direct-current system and the single-phase, alternating-current system is unprecedented, and, except in America, would be impossible. Unquestionably, each and every problem of electrification should be studied primarily with reference to local conditions, and such conditions might lead properly to the adoption of a system other than that which would be chosen to solve the more general problem of electrifying not only a terminal and limited suburban zone, but a railroad division or trunk line. The clear conviction and admirable courage of Frank J. Sprague in installing the multiple-unit system of train operation on the South Side road in Chicago was a most important advance in the art of railroading. The applicability of this system to trains requiring tractive efforts exceeding 50,000 pounds was demonstrated first in the New York Subway. The equipment of the New York Central had contributed to the demonstrated utilities of third-rail construction. The New Haven installation, substituting, as it does, 11,000 volts for 600 volts, and eliminating substations, opens the door to possibilities of electrification of railways over zones far beyond the reach of 600 volts, direct current.

A. H. Armstrong said that Mr. Murray was certainly entitled to the greatest praise for the frank presentation of the development period of the New Haven electrical installation. It was instructive to know how nearly the early claims which were advanced for the alternating-current systems have been fulfilled in the completed installation. The overcoming of difficulty after difficulty met with in operation is proof of the progress made in perfecting the complete electrical and mechanical equipment. In other words, the entire system, from the motors to the transmission, had been entirely changed from the original specifications, and this was what had been pointed out when the system was first announced. It was his experience that it costs fully twenty-five per cent more to construct an alternating-current, single-phase locomotive than one of equal weight equipped with direct-current motors.

He finds it hard to justify Mr. Murray's present enthusiasm for the system, which appears to him to be in many ways unsuited to the New Haven conditions.

Mr. Armstrong presented some figures which, he stated, showed that with approximately the same total weight a single New York Central locomotive unit has a capacity equal to two New Haven units, although the motors of the latter are cooled by forced ventilation, while in the New York Central motors natural ventilation is employed. Comparing the hauling capacity of the New Haven locomotive in handling a trailing load of 200 tons, he showed that the single New York Central locomotive was handling trains running from slightly over 400 tons to almost 700 tons. He said that each of these trains would have required at least two of the New Haven locomotives.

Mr. Armstrong said that he believed absolutely in the future of the alternating-current locomotive, but that it was his conviction that it was not adapted to the road upon which it was now being used.

N. W. Storer said that the publication of this paper should do much to silence the criticism which has been heaped upon the New York, New Haven & Hartford Railroad, and he paid a tribute to E. H. McHenry, who had borne the brunt of the storm without faltering in his determination to make the system a success. He took exception to some published reports which, he said, were written evidently without true knowledge of the capabilities of the single-phase motor. These motors have armatures, compensating winding and field all in series. They therefore have torque characteristics similar to those of a direct-current motor, in that, with a given current, the torque is the same for all speeds; that if the New Haven locomotive motors are taking 1,200 amperes each, that the tractive effort is 10,000 pounds, no matter whether the train is standing still or running at a speed of fifty-five miles per hour. The power-factor of the single-phase motor limits it only as it limits the maximum current that can be taken by it. Curves which he had plotted showed that the tractive effort at the one-hour rating for the New York Central motor is slightly more than double that of the New Haven. However, owing to the forced ventilation on the New Haven locomotive, its continuous capacity both in speed and tractive effort is higher than on the New York Central. This indicates that the New Haven locomotives will handle about the same weight of trains in express service as the New York Central, where the service is sufficiently continuous for the latter to get warmed up, even if the rate of acceleration is not so high.

H. P. Davis said that the problems encountered on the New Haven road are not simple nor within the scope of ordinary or established practice. Many conditions have arisen which it was impossible to foresee and guard against. Constructional difficulties, so long as they are not fundamental, do not affect the delay chain, except to the degree of time sufficient to investigate the troubles and to provide means to correct and eliminate them.

The paper was also discussed by E. B. Katte, Philip Torchio, Prof. C. L. de Muralt, William McClellan and Doctor Steinmetz.

Doctor Steinmetz said that his conclusion, from the evidence and data now available, was that those railway problems which cannot be handled by direct current must be solved by the alternating-current motor, and, as we know now, can be solved by the alternating-current, single-phase motor. But where direct current as well as alternating current can be used, the higher weight efficiency—that is, the greater draw-bar pull per pound of motor weight—afforded by the direct-current motor necessarily makes this motor preferable from the electrical engineer's point of view. It is interesting, then, to note that in those railway problems which can be handled by alternating-current motors as well as by direct-current motors, the decision whether one or the other type of motor shall be used has shifted from the electrical engineer to the railway engineer or the railway manager, and is determined by the economical question whether higher weight efficiency—that is, higher draw-bar pull per pound of motor weight—and at least at present a somewhat lower reliability of service are sufficient compensation and should be sacrificed for the possibility at some time of being able to extend the same system of operation over those parts of the road which cannot be operated by direct current, and over such other roads where direct current cannot be used; or whether the higher weight efficiency of the direct-current motor and present greater reliability of service compensate for the possibility that at some future time we may have to replace the locomotive equipment or change locomotives at the end of the direct-current zone and the beginning of the alternating-current zone.

After some desultory discussion the meeting was adjourned.

Northwestern Electrical Association.

The annual meeting of the Northwestern Electrical Association will be held at the Hotel Pfister, Milwaukee, Wis., January 20 and 21, 1909. An address will be made by Prof. B. H. Meyer, chairman of the Railroad Commission of Wisconsin, and discussion will be had on the rulings of the Commission, on tungsten lamps and other timely subjects.

QUESTIONS AND ANSWERS.

Use of Bells on 220-volt Circuit.—I have a number of bells that I wish to connect to a 220-volt direct-current circuit. They are now connected to dry cells, that I want to discard. What kind of apparatus must I have? I want something simple that I can make myself. Can ordinary dry batteries be recharged on direct current?—J. A. B., Chicago.

Substitute the 220-volt circuit with a 220-volt incandescent lamp in series for the dry batteries as the source of current. The lamp reduces the voltage at the bell to approximately what it is designed for. To prevent arcing at the bell contacts, a high-resistance shunt should be connected across them; a small coil of German silver wire, wound non-inductively, will suffice. Dry batteries cannot be recharged with any practical success, as the chemical action occurring therein is reversible with only a very low efficiency. When such a cell is exhausted it is much cheaper to throw it away and buy a new one than to expend any effort to recharge it.

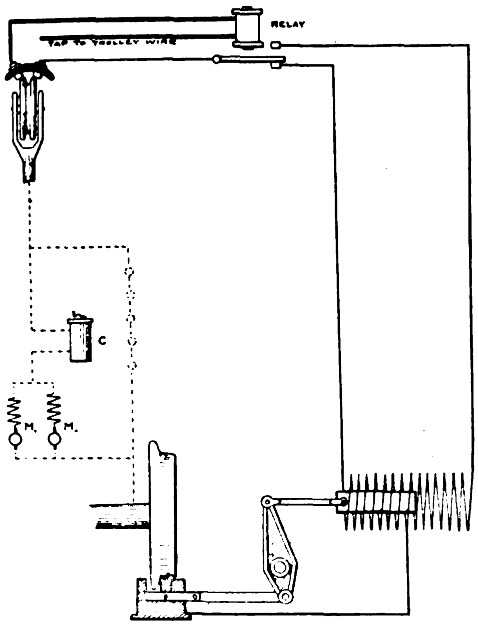
Rating of Open and Enclosed Motors.—A number of shunt motors that I have noticed are rated at so many horsepower and so many amperes "closed" and so many horsepower and amperes "open." What is the meaning of these terms as regards such motors?—M. A. L., Peoria, Ill.

When a motor is operated with the ordinary open frame there is much better ventilation of its windings than when the motor is more or less housed in or enclosed. In the latter case a smaller current will produce the same temperature rise of the conductors than a considerably larger current produces in an open motor. For this reason some manufacturers have a lower nominal rating for their "enclosed" motors than they have for the same motors in an "open" framework.

Automatic Track Switch.—Kindly explain the operation of the automatic street-car switches used on the South Side, as, for instance, the one at 18th Street and Wabash Avenue.—H. D., Chicago.

About sixty feet back of the track switch there is installed on the trolley wire an inverted trough with separate side contacts adapted to be engaged by the rims of the trolley wheel. The trolley wire is carried over this trough and is connected with one of the contacts through the coil of a relay mounted vertically on the trolley pole at the curb line. The contacts on the opposite side of the trough connect to the armature of the relay through a high resistance and fuse (not shown in the accompanying diagram). To the contacts engaged by the relay armature are connected the terminals of the two half windings of a solenoid, the core of which acts on the tongue of the track switch through a lever, the whole being mounted in a sealed box embedded between the rails.

When the motorman, in approaching the switch, allows the car to coast with his controller "off," the trolley wheel connects the opposite contacts in the trough, establishing a circuit through the relay, the high resistance, the armature of the relay, the lower contact and half the solenoid winding to ground. This current is not strong enough to actuate the relay, and therefore its armature remains on the lower contact, sending the current through the left half of the solenoid, and moving the switch to one side. When the motorman approaches the switch with the controller "on" the first or second



AUTOMATIC TRACK SWITCH.

point, the current through the relay is much stronger than before, since it finds a path of low resistance through the motors; the armature is therefore drawn up, and this sends current through the right half of the solenoid and throws over the switch. A strong spring in the track box aids in throwing the switch and holds it in locked position. This type of automatic switch is called the Chatham electric track switch.

Small Gasolene-driven Lighting Plant.—(1) In reading the article on "Lighting Country Homes by Private Electric Plants," that appeared in the Western Electrician of October 24, it was not clear to me whether the lights can be run directly from the dynamo while charging the battery. (2) If a person had a 110-volt dynamo, could he not use that by cutting in proper resistance while charging the battery? (3) Is it good policy to put the dynamo on a concrete foundation without putting a layer of wood between the machine and the foundation? (4) With the size of engine mentioned in the article (two horsepower) would it be necessary to have heavy fly-wheels on the engine to give steady speed or would a small marine engine do?—B. E. M., Seattle, Wash.

(1) The diagram of connections, shown in Fig. 5 of the article referred to, does not provide for running the lights from the dynamo when charging the battery except by closing switch s_2 while s_1 is down. During the battery charge the dynamo voltage is thirty to forty volts; this is pretty strong to put on twenty-five-volt lamps. The plant has been designed to be of as simple design as possible, therefore auxiliary apparatus to permit the object desired has not been contemplated. However, a rheostat of low resistance and large current capacity could be inserted in the lighting circuit above s_2 to cut the voltage down to twenty-five volts; it would have to be adjusted from time to time as the generator voltage was raised and the number of lights changed. (2) The use of a rheostat with a 110-volt dynamo to supply twenty-five-volt lights or a thirty to forty-volt battery is not advisable, as there would be too great an energy loss in the rheostat; in fact, two or three times as much energy being converted to heat as would be usefully employed. The rheostat, too, would have to be quite large and expensive in first cost. (3) A dynamo can be put down directly on the foundation if it is well bolted down to make it free from the engine vibrations. If the dynamo and engine are on the same foundation, a layer of wood would tend to deaden the vibrations. (4) Fairly heavy fly-wheels should be provided to give uniform speed. For this service specially-designed engines are now on the market.

Construction of Condensers.—Certain condensers used in wireless telegraphy have, I have noticed, a dead or disconnected conducting plate inserted midway between the active conducting plates. What effect does this arrangement have on the capacity of the condenser?—F. D. M., Uvalde, Texas.

The capacity of a condenser varies inversely as the square of the distance separating the plates. Thus if the dielectric and area of the plates remain the same and we are to halve the distance between them, the capacity of the condenser will be fourfold its original value. Again, two similar condensers connected in series have a combined capacity half that of either. It is evident that in the case of two "active" plates between which is a free or disconnected conducting plate, we have two condensers in series, either one of which would have four times the capacity of that between the two outside "active" plates, since its plates are at only half the distance. Thus the net increase in the capacity of the condenser has been to double its effective capacity, without decreasing the actual dielectric distance between the connected plates, which determines the breakdown point of the condenser.

BOOK REVIEW.

"Heating and Ventilation," by Charles L. Hubbard. Chicago. The American School of Correspondence. 7x10 inches. 221 pages. Cloth. Supplied by the Electrical Review and Western Electrician for $1.50.

This volume was designed and written for purposes of self-instruction and home study. For this reason the language, and the explanations of the various apparatus and processes followed in heating systems are simpler than is usually the case in text-books. The book is divided into three parts, entitled, respectively, "Systems of Warming;" "Indirect Steam Heating," and "Vacuum Systems."

The first part describes the various systems in use, including the common hot-air furnace and direct steam-heating systems. This part is rather elementary in character and presents numerous illustrations of forms of apparatus, methods of piping and details of construction. The calculations necessary for the proper design of a heating system, both as to heating surfaces and the radiating surfaces of rooms or buildings, are explained in a clear and simple manner.

Part II, dealing with indirect steam heating, hot-water heating and exhaust-steam heating, covers much the same ground in relation to these systems as does Part I, in regard to the systems there discussed. The same may be said of Part III, dealing with vacuum heating. Temperature regulation is described in this section, and a short note is appended on the care and management of apparatus. The book contains much information of value to the student, although he is required to take much for granted. Information is not given as to the derivation of the rules or laws laid down in the work, and the student will have to go to other sources to find them. However, these rules and laws, together with the tables accompanying them, are conservative in their values and well on the side of good

Thirteenth Annual Meeting and Banquet, December 11.

The thirteenth annual meeting and dinner of the Electrical Trades Association of Chicago was held in the banquet hall of the Chicago Athletic Association on Thursday evening, December 11. An excellent menu was discussed, Thomas I. Stacey, treasurer of the Electric Appliance Company, acting as toastmaster. Addresses were made by B. E. Sunny, president of the Chicago Telephone Company; Albert H. Elliott, secretary of the Pacific Coast Electrical Trades Association; James J. Barbour, of the Chicago Bar; A. O. Kuehmstedt and F. M. Pierce. William A. Browne, president of the association, introduced the toastmaster. During the progress of the banquet a number of old songs were sung, led by the master chorister, Harry R. Parsons.

A very pleasant feature of the dinner was the rendition by A. O. Kuehmstedt, in a fine tenor voice, of an original song to the tune of "Illinois," interpolating a sketch on "Mr. Vose." Toastmaster Stacey read a poem which he had composed himself as a tribute to James Wolff, National Representative of the association, but who was unfortunately absent. Those present insisted upon hearing Mr. Stacey's effort, which was received with the greatest enthusiasm:

Whose "glad hand" is always out
With welcome warm, and hearty shout?
Sunny Jim, Sunny Jim.

Who has the car that always motes
As many friends around he totes?
Sunny Jim, Sunny Jim.

Who has the tickets to the show
Where willing buyers gladly go?
Sunny Jim, Sunny Jim.

Who is it shows the boys the town
When strictly business brings them down?
Sunny Jim, Sunny Jim.

Who is it travels "down the line,"
But comes back smiling fresh and fine?
Sunny Jim, Sunny Jim.

Who has the lines that always sell,
And their good points, who knows so well?
Sunny Jim, Sunny Jim.

Who is it takes the orders in
When others say that trade is thin?
Sunny Jim, Sunny Jim.

Who is it smiles and winks his glim
When rivals try the axe on him?
Sunny Jim, Sunny Jim.

Who is it brings about a truce
When all the rest would raise the deuce?
Sunny Jim, Sunny Jim.

Who is it smooths the troubled way
When others say there's "hell to pay?"
Sunny Jim, Sunny Jim.

My song is sung—My muse is dim,
Step lively, boys, the treat's on him.
Sunny Jim, Sunny Jim.

The report of Secretary-Treasurer Frederic P. Vose showed that the present membership is 201, as compared with 188 a year ago. There were handled during the year 4,315 listings, as compared with 3,106 last year, making a total of 19,680 since the organization of the association in 1896. Last year there were 3,318 settlements effected. The Executive Committee had declined to act on only thirty-four complaints because of disputed accounts.

The election of officers resulted as follows: President, William A. Browne, M. B. Austin Company; vice-president, F. M. Pierce, Manhattan Electrical Supply Company; Executive Committee (to serve until 1911), H. R. Parsons and F. M. Horton; national representative, James Wolff.

Wilmington Electric Company Awards Prize of House-Wiring.

The Wilmington (Del.) City Electric Company recently held an exhibition at its salesrooms and offices, 603 Market Street, and during the exhibition each of the callers at the salesrooms was requested to register. At the conclusion of the registration the names were all placed on small cards, put into a box and well shaken. J. Berndt, who is in charge of the specialty department, for the company, stepped to the door and called in a small boy from the street, and the lad drew three of the checks, the third to be the one bearing the reward, which was tendered to G. Brown, 510 East Ninth Street.

As a result, Mr. Brown will have the privilege of having his house wired to the extent of $25 worth of material and work. Had his home been already wired he would have had the privilege of selecting the best table, or standing lamp in stock in the store. The award was conducted in the front window of the establishment, and the spectators witnessed the action with interest.

Electrotherapeutic and Radiology Convention.

A convention devoted to the medical and scientific professions will be held from July 6 to July 9, next year, at the University of London, England, to discuss the most recent developments in electrotherapeutics and radiology. Exhibits of apparatus and appliances will be made, and the object of the conference and exhibition will be to attract the attention of the medical profession generally to the developments of these branches of science. The organizing secretary is Ernest Schofield, 11 Chandos Street, Cavendish Square, London, W. C., England.

HISTORY OF AXLE LIGHTING.[1]

BY W. L. BLISS.

Axle lighting is as old as any form of electric lighting ever suggested for or experimented with upon railroad cars. It is older than the head-end steam system, and dates back to within less than half a dozen years of the commercial births of the incandescent lamp and the storage battery, while the first practical and commercial dynamo is not more than a dozen years older than the first proposition to light a railroad car with an axle-light system. It is the intention of the writer, not so much to compile a thoroughly accurate chronological record of this art, nor to discuss in detail the various schemes that have been brought forth from time to time, but to deal more particularly with the development of methods and principles, leaving the minor details to be discovered and discussed by those who are interested in the subject.

The patent history of axle lighting is quite voluminous, several hundred patents having been issued to various American inventors alone for their improvements in axle-lighting apparatus, while numerous foreigners have protected their inventions in the United States. The earliest English patent that the writer has been able to obtain upon this subject is No. 5316 of 1881, issued to Richard Laybourne, in which the broad principle of a generator driven from a car axle and used in connection with incandescent lamps and a storage battery, was applied to the lighting of a railroad car. As he names the four essential elements of any axle-lighting system, this patent certainly must be regarded as fundamental.

As far as the writer has been able to discover through the records of the Patent Office, the oldest man in the axle-light business who is still actively engaged in this work, is Morris Moskowitz. The next oldest, in point of years devoted to this art, is Patrick Kennedy, while the writer believes that he himself is entitled to third place.

The writer believes that the first incorporated company to exploit axle lighting in the United States was the National Electric Car Lighting Company, of which Morris Moskowitz was the electrical engineer. This company is no longer in existence, but has been absorbed by the Consolidated Railway Electric Lighting and Equipment Company, which is still very much in existence and which has absorbed and taken over a number of companies identified with axle lighting. Mr. Kennedy began his active career with the American Railway Electric Light Company, which likewise has been absorbed by the Consolidated Railway Electric Lighting and Equipment Company. The writer began his stormy career, not with any company, but between two companies, the American Railway Electric Light Company and the Lewis Electric Company. Both had their births in the factory of the Riker Electric Motor Company, of Brooklyn, N. Y., where the writer was employed in the humble capacity of chief enginer, head draftsman, office boy, guest entertainer and general utility man. These were the early days of axle lighting. Many were the schemes propounded and many were the disappointments encountered. But with these small beginnings, the writer believes that today we are on the verge of a great era of axle lighting, and that many of those who were pioneers in this early work and assisted in its development will yet witness the triumph of this wonderful art. It has been fascinating to all those who have engaged in it, and while enormous sums of money have been spent in its development without corresponding returns, the writer believes that the day is not far distant when those who have created and developed this industry will reap the benefit of their exertions.

As mentioned in the patent history above, the essential elements of an axle-lighting system are a revolving axle, a generator driven thereby, a set of storage batteries and some incandescent lamps. This sounds very simple and easy of application, but twenty-eight years have elapsed since this proposition was first propounded. In all that time, axle-light apparatus has not become as standard as automobiles, although it is probably more standardized than flying machines. It was early seen and appreciated that more apparatus would be needed than the four elementary pieces already mentioned.

Beginning with the axle, there has probably been quite as much ingenuity and both useful and useless effort expended upon methods of driving the generator as there have been upon any other parts of the system. The earliest practical method of driving the generator was by means of a belt, the generator being mounted directly upon the body of the car. This method was applicable and feasible in England, where cars with rigid trucks were almost exclusively the rule, and even today this method continues to be the favorite in England on rigid truck cars and has even been extended to swinging or bogie-truck cars in England, the United States and a great many other countries. The body-mounted belted generator was certainly the pioneer, and it has not been entirely supplanted at this date. All sorts of methods have been devised for maintaining the tension of the belt. Idlers of all kinds, double, single and multiple, have been suggested and experimented with. All kinds of supports and mountings for the generators have been developed. They have been pivoted on the top, pivoted on the bottom, placed on rollers and supported on slides, while means for producing resilient tension have consisted of spring, gravity, compressed air, magnetic, vacuum, hydraulic, centrifugal and various other kinds of devices. We also find that it has been the intention of some inventors to allow their belts to slip, others to keep them from slipping, while most inventors have generally succeeded in developing a method of maintaining the tension on their belts that has acted exactly the opposite from what they intended. In most cases where it was intended that the belt should slip, it has generally stuck fast and driven with great vigor. In cases where it was intended that the belt should stick, it has slipped most provokingly.

It will be impossible to relate the various troubles that have developed in simply the means for maintaining belt tension. To obviate the difficulties in maintaining proper belt tension, schemes have been developed whereby the tension could be adjusted by an attendant in the car. Automatic devices for varying the tension of the belt to compensate for wear in bearings, stretch in the belt, etc., have been designed which have contained as much machinery in the shape of motors, worms, gears, limit switches and the like, as would be found in a complete and modern axle-light equipment.

When we consider, however, the question of driving the axle generator in connection with the problem of taking care of its polarity, the task of the historian becomes Herculean. To describe the double-belt systems, using open and crossed belts, the shifters for changing from one belt to the other, the ratchet schemes for allowing one belt to drive in one direction and the other in the other direction; to describe the countless methods of maintaining constant speed by

[1]Abstract of a paper read before the Association of Car Lighting Engineers at the convention in Chicago on November 16.

means of belt combinations with cone pulleys of the Evans type, flyball governors, revolving oil tanks, sliding collars, drums, worms, back gears and sundry similar schemes, would occupy too much time and be altogether uninteresting.

There have been one or two fairly good propositions brought forward for maintaining motion of the generator after the train comes to a stop. The best of these schemes, it seems to the writer, was that employing an air compressor driven from the axle, which stored air in a tank and in turn operated an air-driven engine connected to the generator. The efficiency of such a system could not be high, but it at least has the virtue of being a means of storing energy without employing a storage battery. While schemes of this kind evoke perhaps a smile, they are really no farther from being adopted by practical railroad men than many of the other apparently more feasible schemes that have been advanced from time to time.

The early methods of gear drive were all designed to overcome the difficulty that arose from the fact that the distance between the center of the axle and the center of the generator continually varies unless the generator frame be journaled upon the car axle in the manner adopted in all modern street-railway motors. The only parts of a railroad truck that maintain any kind of a fixed relation with the axle are the journal boxes and equalizer bars, and even these do not maintain a strictly constant relation. The equalizer bars were early employed to secure the bearings for a gear which might in turn engage with a gear upon the axle, and from the gear mounted upon the equalizers, a connection was carried to the generator, either inside of the car or upon the track. The writer's earliest experience with an axle generator was with one of this type wherein the generator was located inside of the car above the truck and a telescopic shaft with two universal joints transmitted the motion from the gear mounted upon the equalizer bars to the generator inside of the car. Complicated as this construction may seem, it is exactly, in all respects, the standard form of transmission found in the best automobiles today, and there isn't any real reason why a system of transmission such as is employed on automobiles should not be used for operating an axle generator. Developments have not taken that trend, and it is doubtful whether anything further will be developed in this line.

Several other types of direct gearing have been developed and experimented upon. Probably the best known of these methods were the false-sleeve system of Biddle and Kennedy, and the hollow-shaft system of the writer. Both of these systems aimed to accomplish the same purpose. In the former device the false sleeve was mounted upon the axle, and upon this sleeve the proper journals were turned and the proper gear seat finished for making a veritable street-railway mounting, the idea being to take the rough axle as it was found and leave it in the same condition, no tooling or machining of the rough axle being permissible. It is the writer's belief that, if the railroads had met the problem of axle lighting in a more liberal manner and had had special axles prepared, as in street-railway practice, axle lighting would have been developed, so far as the generator is concerned, a great deal earlier, although it must be said that generators mounted inside of the truck have the great disadvantage of inaccessibility, and steam railroads are not prone to furnish inspection pits for facilitating the care and inspection of axle-light apparatus.

The direct-gear system, devised by the writer, differed from that of Biddle and Kennedy in that none of the weight of the machine was carried upon the axle. The hollow shaft surrounded the axle, but did not touch it. Motion was communicated by a flexible though positive connection from the axle to the hollow shaft, and upon the hollow shaft was mounted a gear which drove the generator pinion. The bearings for the hollow shaft had to be considerably larger than in the case of the Biddle and Kennedy arrangement, but the machine had the advantage that it rode upon the truck frame and was free from the direct shock communicated by the axle in the Biddle and Kennedy device. Both these arrangements were developed on a commercial scale and went into actual service; it is the writer's belief that a few of them can be found in commission today.

[To be concluded.]

New York State Public Service Commission Notes.

The report of the gas-meter tests by the New York Public Service Commission for November shows that during that time 30,126 meters were tested, of which nine per cent of the meters complained of were correct, fifty-seven per cent fast and thirty-four per cent slow. Of the total fast meters, thirty-six per cent were two per cent or more fast; and of the slow meters, ten per cent were more than two per cent slow, leaving fifty-four per cent within two per cent of normal.

The report shows that forty-seven electric meters were tested, of which 76.5 per cent were within four per cent of normal, 8.5 per cent were four per cent or more slow, and fifteen per cent were four per cent or more fast.

The Public Service Commission has decided to requisition the Board of Estimate and Apportionment for $987,500 to defray the expenses of the Commission for the calendar year 1909. This compares with $1,095,000 for the present year.

The Public Service Commission, Second District, has issued an order to all railroad companies, requiring them to file with the Commission, on January 1, a statement as to the methods employed by corporations respecting the transmission, filing, arrangement, and the checking at stations of schedules showing rates, fares and regulations applying to the transportation of passengers and property.

Comparison of the Working Costs of Small Arc Lamps and High-Candle-Power Osram Lamps.

A recent number of the *Elektrotechnische Zeitschrift* contains an article by H. Remané, dealing with this subject. It appears that the Auer Company is turning out osram lamps of 200, 300 and 400 candlepower, suitable for burning on circuits whose voltage lies between 110 and 130 and between 200 and 270 volts. These lamps have a life of about 800 hours, the candlepower diminishing five or six per cent in that time. The ratio of the mean hemispherical illumination to the mean horizontal illumination is about 0.82, and the efficiency is about 1.33 watts per candlepower. These lamps, when used for interior lighting, are fitted with a reflector, and when employed outside, with both a reflector and clear-glass globe, the figures for efficiency then become 0.98 and 1.05 watts per candlepower, respectively. The results obtained of the cost of energy with different types of lamp and by different observers, taking the cost of current to be four-and-one-half pence per unit, are given in the tables below:

Table I.—Consumption in Watts per Candlepower for Direct-Current Enclosed Arc Lamps.

Amperes.	Remané.	A. E. G.	S. S. W.*
3	2.1	1.01	1.05
4	1.7	0.95	0.9
5	1.5	0.84	0.86
6	1.4	....	0.93

Table II.—Upkeep Cost in Pence per Hour per 1,000 Candlepower.

	Osram Lamps.	Arc Lamps.	
Amperes.	Remané.	Remané.	A. E. G.
1	....	....	....
2	4.65	....	....
3	4.65	9.6	4.7
4	4.65	7.7	4.4
5	....	7.7	3.8
6	....	6.2	....

*Siemens-Schuckert Werke.

Electricity Versus Steam for Trunk-Line Operation.

In the New York *Times* of November 29, William J. Wilgus, under whose direction the electrification of the terminal zone of the New York Central & Hudson River Railroad Company was inaugurated and carried well to completion, has written interestingly on the probability of the general electrification of main lines. Mr. Wilgus says:

"While many of those who are engaged in the practical application of electricity to the art of transportation naturally hesitate to prophesy on what the future may bring forth, they may at least venture the expression of a desire for that which they would like to see accomplished in the field of invention.

"The successful substitution of electricity for steam in terminals in large cities has stimulated the curiosity of the public as to the rapidity with which the change will spread, until that well-tried friend of eighty years' standing, the steam locomotive, will be relegated to the museum. Statements have been made that ten years will see this revolution accomplished, but it is perhaps needless to say that they are groundless.

"The early electrificaton of steam railroads in great centers of population is inevitable, because the demand of the public for the removal of the disagreeable features incident to the use of the steam locomotive is reinforced by the benefits that will accrue to the railroads in increased earning capacity and the possibilities of economies that will at least tend to offset the interest charges on the cost of the change. Away from the large cities the prospects for the eclipse of the steam locomotive are very remote, pending the perfection by the inventor of devices that will substantially reduce the cost of installation and thereby minimize the burden of additional fixed charges. For instance, with the direct-current third-rail system the cost of distribution of electric power is large owing to the need of expensive substations for the conversion of high-pressure alternating current, so well suited for economical transmission to the low voltage direct current for working purposes in the third rail and motors. Attempts to escape this expense by the use of the overhead alternating-current system have not been entirely successful where adopted on trunk lines, as the saving in substations has been offset by the greater weight and cost of electric locomotives, and by unreliability of operation.

"This question of comparative cost and reliability is the real point at issue in the warfare that has been hotly waged for the past five years over the relative merits of these two systems. Until this dispute is definitely settled no great progress can be expected in the general application of electricity on steam railways.

"Apart from the substantial reduction in the costs of installation of electricity on steam railroads that will follow a satisfactory solution of the problems of the rival system there are a number of other opportunities for advance in the art. For instance, the development of waterpowers and the utilization of cheap fuel at the mines, combined with an extended permissible radius of transmission, will all tend to lower the costs of current to prospective users at remote points. Then, too, improvements are constantly being made in power station design by minimizing the losses accompanying the conversion of fuel into energy. The simplifying of signal systems so as to reduce the cost on electrified steam railways is also an important item. The necessary safeguards for protecting the movement of heavy trains at short intervals on electrified trunk lines are now very expensive and one of the principal handicaps to the widening use of electricity.

"The high first cost and the expense of maintenance of batteries now preclude their more extensive use for insuring reliability of train service and lessened cost of operation. Their improvement will not only overcome that obstacle, but will also make more practicable the use of electric locomotives that will be non-dependent on third rails and overhead conductors, particularly in yards and terminals.

"It is hoped that in the early future the question of the preferential electric system for adoption on steam railways will be conclusively settled, and that improvements in the generation, transmission and conversion of current, and in signals and rolling stock, with due regard for safety and reliability, will largely reduce the cost and increase the efficiency of electrical appliances. When that time comes the steam locomotive may well look to its laurels."

Mr. Wilgus is chairman of the Board of Advisory Engineers of the Detroit River tunnel of the Michigan Central Railroad, and is prominently identified with a number of other large industrial organizations. He is the head of the Amsterdam Corporation, which is seeking powers to build and operate an extensive system of electrically-operated freight tunnels, serving the water-front and warehouse districts in New York city.

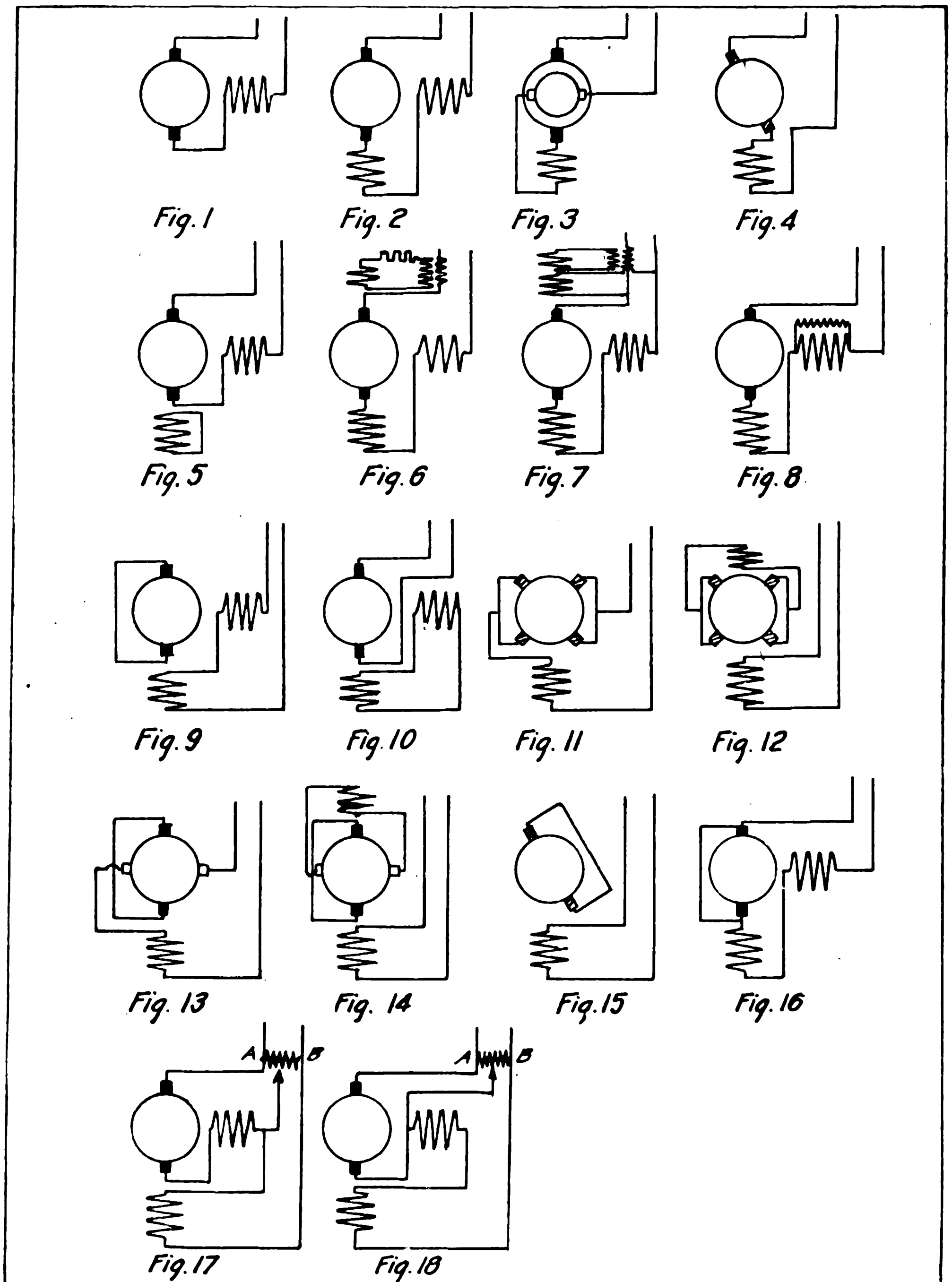
Armour Institute Branch, American Institute of Electrical Engineers.

On December 3 the Armour Institute of Technology Branch of the American Institute of Electrical Engineers held a well-attended meeting, the topic of the evening being the presentation and discussion of a paper by Tracy W. Simpson on "The Alternating-Current, Single-Phase, Commutator Motor."

A large number of commutator motors of various forms, as developed both in this country and in Europe, were described in considerable detail and a brief explanation made of the principle of design of each type. Each type of motor was studied from the standpoints of commutation of load component of current, commutation of short-circuit component of current, rotor reaction, power-factor, torque per volt-ampere, and ability to operate on direct current.

The various methods of improving operation along these lines, as exemplified in the various types of motors, were considered in some detail. In addition to explaining many of the complex phenomena of operation, the new method of improving power-factor, consisting of an auxiliary winding on the exciting field connected as a shunt across the mains, was illustrated by means of vector diagrams. This method is due to Osnos, of the Felten and Guilleaume-Lahmeyer Werke. Attention was called to the superior operating characteristics of the series repulsion motor as well as to the general improvement attainable by motors having both stator and rotor power. It was stated that this motor compared unfavorably with the compensated series type employing resistance leads for long continued overloading at starting, such as would be occasioned by the wheels of a locomotive being locked from too heavy trailing load.

A very interesting set of diagrams, reproduced herewith, was shown of the circuits of most of the motors described. All the diagrams apply to two-pole motors with uniform gap reluctance. The energy axis is shown vertical, the exciting axis horizontal. In the brief synopsis of the various diagrams given below the following abbreviations are used: "Compensated"—in which the pulsating rotor reaction along the energy axis is completely damped; "neutralized"—in which the electromotive force due to the alternating field in the short-circuited coil undergoing commutation is balanced; "rotor power"—that introduced into the



CIRCUIT DIAGRAMS ILLUSTRATING MOTOR CHARACTERISTICS.

rotor by conduction; "stator power"—that introduced into the rotor by induction from the transformer winding on the stator; "rotor field"—exciting field from the rotor, the flux from which is not compensated on the exciting axis; "stator field"—exciting field from the stator coils, fed either by conduction or induction; "series motor"—having the field in series with the energy current of the rotor; "repulsion motor"—having stator power and hence two fluxes of ninety degrees space and time phase and of comparable magnitudes.

The first four diagrams relate to direct-current series motors, since an understanding of the action of these types is useful as an aid to analyzing their alternating-current counterparts and derived forms.

Fig. 1.—Stator field, compensated by changing reluctance from uniform value, i. e., projecting poles not neutralized.

Fig. 2.—Stator field, compensated, or neutralized and compensated, by counter field on energy axis.

Fig. 3.—Rotor field, compensated, or neutralized and compensated.

Fig. 4.—Rotor field, operates due to partial compensation along energy axis.

The following six diagrams illustrate common types of alternating-current series motors; the names given are those of the inventor or manufacturer:

Fig. 1.—Stator field, compensated by high reluctance along energy axis; Finzi.

Fig. 2.—Stator field, conductively compensated; Lamme (Westinghouse Electric and Manufacturing Company).

Fig. 5.—Stator field, inductively compensated; Eickemeyer.

Fig. 6.—Stator field, conductively compensated and neutralized; Oerlikon Maschinenfabrik.

Fig. 7.—Stator field, conductively compensated and neutralized; Siemens-Schuckert Werke.

Fig. 8.—Stator field, conductively compensated, resistance shunt to field; McAllister.

The following seven diagrams illustrate various types of alternating-current repulsion motors:

Fig. 9.—Stator field, stator power, conductively compensated; Atkinson.

Fig. 10.—Stator field, rotor power, inductively compensated, not a true repulsion motor.

Fig. 11.—Rotor field, stator power, conductively compensated; Latour (Felten and Guilleaume-Lahmeyer Werke).

Fig. 12.—Same as Fig. 11, for high voltage.

Fig. 13.—Rotor field, stator power, conductively compensated; Winter-Eichberg (Allgemeine Elektrizitäts Gesellschaft).

Fig. 14.—Same as Fig. 13, for high voltage.

Fig. 15.—Rotor field, stator power, conductively compensated on energy axis, original repulsion type; Thomson.

The last three diagrams show motors having both stator and rotor power.

Fig. 16.—Stator power by over-compensation, excess current thus occasioned is short-circuited; rotor power by series method (Fig. 2); Alexanderson type at starting; General Electric Company (1907).

Fig. 17.—Stator power by action similar to Fig. 9 if field of latter be in rotor circuit, this is only action with moving contact at A; rotor power by series method similar to Fig. 5, this is only action if moving contact is at B; Alexanderson type at running points; General Electric Company (1907).

Fig. 18.—Combination of Figs. 9 and 10, depending on position of contact, stator power only with contact at A; rotor power only with contact at B; both actions repulsion method; Felten and Guilleaume-Lahmeyer Werke.

There were also described several motors having constant speed characteristics, such as the Wagner, Schüler and Fynn types. These are not illustrated in the diagrams, however.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER II. (PART II.)—ROTATING MAGNETIC FIELDS.

ADVANTAGES OF ROTATING-FIELD ALTERNATORS.

From the point of view of simplicity of construction and economy of operation,

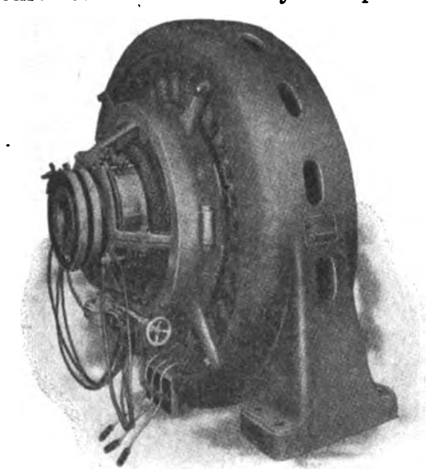


FIG. 48.—ALTERNATOR WITH DIRECT-CONNECTED EXCITER.

there are advantages in rotating the magnetic poles rather than the armatures of alternators. Better mechanical construction, as well as more perfect insulation of the armature windings, is attained in this way, and no collecting rings for the generated current are necessary.

This type of alternating-current generator has almost entirely displaced the revolving-armature type, except in the case of some small alternators. The large machines, of which an example is shown

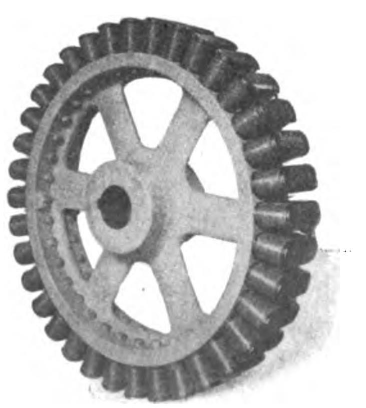


FIG. 49.—REVOLVING FIELD STRUCTURE.

in Fig. 47, are invariably of this type. The alternator illustrated is a 6,600-volt generator, to be connected directly to the prime mover. It has a capacity of 4,000 kilowatts.

DETAILS OF A ROTATING-FIELD ALTERNATOR.

In Fig. 48 is shown a 105-kilowatt revolving-field alternator, having a direct-connected exciter, and arranged for direct-connection to an engine. The revolving-

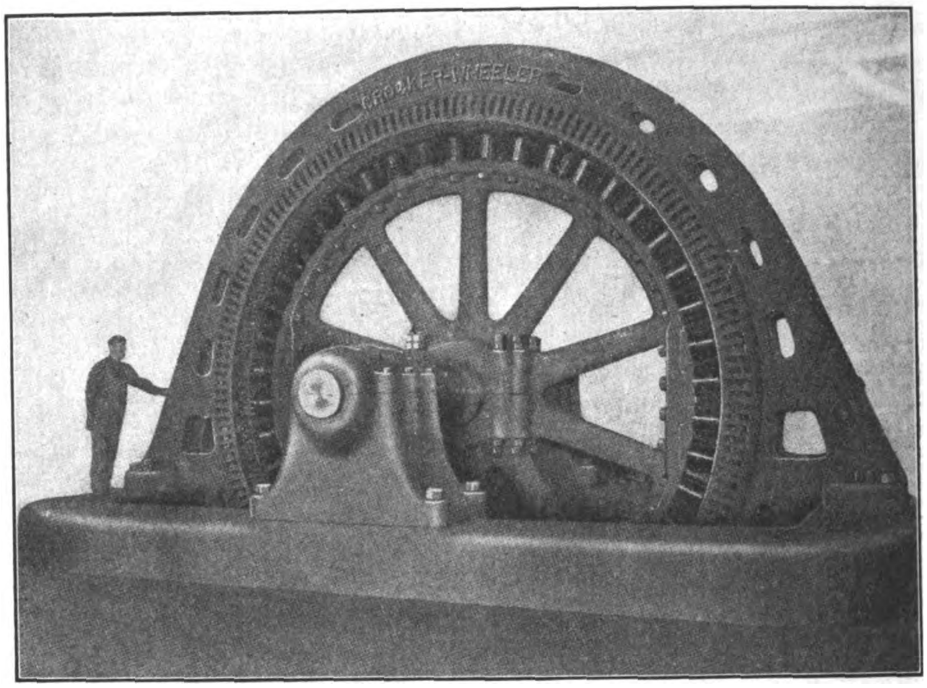


FIG. 47.—4,000-KILOWATT, 6,600-VOLT REVOLVING-FIELD ALTERNATOR.

field structure is shown in Fig. 49, while a more detailed view of the field coil and laminated pole-piece is disclosed in Fig. 50.

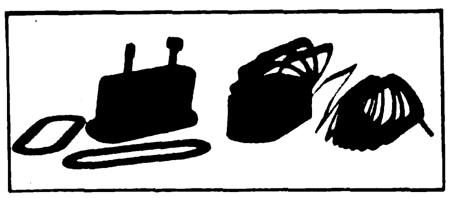


FIG. 50.—LAMINATED POLE-PIECE AND EDGE-WOUND FIELD COIL.

The alternator frame, illustrated in Fig. 51, shows the armature windings on the inner side. In the rear are the coils and frame of the magnetic field of the

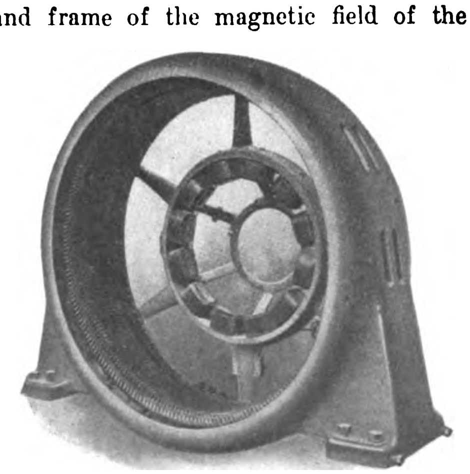


FIG. 51.—ALTERNATOR FRAME AND EXCITER FIELD.

exciter, the armature of which is illustrated in Fig. 52. This is mounted on the shaft close to the revolving field and generates a direct current to supply the field coils.

Fig. 53 shows the method of winding the separate armature coils, which are shown assembled in place in Fig. 51.

A detailed view of the arrangement of

FIG. 52.—EXCITER ARMATURE.

the armature coils of a 500-kilowatt alternator of the revolving-field type is shown in Fig. 54.

EXCITATION.

Most generators of this type are separately excited. In some cases the exciter

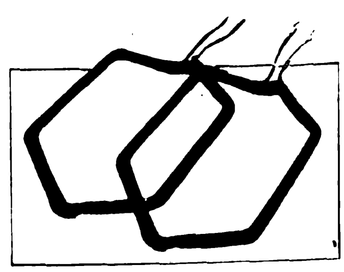


FIG. 53.—ARMATURE COILS.

armature is mounted on the same shaft with the field coils, as already shown in Fig. 48. With large generators, the exciters are usually belted either to the alternator or directly to the prime mover, or may be driven by a separate engine or motor. The electromotive force of the exciter is usually about 125 volts.

COMPOSITE EXCITATION OF REVOLVING-FIELD ALTERNATOR.

In sizes below 100 kilowatts capacity it is customary to build machines with composite field windings, as illustrated in Fig. 55. G represents the alternator and D the direct-current exciter. Y is the shunt-wound field coil of the exciter and X the series coil. The shunt winding contains the rheostat, r, while another

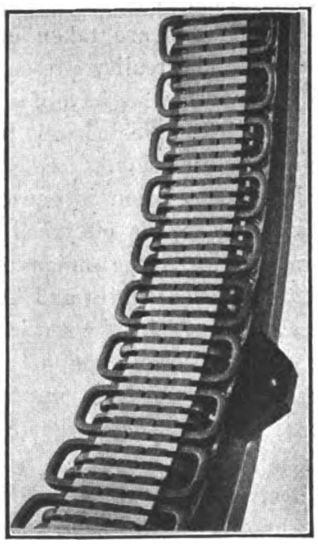


FIG. 54.—STATOR FRAME, SHOWING ARMATURE COILS IN POSITION.

rheostat, R, is connected in series with the exciter circuit. The circuit terminates in the collecting rings, L, which conduct the current to the revolving field coils. The two rheostats allow a wide range of variation of the exciting current. Additionally the commutator, C, feeds the field coils from the transformer, T, whose primary, P, is in series with the line, while the secondary, S, is connected to the commutator, C, which rectifies the current delivered to the field coils.

VENTILATION.

The hysteresis losses in the iron cores of the armature and fields appear as heat, as do also the I^2R losses in the conducting coils and the eddy current losses. It is, therefore, very essential that proper precautions be taken for cooling both the armature and the field. An excellent method of accomplishing this is illustrated in Fig. 56. The air passes up through the ventilating ducts of the field cases and then through those of the armature as shown by the arrows.

VOLTAGE CONTROL.

Voltage control of large alternators is usually attained by hand regulation, and an attendant is stationed at the switchboard for this purpose. For medium-sized machines, however, automatic regulation is being introduced to some extent as, for example, by the Tirrill regulator, which is essentially an automatic field rheostat.

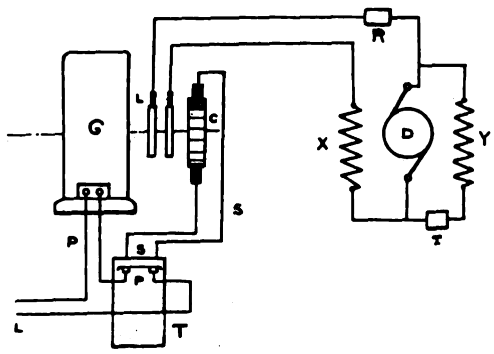


FIG. 55.—COMPOSITELY-EXCITED ALTERNATOR.

It operates by periodically short-circuiting a fixed resistance, instead of varying the amount of resistance in the circuit. The effect is practically the same as cutting out some of the resistance in circuit. With a normal resistance of ten ohms which is short-circuited for one-half the

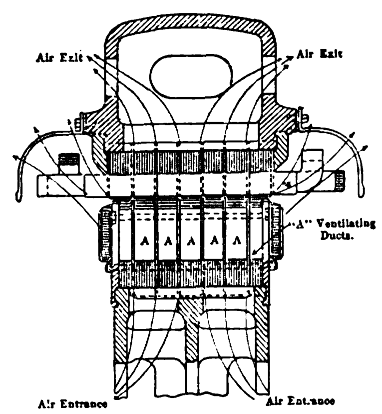


FIG. 56.—CROSS-SECTION THROUGH FIELD AND ARMATURE, SHOWING VENTILATING DUCTS.

time the result is evidently the same as if there was a resistance of only five ohms in the circuit.

New York Independent Telephone.

Justice McLean, in the New York Supreme Court, Friday, December 11, reserved decision on the application of the New York Independent Telephone Company, for a writ of mandamus to compel the Commissioner of Water, Gas and Electricity of New York city to permit it to run an electric wire through the pipe of the Empire City Subway Company, along the south side of Wall Street, from William to Hanover Streets. The corporation counsel opposed the application, and said that, while the application was only for a writ for that one space, it was, in reality, an attempt to get the use of all the city streets and subways.

Non-Magnetic Yacht for Ocean Surveys.

The Carnegie Institute, Washington, D. C., has awarded a contract to the Tebo Yacht and Basin Company, of Brooklyn, N. Y., for what will be in many respects a unique vessel. The Department of Terrestrial Magnetism of the Institute has authorized Wallace Downey, the builder of the yacht Meteor, for the German emperor, to construct a yacht to be used in making surveys. It is understood that, with one possible exception, there will not be a scrap of steel or iron in the craft, although it will, of course, be provided with an engine, machinery, and all other equipment of a modern vessel.

The yacht is to be called the Carnegie, and will be used in making ocean surveys. It is planned to eliminate errors which have crept into ocean surveys, due to magnetic variations, caused by the influence of steel on board ships. The vessel will be 155 feet long, thirty-three feet beam, twelve feet draft, and will be barkentine rigged and cost approximately $125,000. It will be primarily a sailing vessel, with an auxiliary gas engine. The propelling engines, machinery and other parts of metal on the craft will be of manganese bronze and gun metal. The contract calls for the delivery of the vessel to the Carnegie Institute by July 1, 1909, and it is announced that its first voyage will be to the North, visiting Hudson Bay and Greenland.

Electric Traction at Odessa.

The *Elektrotechniker* announces that the municipality of Odessa has decided to construct a system of tramways, and has granted a concession to a Belgian company which holds similar rights over the present horse lines. The system in question, says the London *Electrician,* will have a mileage of ninety-five, half of which will be single-track. The gauge will be one metre, and Phœnix rails, weighing ninety pounds per yard, will be used in the town and Vignoles rails, weighing seventy-six pounds per yard, in the suburbs. The trolley system will be adopted throughout. The generating station will contain four generator groups, each having a capacity of 1,000 kilowatts. Alternating current will be distributed at the generator pressure of 6,000 volts to six substations, where it will be transformed to continuous current at 550 volts. The rolling stock will be made up of 250 motor cars, as well as trailers. It is estimated that the total expenditure will exceed £1,250,000.

Co-operative Credit Protection.

An address on "Co-operative Credit Protection" was delivered before the Chicago Credit Men's Association by Frederic P. Vose, secretary of the Electrical Trades Association of Chicago, last month. Mr. Vose said in part:

Co-operation in business is an economic ideal; in social science it is applied to voluntary unions of persons; in matters of joint protection, purchase, distribution, consumption and the like on an equitable basis for their mutual benefit. It is the concert of many for the compassing of advantages impossible to be reached by one. It is fraternal.

We have all learned that commerce does not necessarily mean relentless competition and eternal strife; rather it is intercourse and exchange not only of wares and merchandise but of thoughts, ideas and practical information, and we have in this co-operative association work a combination or mutualization which makes for business morality, stability and prosperity. It is thoroughly opposed to petty trade jealousies, levels the selfish barriers between competitors and promotes the spirit of conciliation and unity of interest between those engaged in the same line, and from its inception has taught that co-operation and not competition makes for the more abundant and satisfactory life in and out of trade.

"Co-operative credit protection" has become the motto of organizations formed in the electrical trade as well as those among manufacturing and jobbing plumbers, heavy and light hardware dealers, jewelers, woolen manufacturers, paint manufacturers, stationers, brewers, butchers, bakers and candlestick makers, and a thoustand and one more.

Confining ourselves now to the consideration of how these organizations work, it is sufficient to say that in the main those engaged in a given line of trade become members of a corporation, organized not for pecuniary profit but in order to secure a more cordial feeling between members for the protection of their mutual interests and for the collection and distribution of valuable trade information and to protect them against making unsatisfactory credits. All members are supplied with certain uniform blanks or forms and when a customer of a given member does not respond to the usual demands for settlement of a past-due account, that member, in lieu of sending the claim at once to an attorney for collection, forwards to the delinquent Form No. 1, which calls upon him to pay the amount of the claim within three, five or ten days from date, and states that if it is not done the matter will be handed to the Co-operative Credit Association for attention, but ending with a statement that prompt remittance will render this action unnecessary.

If, after the lapse of the time specified, no satisfactory results have been obtained, since the circular letter No. 1 was mailed, the member sends to the association office Form No. 2, advising the secretary of the name and address of the tardy customer and the amount owing, whereupon the secretary sends Form No. 3, which is the last form, or communication, which the delinquent receives, in which the customer is advised that his name has been reported to the association as delinquent in his payments to a given member named, and also the amount of the indebtedness. He is urged to settle the amount within ten days. This form letter ends substantially as follows: "Should there be any question whatsoever as to the justice of the claim, or as to its being past due, the secretary will be glad if the customer will at once send a full statement of the facts so that the matter may be carefully investigated, as it is not the intention to do an injustice to anyone." Right here, you perceive, that the alleged delinquent is thus granted his day in court. If he is honest and business-like he will at once respond by making payment in whole or in part, or offer a satisfactory reason for deferring somewhat. All answers are carefully considered by the association and no honest debtor has cause to complain, as his rights are safeguarded equally with those of the members themselves. But if this form does not effect a satisfactory settlement of the account within the stated ten days, then, upon written request from the member, and with his permission, the indebtedness is reported to all of the members of the organization in a confidential communication, which simply gives the name of the delinquent customer, his address and the amount of the indebtedness. This information along with about a hundred other names is sent out by the organization twice each week. The form states that the information is strictly confidential and for the exclusive use of the member who is directly interested in receiving same for his credit protection and that it is not intended to impute dishonesty or financial irresponsibility to the customers named therein.

As soon as the account is settled the name is immediately withdrawn and the members are at liberty to sell the party on such terms and extend such credit as they may deem warranted.

Shortly after the first of each month, printed booklets containing about 5,000 names that have been reported to the association for unsettled indebtedness are distributed among the members and all the information that goes forth on the supplemental forms throughout the previous month appears in the book. Those names reported delinquent are added to the book and the names of those who have settled their accounts are taken out, so that the monthly in reality presents the names of customers who have failed to liquidate admitted indebtedness to the members of the association.

The Chicago association is one of the five organizations in the electrical trade carrying on identically the same work, so that the entire United States and Canada are practically covered by the service, and about 450 of the leading manufacturers and jobbers throughout the country are thus co-operating in the exchange of credit facts.

From the statistics at hand the Chicago association has collected for its members during the twelve years that it has been operating, over $2,000,000 of delinquent accounts. The amount settled during the past year exceeds $286,000. The average amount, therefore, collected for the 200 members of the association during the past fiscal year was $1,430. If these accounts had been turned over to an attorney and collected on the usual ten per cent basis the commission would have figured $143; as against this the members have simply paid annual dues to the extent of $30, so this is a net saving to each of them of $113.

The ratio of accounts collected through the association to those reported this year has been seventy-five per cent; last year it was seventy-four per cent, and the year before seventy-seven per cent; the year before that seventy-six per cent. This does not take into consideration the number of accounts that are settled by the use of Form No. 1 simply, of which the association has no record, as this form is sent direct by the member to the customer, but from reports recently received at this office it would appear that Form No. 1 alone effects settlements anywhere from sixty-five times to ninety times out of a hundred, and this, too, without any aid from any collection agency or commissions or fees paid to attorneys.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

SYRACUSE RAPID TRANSIT.

The Syracuse Rapid Transit Railway Company's report, as filed at Albany, for the quarter ended September 30, 1908, shows as follows: Gross, $335,648; expenses, $228,023; net, $107,625; taxes, $15,356; operating income, $92,269; other income, $1,095; gross income, $93,364; charges, $90,282; net income, $3,082, a decrease of $34,039, as compared with the corresponding quarter of 1907. Cash on hand September 30, 1908, $41,354; profit and loss surplus, $478,013

CHICAGO & MILWAUKEE ELECTRIC.

The receivers of the Chicago & Milwaukee Electric Railroad report for the month of October and from January 28 to October 31, 1908, as follows: October—Gross, $49,325; expenses, $41,803; net, $7,522. January 28 to October 31—Gross, $468,451; expenses, $330,507; net, $137,944.

Net earnings for October were the smallest of any the current fiscal year, while August, with net of $35,572, was the best.

SCHENECTADY RAILWAY.

Schenectady Railway Company's report, as filed at Albany, for the year ended June 30, 1908, is as follows: Gross, $979,682; expenses, $723,305; net, $256,377; other income, $12,678; total income, $269,055; charges, $125,889; surplus, $143,166, which compares with $196,820 for the preceding year.

CHICAGO TELEPHONE.

The Chicago Telephone Company's earnings for the ten months ended October 31, 1908, are as follows: January 1 to October 31—Gross earnings, $7,211,039; operating expenses, $3,276,878; net, $3,934,161; maintenance and reconstruction, $2,027,533; balance, $1,906,628; dividends and reserves, $1,817,205; surplus, $89,423, as compared with $159,487 for the same period of 1907; average number of stations, 215,562.

President Sunny says: "November marked the turn, however, as is shown by the following: There were installed 4,708 new telephones, or an increase of 488; there were removed 2,397 telephones, or a decrease of 719, making a net gain of 2,311.

"Because of the general business depression, traffic during the year up to November 1 was somewhat less than in 1907, notwithstanding a large increase in the number of stations. Since November 1 there has been a marked and satisfactory increase in the number of telephone connections, a sure indication of a return to normal conditions.

"Telephones installed in the eleven months to December 1 were 59,817, an increase of 2,400; telephones removed were 33,650, an increase of 6,144; a net gain of 26,167, a decrease of 3,744."

Skyscrapers Discussed at Stevens Institute.

On the afternoon of December 3 the students of Stevens Institute of Technology, Hoboken, N. J., were afforded the pleasure of hearing a lecture on the construction of "Skyscrapers," given under the auspices of the Engineering Society.

The speaker was Charles G. Armstrong, the architect of the Singer Building in New York city, and his treatment of the subject was limited more particularly to a consideration of that structure. Starting with a definition for "skyscraper" and the necessity for its erection, Mr. Armstrong immediately digressed to the subject of elevators, clearly pointing out the fact that the modern skyscraper was almost totally dependent for its usefulness upon the modern elevator.

By means of lantern slides the speaker drew a comparison as to size between various noted edifices of the world, and after a brief sketch of the general proportions of the Singer Building began an exposition of how it grew. Especially interesting was the description of that hazardous work necessary in all skyscraper construction on Manhattan Island—the sinking of caissons to bed-rock in order to obtain proper foundations. Special attention was paid to the manner of anchoring the massive tower. In this connection Mr. Armstrong stated that the feet of the tower columns were secured to the foundations in the sub-cellar by stout steel tie rods running down forty feet in the concrete, and that the enormous lifting force of 250,000 pounds per square inch would be necessary to budge a column. Some interesting photographs taken during construction made apparent the danger of the housesmith's occupation.

Turning to a consideration of the structure as a completed unit, the speaker described its various conveniences and luxuries: Costly bronze grille work, expensive marble, elaborate office furnishings in the way of plumbing, ventilation, automatic heat control, vacuum cleaning apparatus, bell and telephone service, etc. A matter of special interest presented, typical of twentieth-century progress, is the elaborate clock system, one master clock in the main hall having control over hundreds of clocks elsewhere in the building.

After a short description of the various safety devices and signal apparatus, shop facilities for repair work, etc., Mr. Armstrong took up the consideration of power. He stated that the Singer Building uses as much power as a moderately sized city —approximately 2,000 horsepower. Boilers, engines and electrical apparatus are of the highest type, securing economy, convenience, and safety adequate to wide possibilities of accident and extremes of load. Mr. Armstrong also described the external lighting system of the tower, used for advertising purposes.

In closing his lecture Mr. Armstrong made an appeal to technical men to take up as a vocation the operation of great power plants and buildings, with the view of improving upon the wasteful methods of running them today. He then presented to the Institute a handsome litho-engraved picture of the Singer Building, eight feet high.

Independent Telephone Men Make a Bid for Long-Distance Service.

An offer has been made to the Chicago City Council Committee on Gas, Oil and Electric Light, by C. H. Moulton, of Indianapolis, president of the International Independent Telephone Association, and H. D. Critchfield, of Milwaukee, general counsel of the association, and president of the Wisconsin Independent Telephone Association, to take over the telephone franchises and properties of the Illinois Tunnel Company. As a companion offer, the Independent companies announced that they would enter into a contract with the tunnel company to connect with its telephone lines inside the city, providing it would agree to establish, within two years, a system of 20,000 telephones in Chicago and extend the system so as to get its share of the Chicago local business.

The Council committee has taken no action on either of these proposals, but in this connection an amendment to the ordinance which would give the tunnel company two years more to meet the requirements of its ordinance was discussed. This amendment would allow the two years' extension on condition that the tunnel company contract with the operators of long-distance lines other than the Bell system for an entrance into Chicago.

MERGENTHALER LINOTYPE ELECTRIC-MOTOR DRIVE.

BY S. H. SHARPSTEIN.

Several years ago Perry Walton, who was then purchasing agent for the *New York Journal,* found that the monthly bills for driving a small number of Mergenthaler linotype machines in the Morgen *Journal* office by electric motors were increasing out of proportion to the amount of work done.

As the *Journal* was buying electricity from the New York Edison Company, Mr. Walton requested that it make an investigation. It reported that the meter was in proper condition. Later the manufacturers of the motors were asked to try to locate the cause for the increased current consumption, and they sent a man who seemingly rectified the trouble.

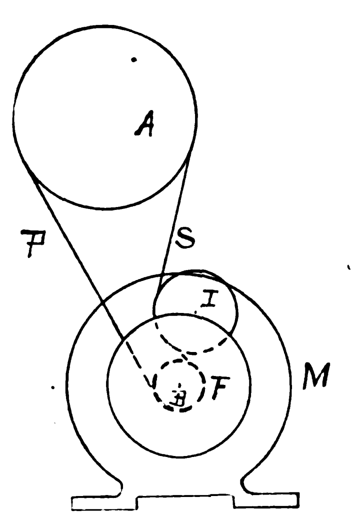
After a little investigation, Mr. Walton found that the motors, which were located in, and geared to, the linotypes, had bearings close to the driving pinions that were supposed to be lubricated by oil feeding from small cups. It was then, as now, customary to lubricate motors by means of ring bearings that would operate at least a week without attention, but special bearings on the motors mentioned above required almost constant attention, or they would run dry and produce excessive friction.

The classes of motors that have been installed in many cases to operate Mergenthaler machines are inferior and have almost driven the managers of newspapers back to the use of shafting drive.

One of the best authorities on print-shop practice, a man of long experience with motor drive, advised one of the New York dailies to adopt group **drive in** preference to individual motors. Group drive was installed with one exception. A Mergenthaler machine that was located on another floor was driven with a late type of electric-motor drive, and the armature of the equipment burned out during the first month that it was in operation.

Individual motor drive has some good features which group or shafting drive has not. One argument in favor of group drive is that the power of the larger motor installed to drive the four or more linotypes has sufficient capacity to maintain the speed when the type-casting device, at times, requires excessive power. This extra demand for power can be met when the individual motor is used by placing a flywheel F on the motor shaft, as shown in the illustration. With group drive, even though the motor be large, the belt running from the shafting to the Mergenthaler may slip, but with a good individual motor rig, under normal conditions it cannot.

Referring to the illustration, assume that A is a driven pulley on a linotype, M a motor installed to drive it by means of a belt. If the pulleys A and B are wide enough to take a good pliable single leather belt of sufficient width to drive the linotype under all normal conditions, B having a flywheel rim F that will produce a momentum to pull the linotype at any time when it requires power above the capacity of the motor, and an idler pulley I be provided to operate on the slack side S of the belt with a spring to compel it to follow up the belt when it happens to stretch, no surer drive can be had when the apparatus is properly designed and constructed.



LINOTYPE MOTOR DRIVE.

With group drive, the shafting is usually placed on the floor near the machine, necessitating a short belt between the pulley on the linotype and the pulley on the shafting. Almost any belt will change in length with the changes in the weather, making it next to impossible to get the best belt-driving conditions where it is so short, without a good idler pulley.

If the idler pulley is of the right diameter to keep its revolutions per minute low, its bearing will not require lubrication when properly made and installed. A slight spring pull that will follow up the belt is of more importance than excessive idler-pulley tension with no spring. A motor of the right design and speed will allow of starting with a switch located in a convenient place, without the use of a starting box.

Where the men operating the linotypes get their pay by the piecework system, they often want the machine to run above normal speed. All individual motors installed to drive such machines should be capable of having sufficient speed variation by inserting resistance in the field winding to give an increase of about fifteen per cent above the normal speed of the motor. It is poor practice to try to get this speed variation by placing resistance in circuit with the armature, which is sometimes done. If there is not some way of easily changing the speed of an equipment, when a motor is used, it is rather difficult to get the proper revolutions, as no two motors of the same capacity and manufacture are apt to have like speeds on the same voltage, and again, the pulleys may be arranged for a certain line voltage which will vary a small percentage.

Good practice demands that a motor, which is to be used to drive Mergenthaler linotype machines, either by being belted or geared direct, or by means of group drive and shafting, should be capable of having its field strength varied sufficiently to allow a speed variation of about fifteen per cent without excessive sparking at the brushes and that it should be supplied with a small field rheostat to be placed, in case of individual drive, where it is easily accessible to the operator, and with group drive near the motor. In the latter case a combination starting box and field regulator would be best.

The Mergenthaler linotype machine is a well-made and expensive piece of apparatus, but for some reason there has seemingly been undue pressure to keep down the price of electric motors used for individual drive. The result is in many cases a large amount of money invested from which the proper returns are not obtained, because cheap electric drive keeps down the production. To be in line with the Mergenthaler and the importance of the work, the electric drive should be the best that motor manufacturers can turn out.

When it is desired to place these machines in scattered positions and not in straight lines, side by side, the use of individual motors is almost imperative. After the use of direct drive is decided upon, the question comes up of supporting the motors from the linotype frame or placing them on a small base on the floor. If the motors are supported from the driven machine, the equipment can the more easily be moved from one place to another, it is easier to clean about the machines, and the motors are not so liable to get dusty. On the other hand, if the motors are placed on neat pedestals, they are easy to inspect and repair and are not so liable to be in the way when oiling or repairing the linotype. In the above cases it was assumed that belt drive would be used. The belt is often objected to on the point of appearance, but it is a very flexible transmitter for such purposes and allows the motor to be made up of standard parts, which is of the utmost importance to the printer. When the electrician in charge of the motors wishes to make changes or repairs to them, he can do so without interfering with the linotype if belt transmission is used. It is a good machinist's job to get a motor in position so as to make gears mesh properly when once removed.

The speeds of motors for individual drive should be sufficiently low to allow being belted direct to the linotype. Intermediate shafts with their extra belts are not good practice and should never be adopted unless for special reasons. Sometimes direct current cannot be obtained where direct drive is desired. Engineering difficulties might arise in case it was desired to use alternating current, making it advisable to have a secondary shaft on the motor. Especially when individual motors are used, they should be enclosed to keep type metal from getting into them. It is desirable to have the binding posts protected by an iron case, provided with a cover to allow connecting up and testing, and a hole tapped into one side to take a pipe into which the wires are to be pulled.

When group drive is used it is essential to get the linotypes divided up, so that they can be operated to advantage. If, during a portion of the day, only four men are employed at the machines, there should be a one-horsepower motor belted to a shaft to drive the four machines.

It is not economical to have a five-horsepower motor driving a shaft to which twenty linotypes are belted, of which only four are in use. An installation of sixteen machines of this kind is arranged in four groups of four machines each, the motors being placed next to the wall at the ends of the shafting. With this arrangement the equipments look well, the motors are out of the way, the motor starters are placed conveniently on the wall, and the whole electrical equipment is where it is not liable to be tampered with or damaged by careless or mischievous persons.

A one-horsepower motor is sufficiently large for four machines, if they are placed the regular distance apart and the shafting is properly installed with sufficient hangers. A motor that will do one horsepower of work at the pulley for ten hours without more than the usual rise in temperature, can be made to drive more than four machines, but it is wise to have the usual load of the motor below the normal rating, allowing a surplus for times when a bearing may be dry or a belt tight enough to cause excessive friction.

Ordinary shafting practice will not answer for linotype purposes. It usually requires about one-fourth horsepower to drive one of these machines, until the casting apparatus seems to stick, when much more power is required. The main shaft of the linotype, on which is placed the driven pulley, has a very low speed. The result is a low belt travel, demanding a heavy belt for transmitting only one-fourth horsepower. If a contractor installs a line of shafting to transmit power to drive four of these machines at one-fourth horsepower each, when the linotype machinist puts on his belts the shafting is almost pulled from the floor and trouble begins at once. Unless a very heavy shaft is used, in proportion to the work to be done, the floor hangers should be first-class, with ring-oiling devices.

When the linotypes stand side by side, with ordinary distances between them, the belt pull, which is upward, lifts the line shaft up against the top of the box in the hanger. If the ordinary oiling devices for hangers are used, the shafting, being out of reach of them, gets no lubrication, and soon commences to cut out the bearing. The ring oiler running around on the shaft as it turns, carries the oil from the reservoir in the box to the top of the shafting, and with a properly made bearing lubricates the shaft regardless of whether it touches top or bottom of the bearing. Good practice demands a hanger close to the motor pulley and also near each pulley used for linotype drive.

Many electricians who wire electric motors do not seem to understand how to place an idler pulley to keep the slack out of a short belt. At times the idler pulley is put on the pulling side of the belt and set up hard enough to make the belt operate the load, and then the equipment is condemned as worthless.

If the motor-driving pulley is small compared to the driven pulley, the belt should be slack enough to let the idler pulley, which should be on the motor, force the belt to wrap about one-half of the driving pulley, then, if the belt is pliable, there is not much spring tension necessary to keep the troublesome slack out of the belt.

Possibly the best argument in favor of group or shafting drive is the lower cost of maintenance and higher motor efficiency of one large motor as compared to a number of small ones.

If the individual motors are made of standard parts of first-class motors, the maintenance and efficiency will be of small importance compared to the flexibility and reliability of individual drive. All motors will require renewal of brushes and repairs after a time. If a five-horsepower motor should stop, for want of oil or a brush, and put twenty linotypes out of commission, when there was a rush for composition, the expense of the shutdown might cover the small cost of maintenance on twenty good individual motors for many years.

Western Union Dividend.

The directors of the Western Union Telegraph Company have restored one-quarter of one per cent to the dividend rate, which was reduced last summer, by declaring a quarterly dividend of three-quarters of one per cent, payable January 15 to stockholders of record of December 19. This places the stock on a three per cent annual basis, compared with the old rate of five per cent, which prevailed previous to last July 15.

The report for the quarter ended December 31, with figures partly estimated, shows net revenues of $2,000,000, an increase of $1,196,057 over the same quarter in 1907. The surplus, after the payment of dividends and bonds interest, was $820,115, which, compared with last year's deficit for the same quarter, shows an increase of $1,666,235. By combining, the last two quarters of the year show net earnings of $3,864,955, an increase for the six months of $3,372,505.

Commenting on the increase of the dividend for the current quarter, President Clowry said: .

"Notwithstanding the setback caused by last year's strike and the long depression which followed, we feel encouraged with reference to our business. We paid one-half of one per cent dividend for the quarters ended June 30 and September 30, or at the rate of two per cent per annum. For the present quarter ending December 31 our estimated net earnings over and above all fixed charges are one-and-one-half per cent, or at the rate of six per cent per annum, and it was deemed best to increase the dividend three per cent per annum."

Electrification of Railroad Terminals Discussed by Steam-Railroad Men.

On the evening of December 11, the Electrical Section of the Western Society of Engineers held a meeting in Chicago for the further discussion of the paper that was read before the main body of the society on December 2, by H. H. Evans, entitled "Developments in Electrification of Railway Terminals." An abstract of this paper appeared in these columns last week.

The discussion was opened by Chairman D. W. Roper, who traced the history of urban transportation and compared the transit means of some thirty years ago with conditions of today. Throughout the days of horse and cable cars, there was a long gap between the length of haul of street cars and of steam suburban roads. The introduction of electric cars caused a decided lengthening of haul and reduced the suburban traffic of the steam roads. The elevated railroads have increased this tendency and brought still greater speed and further inroads on steam suburban service. These factors have brought electrification of this service to the front. Electrical operation permits higher speed than steam. Still higher speeds will be required in future to accommodate the suburban resident who wishes to spend not more than thirty or forty minutes in going to and from his home.

W. B. Storey, Jr., chief engineer of the Santa Fe Railroad, contended that the statement, that electrification of the Illinois Central or other roads is inevitable, is not justified. He does not believe that electrification of terminals in Chicago is feasible or necessary. The smoke nuisance is the only possible excuse for such an undertaking. This is not caused, however, by railroad smoke, but by the smoke problem of the city as a whole. Railroad smoke is only a very small part of the total produced. He does not believe that electrification in general doubles the capacity; it may be that the new terminal of the New York Central may have twice the capacity of the old one on account of extraordinary conditions, special new features and rearrangements aside from electrification, having largely helped to increase this capacity. Mr. Storey contends that the nuisance due to steam operation is insignificant, especially in Chicago. The extra cleaning of passenger coaches is a trifling feature in his opinion. Deterioration of steel work in viaducts is not marked, if these are properly protected. He admits an increase of capacity, due to some dead mileage being eliminated. The railroads wish to have detailed figures given showing the advantages of electrification. The electrification of at least one of the California railroads that were cited was for the object of selling current, as the company bought the road only to use up some of the surplus electrical energy from its large plant; he thinks it was a great mistake. Mr. Evans' statement as to maintenance of electric locomotives being not over three cents per mile, he does not believe to be justified, as the experience with electric locomotives is too short, nor does he believe that electrical equipment is at all standardized as yet. Advocates of electrification should separate their statements about multiple-unit and electric-locomotive operation and give figures for each. He admits that the electrical operation of new heavy suburban lines is warranted, but not the general electrification of terminals. The building of warehouses over tracks is feasible with steam roads also, and, in fact, has been done. He contends that the scheme as to fast and frequent freight service is entirely impracticable, as railroads cannot do what they wish in the operation of freight traffic, but must meet the wishes and conditions imposed by the shipping public. The electrification of the terminals of the New York Central and Pennsylvania railroads in New York city is justified, as it increases their capacity and is necessary in tunnel work. Such conditions are not present in Chicago. It has plenty of room to expand. When economic conditions require it and when definite figures of possible savings are presented, the railroads will be glad to adopt electricity. Where electrification has been adopted in the projects that Mr. Evans cited, it was due to tunnels or special conditions or to governmental experiments, but not due to private corporations voluntarily putting millions into such projects. As to the Illinois Central, he does not believe that the $4,000,000 estimated will be at all sufficient, nor even twice that amount.

W. E. Symons, president of the Pioneer Cast Steel Truck Company, asserted that dust in railroad travel is not caused by steam locomotives, since less than three per cent is due to cinders and soot, most of it being due to air currents caused by the suction of trains. In Chicago over eighty-three per cent of the smoke of the city is caused by other than locomotive chimneys. Damage to property due to railroad nuisances is nil; on the contrary, railroads have enhanced values tremendously. Steam transit is by no means unattractive; the steam locomotive is as fine a piece of mechanism as there is. No reduction of expenses due to wear and tear of rolling stock may be expected from electrification, as this is due principally to switching, and would not be minimized appreciably; it is even now always kept down to a minimum. The standardization of steam-locomotive equipments has not been carried out to a high degree in general, as great variation exists in type of engine and sizes of cylinders and other parts, and since it is almost impossible with diversified management and the conflicting ideas of various division heads as to type of motive power. To show the possibilities in this line, he cited the relatively high development of locomotive standardization on the Harriman lines, with 18,000 miles of railway, where the types have been reduced to five. With the electric locomotive in its present experimental stages, no standardization has been attained, in Mr. Symons' opinion. From the figures on maintenance charges of steam locomotives of three of the largest roads running out of Chicago which he had available, the speaker gave 4.6 cents as an average charge per mile instead of eight to eleven cents, as given by Mr. Evans. He also read extensively from the report of the superintendent of the Baltimore Division of the Baltimore & Ohio Railroad, showing that the maintenance cost of electric locomotives used in the Baltimore tunnel is from three to four times that of steam locomotives. Reduction of track repairs, he thinks, is not important, as eighty per cent of these repairs are caused by the elements, and not by service. In regard to the electrification projects around San Francisco, he spoke of the great traffic handled by the Southern Pacific Railroad during "Fleet Week" last May, while the electric "Key Route" made a dismal failure.

W. L. Abbott said that the steam engineers should wake up from their conservatism to a conception of newer engineering methods. No mention has ever been made by them about the scrapping of steam locomotives on the elevated roads. In Chicago and within 100 miles of it there is more electric than steam railroading. Mr. Abbott told a story about Cornelius Vanderbilt as showing how the railroads are becoming cognizant of the competition of electric interurbans. Considering that sixteen electric terminal projects have been carried out, he contended that the conservatism of the local railroad officials in refraining from the adoption of electrical methods does not reflect credit on this great city.

W. M. Camp, editor of the *Railway and Engineering Review,* thought that the public agitation of the subject is driving many, including the author of the paper under discussion, to hasty conclusions without proper consideration of actual conditions. Some of these conclusions, in fact, he regarded as far-fetched. For tunnel operation, especially at terminals, electrification is necessary, regardless of cost and possible saving. However, electrification of all terminals does not follow. The railroad smoke nuisance, he thinks, is a bugaboo. He spoke of the dense clouds of smoke over the Chicago Stock Yards and the Illinois Steel Works at South Chicago —no one ever speaks of these. Therefore the agitation about Illinois Central smoke was prejudicial. Experience has shown that we must always expect public clamor about various inconveniences of a large city. Let those who do not like the discomforts of a large city, go back to the country. The electric locomotive is still largely experimental. Conditions in Baltimore and New York are not typical, but special. The operation of the New York terminals has not been perfectly smooth. Many changes have been found necessary as the work progressed. He cited the bad wreck of a double-headed electric train on the New York Central terminal as being due, probably to faulty design of the locomotives. The Pennsylvania Railroad has experimented with various types, and adopted, he believes, a type quite different from the New York Central electric locomotive. He elaborated on the changes made in the New Haven locomotives, particularly the addition of idler wheels on the trucks. Aside from changes in wheel-base design, he cited from Mr. Murray's American Institute of Electrical Engineers' paper (referred to in another column) a long list of changes that had been made in both the mechanical and electrical features. All this shows conclusively that the electric locomotives are not standard, but experimental. So is the line equipment, as shown by the New Haven auxiliary trolley. The whole project, he regards, as still experimental. The railroads do not know yet which is better, the overhead single-phase or the third-rail system. If electrification of passenger terminals is to be brought about, why not that of the freight service, as it causes as much smoke and cinders as the others. For carrying this out an enormous expenditure would be requisite. The statement of maintenance of electric locomotives at three cents per mile is not according to facts. The repairs to armatures will probably be very great in heavy service. Track maintenance, particularly at curves, he thinks, will also probably be greater, due to concentration of weight low down on the trucks.

H. H. Evans closed the discussion by giving a great many data on maintenance costs per locomotive mile that verified his estimate of it as being below three cents per mile. He also gave authorities verifying his statement as to track maintenance. He called attention to the fact that the Baltimore & Ohio electric locomotives were the first electric locomotives used for heavy railroad service, and, in fact, that the service in the Baltimore tunnel was very severe. The entire installation there is twelve or thirteen years old and was in many ways below the standard of good practice of today. There is no doubt that railroads develop property values up to a certain point, when the attendant nuisances become excessive.

Ithaca Section, A. I. E. E.

At the meeting of the Ithaca Section, American Institute of Electrical Engineers, December 11, Prof. H. Wade Hibbard, head of the railway mechanical department of Sibley College, presented a paper on "The Handling of Men." This topic is one of unusual interest, but it is also one that receives comparatively little attention in technical schools.

Professor Hibbard outlined the features of executive work, and pointed out the essential elements of successful co-operation between employers and employes. He advocated courses of instruction in handling of men for undergraduates in technical schools, and instanced the Charlottenburg Technical High School of Berlin as an example. Professor Hibbard has had large experience and many opportunities for observation, and the results of all this were condensed into a trenchant and stimulating paper. The presentation of the paper was followed by a lively discussion.

In view of the fact that the local branch of the American Society of Mechanical Engineers was formed on December 10, a resolution was passed by the Ithaca section of the Institute, extending to the members of the new organization "the best wishes and assurances of hearty co-operation in their work and plans."

Pittsburg Section, American Institute of Electrical Engineers.

The regular December meeting of the Pittsburg Section of the American Institute of Electrical Engineers was held December 8 in the Carnegie Institute lecture hall, with W. Edgar Reed, chairman, presiding. The attendance was 110. The subject for the evening was "Some Experiences in the Use of Gas Engines for Electric Power Generation," an original paper by J. R. Bibbins.

In the discussion the following participated: Prof. W. Trinks, of the Carnegie Technical Schools; W. E. Moore, of the West Penn Railways Company; William Hoopes, of the Aluminum Company of America; C. D. Smith, of the United States Geological Survey; E. B. Tuttle and R. A. L. Snyder, of the Central District and Printing Telegraph Company; J. G. Schroeder, of the Union Switch and Signal Company; W. F. Flint and E. B. McClelland, of the Westinghouse Machine Company, and P. M. Lincoln, W. L. Waters and D. W. Burke, of the Westinghouse Electric and Manufacturing Company.

The subject of electric furnaces will be discussed at the next meeting, to be held on January 12, at which time an original paper will be presented by William Hoopes.

Franklin, the Telephone Man's Ideal.

In pointing out the value of promptly obtaining and turning over funds, as well as the saving of expenditure, in the operation of a telephone system, Roy Owens, engineer of the Citizens' Telephone Company, Columbus, Ohio, in a paper before the International Independent Telephone Association at Chicago, said:

"It is as true now as in the days of the first man who braved the lightning's current on an insulated line, that 'A quick sixpence is better than a slow shilling.'

"In such a meeting as this I ought not to pass an allusion to Benjamin Franklin without expressing a wish that our engineers might emulate his scientific care, our managers his thrift, our cashiers and contract agents his diplomacy, our spokesmen his strength of expression, our financiers his capacity for persuading funds out of the most unwilling of lenders, and all of us his zeal for knowledge."

Later in the telephone convention a member discussing the application of insurance to telephone properties, brought out the fact that the first insurance company in this country was organized by Benjamin Franklin, of Philadelphia.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

SIMPLE AND PRACTICAL METHOD OF ASCERTAINING THE CHARACTER OF A CURRENT.

In many instances it is of importance to know the character of the current feeding an installation, and in order to ascertain this it is sufficient to approach a magnet to an incandescent lamp fed by the current to be analyzed. If the current is direct the filament will bend each time the magnet is approached; if it is alternating, the filament will begin to vibrate in synchronism with the current and will appear to the eye as a filament of varying thickness. The phenomenon is very distinct and may be made to manifest itself by means of a small magnet that can be carried in the pocket.—*Translated and abstracted from L'Industrie Electrique (Paris), November 25.*

PROFESSOR MAJORANA'S EXPERIMENTS IN WIRELESS TELEPHONY.

The members of the Italian Electrotechnical Association were recently invited by Professor Majorana to witness his experiments in wireless telephony. Professor Majorana has constructed a generator furnishing continuous electrical waves of ten to twenty thousand periods a second. At the transmitting station he employs an arc in a hydrogen atmosphere with a magnetic blowout, the invention of Poulsen, in a Duddell circuit, and a hydraulic microphone invented by himself. A current of about 500 volts and ten to twelve amperes is used in the primary circuit. The operation of the hydraulic microphone, which is connected in the antennæ, between the secondary coil and the ground, is based on the difference in capillary contraction which the liquid column, consisting of a fine jet of acidulated water, undergoes under the influence of the voice. The liquid jet, which is thus continuously modified, presses on two metallic contacts and varies the resistance interposed between them. An ordinary microphone could not be used, as the high-tension currents would burn the carbon grains. As a wave detector the professor uses a thermopile of non-metallic (sulphurous) elements, as he found electrolytic and other wave detectors used in wireless telegraphy unsuitable for the purpose. Experimental stations have been established at the General Post and Telegraph Office in Rome and at Monte Mario, and a third station at Porto d'Anzio, a distance of fifty-four kilometres. The experiments were entirely successful, in spite of a heavy rain and frequent lightning discharges.—*Abstracted and translated from L'Elettricista (Rome), November 1.*

THE KINLOCHLEVEN WORKS OF THE BRITISH ALUMINUM COMPANY.

The British Aluminum Company has completed its 39,000-horsepower aluminum works at Kinlochleven, in the west of Scotland. The company was founded in 1895 to mine bauxite and purify it to aluminum at Larne, in Ireland. The electrodes were prepared at Greenock, Scotland; the reduction was carried on at Foyers, and the metal was worked up at Milton. At the present time the company is drawing its necessary raw material from its bauxite beds in the province of Var, in southeast France, the Irish deposits being kept in reserve. The works at Foyers is capable of developing 7,500 horsepower, and owing to its situation on the Caledonian Canal, communication with the alumina and electrode factories and rolling mills is both cheap and easy. These works have been in operation since the middle of 1896, but is not capable of meeting the rapidly increasing demand for the metal. The company therefore decided to develop the much more extensive waterpower scheme which it had had under its control for some years previously, and early in 1905 a commencement was made with the new works. The company also possesses works at Stangfjord, in Norway, and at Orsieres, in Switzerland, the total capacity of the various works being over 60,000 horsepower. The new development at Kinlochleven is equipped with water turbines of the high-pressure Pelton-wheel type. The whole plant consists of nine large wheels, with an output of 3,200 horsepower each, and two small turbines of 930 horsepower each. There are twenty main generators, each having an output of 1,000 kilowatts at 250 to 275 volts. They are coupled in pairs to the water turbines. All of the generators are of the direct-current, multipolar type, with slot-wound armatures. Each generator is capable of an overload output of 1,100 kilowatts for one hour. The Héroult process for manufacturing aluminum consumes a good deal of carbon, this substance being used in the furnaces and being burned away to carbon monoxide by the oxygen from the reduced alumina. The company has erected a factory for the manufacture of carbon at Kinlochleven, this factory being supplied both for power and lighting purposes by two pairs of aluminum conductors. A railway runs from the factory to the quay at the head of Loch Leven, transporting both outgoing and incoming produce.—*Abstracted from the Electrician (London), December 4.*

NEW APPARATUS FOR WAVE-FORMS.

M. Abraham, a prominent physicist of Paris, who has had considerable experience as an assistant to Professor Blondel in his work on the oscillograph, has devised an instrument which is much simpler and less expensive than the former types, and may be used for obtaining a direct projection of current waves upon a screen. The instrument has been constructed at the Carpentier establishment and consists of two distinct parts, one a special form of galvanometer containing a swinging mirror which is made to follow all the variations of the current; and a second apparatus which is interposed between the mirror and the screen and which serves to spread out the light coming from the mirror so as to give the form of the wave upon the screen. The construction of the galvanometer allows of the production of induced currents in a swinging frame in such a manner that the movement of the latter will follow exactly the variations of the current to be observed. In order to obtain this result an intermediate current is produced outside of the instrument, which is in quadrature with the current or electromotive force to be observed. In the case of an electromotive force a condenser is disposed in series with the galvanometer. For taking the current wave the current is passed through the primary coil of a small transformer whose secondary coil is closed upon the galvanometer. In practice two separate galvanometers are used, placed side by side so as to throw the two waves upon the screen. The intermediate current is thus sent into the fixed coil of the galvanometer, and this coil acts as the primary of a small transformer whose secondary consists of a short-circuited aluminum frame carrying a concave mirror. The second part of the apparatus, known as the synchronoscope, is used to spread out the beam of light which comes from the oscillating mirror. A revolving prism lies at the center of the synchronoscope and revolves the two beams coming from the two fixed galvanometers. The prism is totally reflecting and is caused to rotate rapidly in synchronism with the wave by means of a toothed wheel of soft iron, which is mounted so as to rotate between the poles of an electromagnet, the latter being connected to the source of current, this combination making a simple and effective synchronous motor. Should the prism be revolving and the mirror in oscillation at the same time, the combined action causes the wave-form to repeat on the screen, owing to the repeated reflections from the three sides of the prism; and the latter therefore gives three reflections of the wave per revolution. In order, however, to secure a better image upon the screen, the light which comes from the prism is not sent directly upon the screen, but is further reflected by a set of fixed plane mirrors which are disposed around the prism. These mirrors are placed so as to be about tangent to a parabola, at whose focus is placed the center of the prism. During the rotation of the prism the beam from each of its faces is reflected upon the four mirrors in succession, and at each reflection the curve is thrown in the same place upon the screen, so that for one revolution of the prism there are twelve successive projections of the wave on the screen. In practice the wave is thus traced as a continuous line of light and the electromotive force and current waves have their proper relative positions.—*Abstracted from the Electrical Review (London), December 4.*

THE APPLICATION OF LOW-PRESSURE STEAM TURBINES TO POWER GENERATION.

In this article J. R. Bibbins states that the entire potency of the low-pressure turbine lies in its ability to use a waste product or to so improve the general efficiency of a power system as to force a thorough consideration of its possibilities and limitations. In the engine the losses due to condensation and re-evaporation on cylinder walls during each consecutive cycle are large. In the turbine there is no cyclic change, and therefore no such losses, comparatively speaking, as a fairly constant temperature and pressure obtain at any given point in the expansion range. In the engine the mechanical friction of the enormous sizes of cylinders necessary to accommodate the lower expansion ranges constitutes an effective barrier. In the turbine the lower pressures may be used with comparative ease and without incurring excessive losses, mechanical or thermal. There are two general classes of service in which the low-pressure turbine finds effective field for application: Class A—Where the supply of steam is intermittent and widely varying in quantity, for example, in rolling mills, in driving steam hammers and in operating hoisting engines. All of these involve the regenerative principle, requiring a careful study of the time element in supply and demand, and generally resolving into a special problem for each individual installation. Class B—Intermittent supply without regeneration. This class embraces central power stations for lighting, traction or factory drive, and may be discussed as a general problem of power extension. A plant of non-condensing engines may be changed over to reduce its water rate from thirty or thirty-five pounds per kilowatt-hour to fifteen or eighteen pounds per kilowatt-hour. In other words, for the same expenditure of coal and water a net increase in power of from eighty to 100 per cent may be realized, depending upon the type of equipment. The resulting cost of power is reduced in the same proportion. From a thermodynamic standpoint the low-pressure turbine is the exact counterpart of the familiar complete expansion turbine and possesses the same characteristics as in the high-pressure turbine. The line of total consumption per hour, or water line, is practically straight, resulting in a constantly decreasing water-rate curve. The low-pressure turbine may be regarded as the third cylinder of a triple-expansion system and is equivalent to such a cylinder fitted with a fixed cutoff. A typical example of a low-pressure turbine application is found in the plant of the United States Coal and Coke Company at Gary, W. Va., operating the mining property, serving hoists, pumps, blowers, lights, etc. The low-pressure turbine has carried a little less than half the total load, which was 2,600 kilowatts, on less than twenty-six inches vacuum, and would have carried over 1,500 kilowatts on twenty-eight inches vacuum with better condensing conditions, giving a probable water rate for the engine-turbine plant of approximately 18.5 pounds per kilowatt-hour. Water-rate curves taken on this plant show that the two Corliss engines give an economy of 20.05 pounds per kilowatt-hour condensing and 28.8 pounds per kilowatt-hour non-condensing for a normal load of 1,000 kilowatts in each case. But in combination with the turbine a maximum water rate of 15.8 pounds per kilowatt-hour is secured.—*Abstracted from the Electric Journal (Pittsburg), December.*

THE PRODUCTION OF CAST-IRON IN THE ELECTRIC FURNACE AND IN THE BLAST FURNACE.

An investigation to ascertain whether the production of cast-iron in the electric furnace would in some cases be more economical than in the blast furnace was made by Engineer Remo Catania, and the results were communicated to the Italian Electrotechnical Association at its recent annual meeting. A definite comparison has so far been impossible, as the blast furnace must also be considered as an enormous generator of motive force, and as there are no data available relative to the gas developed by the electric furnace. The largest blast furnaces reach an output of 800 tons a day; electric furnaces producing eight kilograms of cast-iron per horsepower per day would consume 800,000 horsepower. In comparing the two processes one must take into account not only the amount of material introduced into the furnaces, but also that taken from them. In the absence of data concerning the amount of gas obtainable from electric furnaces the author bases his calculations on chemical equations, applying the same method to the electric furnace that has been applied to the blast furnace. The conclusion arrived at is, that in a country where coke costs forty lire per ton the manufacture of cast-iron in the electric furnace will be cheaper than in the blast furnace, if for a production of eight, ten and twelve kilograms per horsepower per day the cost of electric current per horsepower year is, respectively, sixty, eighty and 100 lire, and assuming a complete, rational and direct utilization of the gas in gas engines and not under steam boilers and in steam engines.—*Abstracted and translated from Elettricista (Rome), October 15.*

INDUSTRIAL SECTION

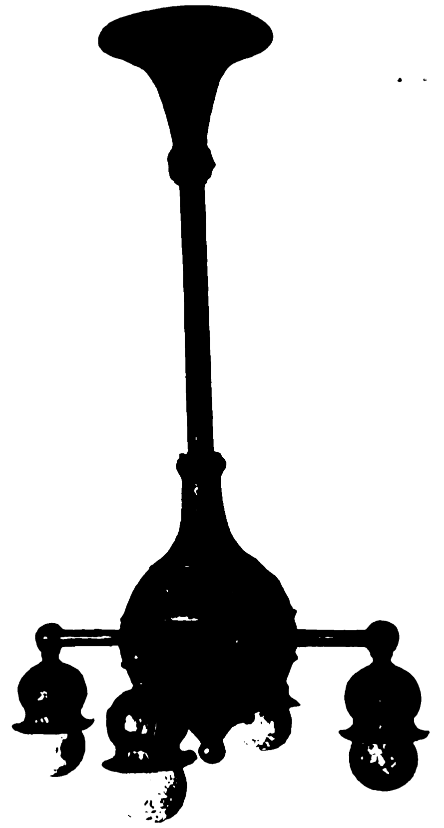
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

New Westinghouse Nernst Chandeliers.

Besides establishing a great economy in the price of light of the best quality, the new Westinghouse Nernst lamp is responsible for the development of a line of chandeliers that give a greater volume of light for a small light source than it is possible to get with any other incandescent chandeliers ever made, says the manufacturer.

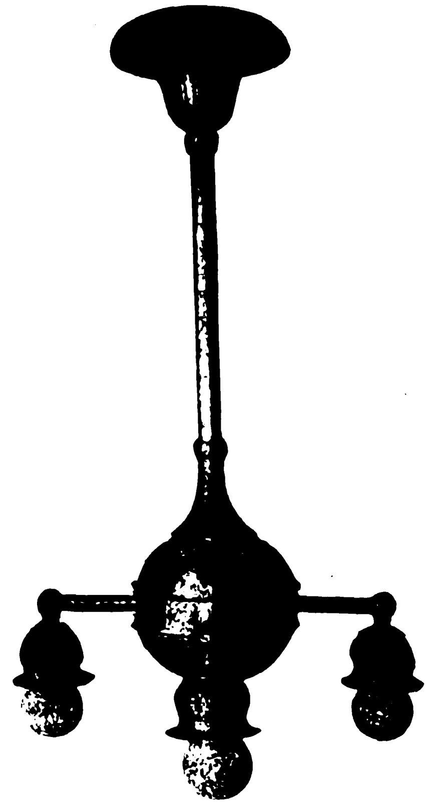
These chandeliers now being put on the market are made in highly artistic designs in the renaissance and art nouveau styles. They are made in solid castings or in a combination of castings and spinnings and finished as standard in statuary bronze and satin brass.

A novel feature about these chandeliers is the arrangement of the mechanism of



NEW FIXTURES FOR WESTINGHOUSE NERNST LAMPS.

the lamps in the central ornamental ball which conceals it completely and at the same time makes it easily accessible. This leaves nothing at the ends of the arms except the small screw-base burners, and these occupy less space than any other incandescent lamps of equal candlepower. The 132-watt burner, for instance, giving light equivalent to that of seven sixteen-candlepower carbon-filament lamps, occupies a space at the end of the arm of only three by four and one-half inches. This makes it possible to get a large volume of



NEW FIXTURES FOR WESTINGHOUSE NERNST LAMPS.

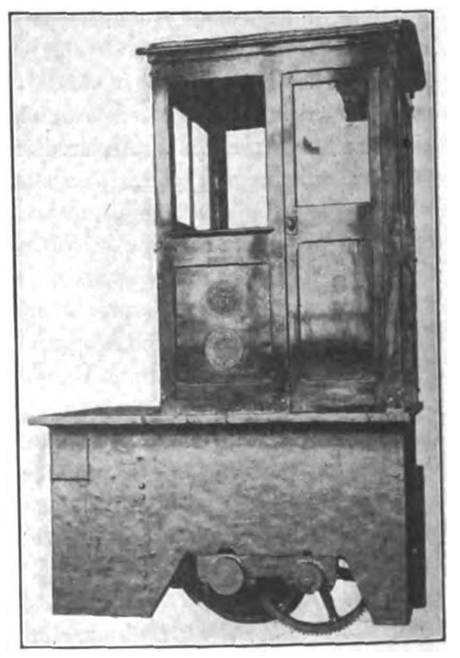
light without using a multiplicity of sources or infringing the law of proportioning by making the sources too large for the other parts of the chandelier.

Electrically-Driven Turntable.

For doing work of a purely laborious sort, requiring mere strength, the human animal is a very inefficient piece of apparatus when compared with such mechanical power devices as electric motors—inefficient, indeed, in point of size, weight and cost of operation. Nevertheless, it has long been almost universally the custom to operate turntables and transfer tables on steam railroads by man power. A striking example of the economy and convenience which results from the use of electric power for this service is shown by the installation of a motor on a turntable on one of the railroads in New York state.

This turntable was formerly operated by hand, requiring the time of a number of men at intervals, which averaged the continuous service of two men for twenty-four hours a day. The donkey was then equipped with a standard type F, high-torque Westinghouse induction motor, rated at twenty horsepower, and using sixty-cycle, two-phase current at 200 volts. This reduced the labor required to one man per day of twenty-four hours.

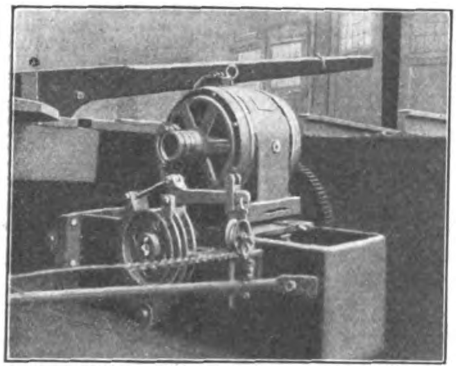
Inasmuch as the men were paid fifteen cents an hour in each case, this motor made a saving of $3.60 a day, or $1,314 per year of 365 days. As the cost of power for the motor has averaged but $8 a month, or a total of $96 a year, the net saving is $1,218 a year. The total cost of the electrical equipment, including the cost of installing the outfit, was approximately $1,500, which is but slightly greater than the actual saving in one year. As a result of this installation four other turntables have been supplied with elec-



CAB AND GEAR CASE OF MOTOR-DRIVEN TURNTABLE.

trical equipment by the same railroad, and plans are on foot for equipping several more similarly.

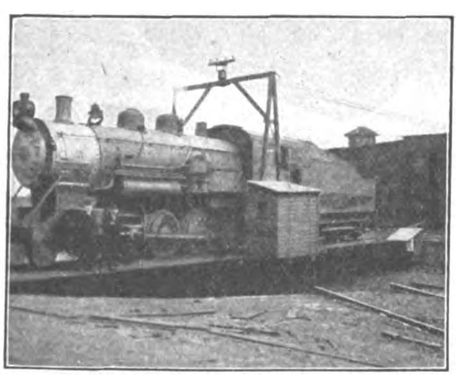
The economy is not the most important point among the advantages of the electrical equipment, although it makes a very good showing. The work of a turntable is intermittent and is usually rushing for a short time and then at a standstill, especially at terminals, where many locomotives often come in at the same time. The length of time required to turn a locomotive by hand depends largely upon the number of men available to do the turning, but even with the handles full (which condition requires from four to eight men), it is impossible to do the work as rapidly as with a motor. Hence the sav-



DRIVING GEAR ON MOTOR-OPERATED TURNTABLE.

ing in time at such periods is of great importance, as the congestion at the turntables is relieved and the movement of traffic is expedited.

The method of supplying power to the table has some interesting details. A bridge is used with overhead wires, which run to a standard Westinghouse overhead collecting switch. This switch is constructed with brushes and collector rings, so that contact is made at all times and in all positions of the turntable. This switch is so constructed that there is no



LOCOMOTIVE ON MOTOR-DRIVEN TURNTABLE.

strain on the line wires, as the cross-arm to which they run does not move with the tables, but is stationary while the table revolves.

In this installation the cab is mounted on the center of the turntable, so that the wires run directly from the bridge to the cab and to the motor. In many instances the cab is mounted at one end, but instead of being directly on the table, it is mounted on the donkey directly over the motor, to overcome the jolting which the cabman would get when the locomotives run on and off. The type of cab which the Westinghouse company has adopted as a standard for this work is shown in one of the accompanying illustrations.

In many cases, especially in a new installation, the feed wires are run underground in conduit and brought up through the king-pin in the center of the table. The same type of switch mentioned above is placed between the tracks, and the connections made from this point in the usual manner.

New Self-Starter for Induction Motors.

A distinctive feature of the new line of self-starters for alternating-current induction motors recently placed on the market by the J. L. Schureman Company, Chicago, is the use of solenoids to perform the various functions of the starter, thus corresponding closely to direct-current practice.

The accompanying half-tone illustration shows the simplest type of these starters, one designed for small motors, capable of being thrown directly across the line to start. It consists of a solenoid-operated switch for closing the motor circuit, together with a small relay, which makes possible reducing the amount of current in the control circuit to a minimum. All parts are mounted on a single slate panel with front connections, and legs for bolting to a vertical surface, making a neat, compact outfit, easy to install and mount.

The main switch is closed through a crank action, which requires very little power to operate, and permits the use of a solenoid of moderate size. No toggle joints are used. The circuits are made and broken on heavy carbon and copper "butt-end" contacts, which can be cheaply and easily replaced, and are very easy of adjustment

The operating solenoids are of a noiseless type and carry current continuously while the starter is in running position. This provides the no-voltage release feature, and in case of a failure of voltage from any cause the starter returns to the "off" position, disconnecting the motor from the line. The current consumed by the solenoids is only a fraction of an ampere.

The usual method of control is from remote push-buttons or by means of a pressure or vacuum regulator. Three small wires are run to the point of control. To start, momentary contact between wires 1 and 2 closes the circuit of the relay, which in turn actuates the main-line switch, connecting the motor to the line. Momentary contact between wires 1 and 3 short-circuits the relay coil, and the circuit to the main-switch coil

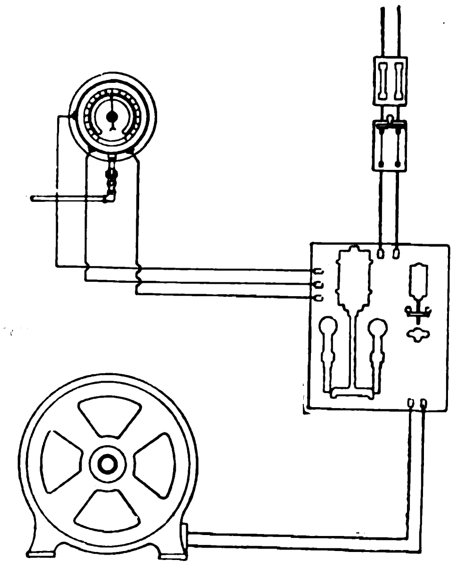
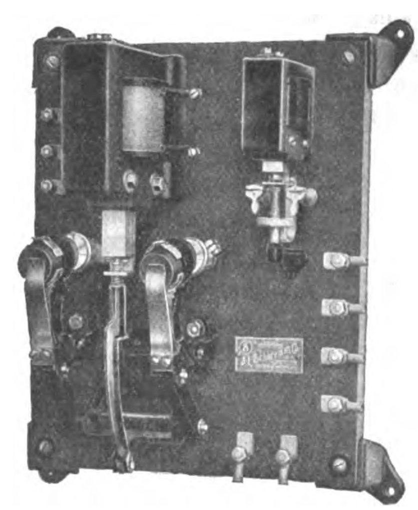


DIAGRAM OF CONNECTIONS FOR SCHUREMAN TYPE AC STARTER, WITH PRESSURE REGULATOR AND SINGLE-PHASE MOTOR.

is broken. The opening of this switch then disconnects the motor from the line.

The relay, when closed, completes the circuit of its coil, so that current is carried by the control circuit only at the moments of starting and stopping. As both the starting and stopping operations



SCHUREMAN ALTERNATING-CURRENT TYPE AC STARTER.

are performed by making contact, no current is broken in the control circuit, eliminating arcing on the control switches.

This type of starter finds its widest use in connection with vacuum-cleaning plants using remote push-button or vacuum regulator control and in connection with small air compressors or fluid-pressure pumps. On pump and compressor installations it is used with pressure-regulator control, starting and stopping the motor on the desired limits of pressure.

Westinghouse Company Reorganized.

The Westinghouse Electric and Manufacturing Company has again become the property of the stockholders, after having been in the hands of receivers since the 23d of October, 1907. As stated in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN last week, the petition for the discharge of the receivers was made on December 5 in Pittsburg, Pa., before Judge Young, of the United States District Court, and was immediately signed by him. The petition was presented by G. B. Gordon, attorney for the receivers and for the Merchandise Creditors' Committee; Paul D. Cravath, attorney for the Stockholders' Committee, and A. H. Larkin, attorney for the Readjustment Committee. Mr. Gordon made the address to the court, in which he gave a statement of the company's affairs prior to the receivership, explained the causes which led to the establishment of the receivership, presented a report of the operation of the company during the tenure of the receivership, and finally led up to the great work which has been accomplished within so short a time by Mr. Westinghouse and the various committees in bringing about the rehabilitation and reorganization of the company. He emphasized the fact that during the year the receivers had been in charge they had not only succeeded in paying off the interest on bonds as it fell due from time to time, but that they also kept the large factories of the company in operation during the entire time, doing an excellent business at a net profit of over $1,000,000.

The action of 5,000 employes in subscribing for $600,000 of stock of the company was another feature presented to the court, which made a great impression, because it demonstrated the amount of confidence the employes themselves had in the company. It was also brought out that the company, under the reorganization, would in every way be in a better condition than at any previous period in its history, as it would start upon the new regime with cash on hand amounting to upward of $15,000,000, with an indebtedness of only about $200,000. Mr. Cravath, in addressing the court on behalf of the stockholders' committee, stated that, in the annals of receiverships, this one stood without a parallel as the most successful.

The board of directors, which consists of George Westinghouse, E. M. Herr, James S. Kuhn, Joseph W. Marsh, William McConway, J. L. Callery, Richard Delafield, Albert H. Wiggin, Charles S. Brooker, A. G. Becker, Charles A. Moore, Edwin F. Atkins, Neal Rantoul, E. C. Converse, Anthony N. Brady and George Verity, held a meeting in New York on December 7 and organized as follows:

President, George Westinghouse.

Temporary chairman of executive committee, E. C. Converse.

First vice-president, E. M. Herr.

Second vice-president, L. A. Osborne.

Acting vice-presidents, G. W. Hebard and W. M. McFarland.

Secretary, Charles A. Terry.

Treasurer, T. W. Siemon.

Assistant treasurers, E. St. John and H. F. Baetz.

Auditor, J. C. Bennett.

Allis-Chalmers Business.

A representative of the Allis-Chalmers Company says business is steadily increasing. The bookings of the company during November were eighty per cent greater than during November, 1907, fifteen per cent above October, and October was sixty-five per cent ahead of September.

Few of the orders were of large size, but they are of a character that suggests that the industrial companies are entering a new era of spending money on small additions and on replacements.

The machinery furnished to the mining and ore-treating companies is of very respectable volume and is increasing steadily.

Turbines and high-pressure fire-fighting apparatus forms a large part of the company's business, and orders for the former and investigations of the performances of the latter are being secured in very gratifying numbers.

A large contract for the construction of a tie-preserving plant for the Pennsylvania Railroad Company was recently secured and is the first installation of a plant of this kind by an eastern trunk line.

A New Rectifier.

An alternating-current rectifier invented by two instructors of the Massachusetts Institute of Technology, Harold G. Crane and Waldo V. Lyons of the Electrical Engineering Department, is now being tested with the purpose of perfecting it for the market. The rectifier has been found satisfactory for such use as the charging of storage batteries, and its economy is declared to assure the success of the new converter.

Auto-Starters for Squirrel-Cage Motors.

It is the usual practice in all squirrel-cage induction-type motors of greater than five-horsepower capacity to employ a starting device of the reactive type, usually termed an "auto-starter," or "starting compensator," the object being to limit the rush of line current according to the load demands. The selection of this device is a very important matter, since even a good motor may be unsatisfactory in starting characteristics if equipped with a poor auto-starter. In fact, excellence in design and construction in any motor may be nullified, in so far as starting characteristics are concerned, unless an auto-starter of proper design is provided.

The auto-starter, made by the Wagner Electric Manufacturing Company, St. Louis, Mo., and shown in the illustrations, is a strong and attractive feature of the motor equipment. In its design and construction no thought or experiment has been spared to produce a practical and effective motor-starting device having the maximum durability.

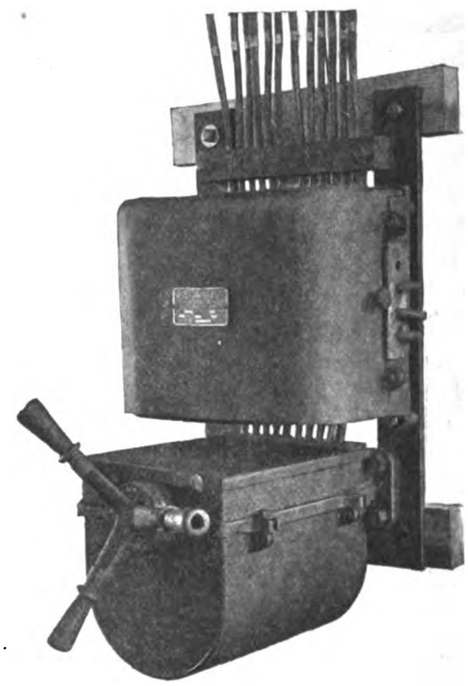


FIG. 1.—WAGNER AUTO-STARTER COMPLETE.

The auto-starter consists of two elements, a transformer enclosed in one iron case, and a switching device enclosed in another case which is oil filled. Brought out from the transformer are a number of sub-voltage taps, giving different percentages of full voltage, and from which any desired tap may be selected for permanent wiring to the switching device, after one or two trials under actual service conditions.

The switching device, as will be noted

from an inspection of Fig. 2, which shows the interior, is of the horizontal-shaft drum type, with the mechanism immersed in oil. A quick-make-and-break cam eliminates all possibility of arcing between the working contacts. In starting the motor, the handle is moved always in the one direction. It may be turned back to the "off" position only from the first starting position, and after once passing the first starting position it cannot be returned to "off" except by going through all of the succeeding positions. The connections for the successive positions are as follows:

In the "off" positions the transformer and motor are both dead. Upon turning the operating handle into the first starting position the motor is connected to the sub-voltage tap of the transformer, with the fuses short-circuited. The connections thus established cause the compensator to deliver sufficient pressure to start the motor with a minimum of line disturbance. Turning the handle to the second position connects the motor to the full voltages and disconnects the transformer, the fuses being still short-circuited. Finally, in the third or full running position the fuses are cut into the circuit.

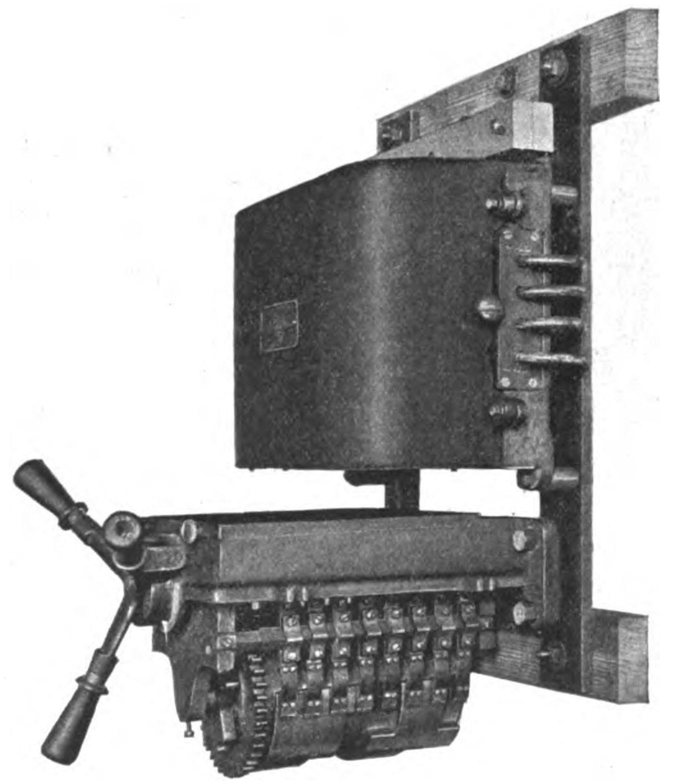


FIG. 2.—WAGNER AUTO-STARTER WITH OIL TANK REMOVED.

The advantages are enumerated as follows:

1. Fuses are short-circuited at starting and first running positions.

2. Transformer is alive with switch upon first starting position only.

3. Motor is disconnected with starter in off position.

4. Motor obtains any desired percentage of voltage according to starting requirements.

5. All make-and-break contacts are of the sliding type and oil immersed.

6. Points of making and breaking of circuit on the drum are separate and renewable.

7. The actual contact points are renewable.

8. All connections are made and broken quickly.

The complete device is of the unit system, a switch and a transformer, and may be arranged to meet best the conditions at the point of installation. The starter is identical as shipped for two or three phase work.

Westinghouse Fixed Charges.

The liability statement of the Westinghouse Electric and Manufacturing Company, as contained in the receivers' report, shows that there are outstanding approximately $36,000,000 bonds and other forms of interest-bearing notes, on which the fixed charges are approximately $4,000,000 a year.

The largest item in this total comprises the five per cent convertibles of $22,135,000. The next in importance is the three-year, six-per cent collateral notes, due August 1, 1910, of which $6,000,000 are outstanding. These latter would seem to be among the earliest obligations to invite retirement, because of the high rate of charge upon them. It is noteworthy also in this collection that the amount of cash on hand on December 4 was greater than one-quarter of the entire outstanding bonds and notes on which fixed charges are reckoned. This does not include $1,525,000 of special cash deposits noted in the receivers' balance sheet.

A FINE STREET-LIGHTING INSTALLATION AT WEST AURORA, ILL.

BY W. R. BONHAM.

The West Aurora Improvement Club, of West Aurora, Ill., which was organized about three months ago for the purpose of improving the business section of the city, has completed its first installation of electric street lamps, and the turning on of the current was an occasion of considerable importance.

It was decided to install multiple tungsten lamps on artistic iron posts, fifteen feet high, and carrying two side-arms, each supporting 100-watt tungsten lamps, at about twelve feet from the ground. A sixty-watt tungsten lamp is placed on the top of the post, and the lamp sockets are supported by the cable conductors, which extend about two inches from the iron support. This method obviates a shock being transmitted to the lamp in case the post should be struck by a passing vehicle. Clear lamps are used, with an eight-inch opalescent globe placed over the lower lamp, and a ten-inch globe over the upper lamp. The posts are placed fifty feet apart, exactly opposite on each side of the street. At street crossings a four-arm post is used.

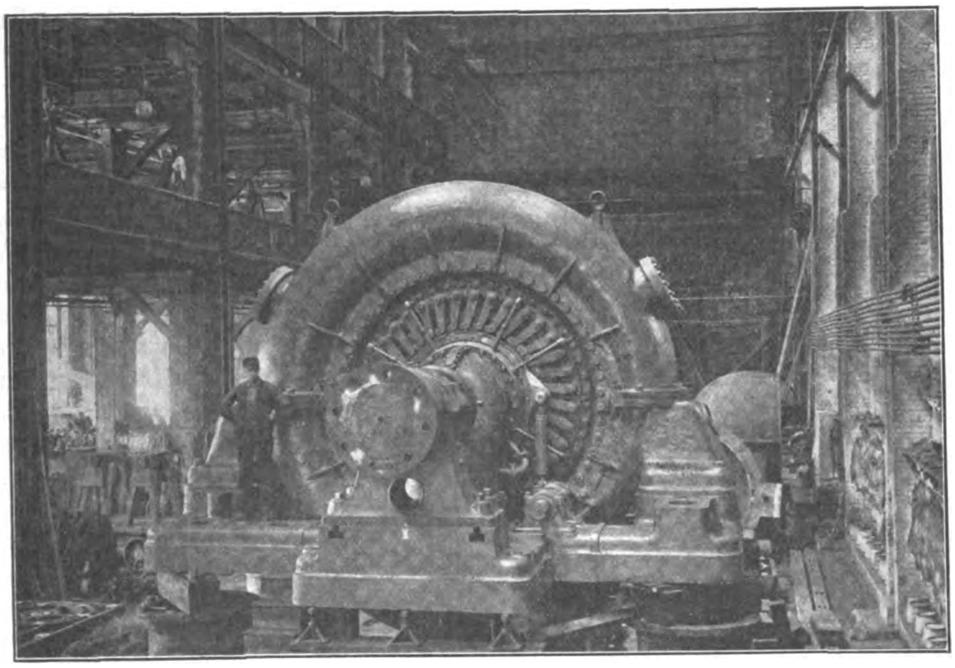
All wires are run in underground conduits, and in the purchase of material and installation, local firms were favored wherever possible. The lamps were purchased from the Sterling Electrical Manufacturing Company, of Warren, Ohio. The installation includes seventy lamp-posts, eight of which carry four cross-arms, and the balance two, providing for 226 lamps. During the entire installation only one lamp suffered breakage, which greatly increased the confidence of the purchasers in the stability and reliability of the tungsten unit.

The president of the club formally presented the installation to the city of West Aurora, which will now maintain it. The acceptance was made by the mayor, and when the current was finally switched on, the greatest satisfaction was manifested.

Two 8,500-Horsepower Allis-Chalmers Water-Wheels for the Telluride Power Company, Grace, Idaho.

In the new waterpower development at Grace, Idaho, of the Telluride Power Company, there are installed two 8,500-horsepower Allis-Chalmers Francis-type water-wheels with double-discharge end horizontal shafts.

The turbines are supplied with water by means of a penstock or pressure pipe five miles long, under approximately 450 feet head, and are required to drive two 5,500-kilowatt, sixty-cycle alternators, whose power at 40,000 volts will be transmitted nearly 150 miles and delivered near Salt Lake City to the electrical distribution system of the Telluride Power Company in Utah.



8,500-HORSEPOWER DOUBLE-DISCHARGE SPIRAL-CORE HYDRAULIC TURBINE, TELLURIDE POWER COMPANY.

Each turbine, when operating at 300 revolutions per minute with an effective hydraulic head of 450 feet, delivers 8,500 horsepower at an efficiency of eighty-four per cent. These units are of the Francis type and consist of a horizontal main shaft carried by two bearings, and a single central casing surrounding a twin runner controlled by a service or "vane" type speed-gate and discharging in opposite directions into two separate draft tubes, all united and supported by an ample bed-plate.

Spiral or scrolltype casings of cast-iron are used with horizontal bottom inlet. The vane shafts are hollow and fitted for forced grease lubrication at both bearings. The runners are of the twin or double-discharge type, and designed to be balanced under running conditions. The draft tubes below the level of the bed-plate are constructed of concrete. The units described are computed to fit the following data: Fall acting on wheel, 450 feet; power at full gate opening, 8,500 brake-horsepower; speed, 300 revolutions per minute.

Electrical Projects on the Pacific Coast.

A number of new corporations have filed articles in the Coast states during the last few days. At Los Angeles, Cal., the Consolidated Reservoir and Power Company has been incorporated with an authorized capital stock of $1,000,000, by H. E. Moore, A. E. Poole, G. I. Lamy, William Lane and others. In Portland, Ore., Goodwin A. Young, Ray W. Lang and N. A. Peery have incorporated the Columbia Railway, Light and Power Company, with a capital stock of $50,000. In Nevada, the interests that are planning to distribute electricity throughout Rhyolite and the neighboring mining camps have organized as the Rhyolite Electric Company, with W. D. Hatton, C. A. Stoible and M. J. Hill of Goldfield, as directors. In San Francisco, the only new incorporation of an electrical nature is that of the Shoenberg Electric Appliance Company, which has a capital stock of $25,000, and of which the organizers are S. G. O. King, S. J. Goldman, M. Shoenberg and H. Shoenberg. The Snow Flake Gold Mining and Power Company has been organized at Salt Lake, Utah, by mining interests in the vicinity of Modena, Utah.

The Griffin Enclosed Gas Engine.

A two-cylinder, three-cycle, enclosed engine has recently been constructed by the Griffin Engineering Company, Limited, of the Kingston Iron Works, Bath, England, designed with a special view to the employment of suction gas as the working agent. This engine possesses a number of original features. By arranging for a scavenging stroke after each explosion, Mr. Griffin is able to use a low compression, and yet get a richer mixture in his cylinder than is possible with even high compressions used with high-speed engines running on the Otto cycle. He claims that he thus combines a low compression with a low consumption of gas per brake-horsepower. The scavenging stroke tends to increase the internal resistance of the engine, but this is compensated for by the use of a special double valve for controlling the supply of gas and air.

Another special feature of the engine is the use of low-tension magneto ignition, a single oscillating magneto firing the charge in both cylinders. Mr. Griffin employs electrical means of breaking the contact, with the result that the magneto used can be fixed at any convenient point of the engine instead of having to be placed in a position giving a straight lead from it for the links to the contact-breaker. Any number of cylinders can, moreover, be fired from the one magneto.

Salt River Reclamation Project.

The Salt River Reclamation Project, involving the construction of the great Roosevelt Dam at Roosevelt, Arizona, is now seventy-four per cent complete, announces the *Reclamation Record*. About 8,500 cubic yards of masonry were laid in the Roosevelt Dam during November, bringing the lowest part of the structure to an elevation of sixty-five feet and the highest part thereof to an elevation of eighty-five feet. About forty-eight per cent of the masonry of the dam had been laid at the close of November. The cement mill, with two kilns running on an average of twenty-one days each, burnt 9,800 and ground 9,500 barrels of cement. The transmission line is completed into Roosevelt, and the setting of poles and stringing of wire is in progress near Phœnix. The foundations for the towers for the Salt River crossing near Tempe are being built. The walls and roof of the switching station are completed. Good progress has been made in the excavation of the South and Grand Canals.

Current Electrical News

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, DECEMBER 5.—The telegraph department of France has adopted a new measure which will be greatly appreciated by the public. Starting December 1, steps have been taken to allow the public to send telegrams, in cities where there is a night service, at the greatly reduced rate of one centime (one-fifth of a cent) per word, with a minimum amount of ten cents in any given case. Thus for 10 cents it is possible to send quite a letter containing fifty words. The messages are sent during the night and are delivered in the first mail of the morning. This "letter-telegram" system was approved by the parliamentary postal and telegraph commission about six months ago. The telegraph rates can be paid by placing postage stamps on the telegram.

A French scientist, M. Louis Paris, has succeeded in producing an artificial sapphire by using the heat of the electric arc. Already the ruby has been formed at a high temperature, but for making the sapphire many difficulties were connected with the operation. Alumina and cobalt oxide are melted together, the latter giving the yellow color, and mixed with a small percentage of lime and magnesia. The result is a stone which cannot be distinguished from the natural sapphire except by the microscope.

Line No. 4 of the Paris Metropolitan subway, which runs from the Clignancourt to the Orleans Gates, is expected to be finished during next summer. This work was delayed on account of the large amount of caisson construction needed for the tunnel under the Seine. One-half of the present subway, running northward from the Seine, is now open for regular traffic. Line No. 6, running from Place d'Italie to Place de la Nation, will be delivered to the Metropolitan company by the contractors in February or March of next year. A rolling incline is now being installed in one of the subway stations in the city as an experiment, as in some cases the tunnel lies at a great depth and the public complain of having to mount the staircases. For the same purpose electric elevators will be tried at another of the stations.

We learn that the Nobel Prize for Physics is to be awarded to Professor Lippmann for his work in the photography of colors. It will be remembered that he is also the inventor of the capillary electrometer, which is one of the most sensitive known, and has carried out other researches in the electrical field.

In order to facilitate the exchange of international telephone messages an agreement has been made between the French and the Italian departments by which a person in Paris, for instance, can be informed by telegraph that someone in Rome wishes to telephone him and that he is to take the message in a certain telephone booth at the designated date and hour. Such telegrams are sent at a reduced rate. A. DE C.

GREAT BRITAIN.

(Special Correspondence.)

LONDON, DECEMBER 4.—An extensive system of street lighting by means of metallic-filament lamps is now under the consideration of the Marylebone (London) Borough Council, in substitution for the present lighting by gas. On the contrary, it may be reported that the City of London Corporation has given facilities to the Gas Light and Coke Company to carry on an experiment in public lighting in the well-known thoroughfare of Fleet Street, by means of inverted, high-pressure gas lamps.

Although reciprocating engines were installed in the first portion of the Greenwich Tramways generating station of the London County Council, turbo-generators have been adopted for the second portion which is now building. The tenders for two 5,000-kilowatt steam turbo-generators have just been received, and it is interesting to note that the British Westinghouse Company has received the order at $204,000, the turbines being of the Rateau type. There were lower tenders than the accepted one, and in order to satisfy the Highways Committee as to the working of this type of turbine, the company took the tramways officers of the Council for a trip to Milan.

The Institution of Electrical Engineers is about to lose its secretary, Mr. G. C. Lloyd, who has held his position since 1904, on the death of Mr. W. G. McMillan. Mr. Lloyd has been selected for the post of secretary of the Iron and Steel Institute, where he was assistant secretary prior to 1904.

The recent fire on the City & South London electric tube railway has awakened the fire brigade committee of the London County Council to the fact that several improvements could be made to the fire-extinguishing apparatus on electric railways. Accordingly, they have reported that periodical inspections of the apparatus should be made by the chief fire officers, that the railway company should provide illuminated signs both on the platforms and on the street level showing when the current is switched on, or off, the live rail, and that in the event of a fire, the fire brigade should be sent for. Hitherto, there has been a rule that the railway employes should themselves cope with a fire on a tube railway.

Hitherto, the National Telephone Company has been assessed throughout the country, for taxation purposes, at a certain rate per mile of wire. The company has now, however, accepted the principle of being taxed according to the earning power of its undertaking in the various districts. This will add considerably to the ratable value in many districts, as much as fifty per cent in some, and in a few quarters this is popularly regarded as a satisfactory retaliation for the imposition of the new rates of charging by the company, which have, in the main, turned out to be an increase over the old rates. G.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, DECEMBER 12.—Application is being made to the Ontario Legislature for an act to incorporate the Eastern Ontario Electric Railway Company. It is proposed to run from Cornwall to Toronto, with a branch from Ottawa to Brockville. Permission is sought to issue bonds at the rate of $25,000 per mile.

The Municipal Council of Brockville, Ont., has entered into an agreement with the Bell Telephone Company, covering a five-year period, by which the company pays the corporation $500 a year rental for the use of its streets and fixes the rate for business telephones at $30 and residence telephones at $25 per year.

It is expected that the city of Peterboro, Ont., will shortly approach the Hydro-Electric Power Commission with regard to electric power. It is proposed to obtain this, if possible, from sources about twenty miles north of the city, and practically the same plan has been worked out as at Ottawa. About 8,000 horsepower will be used by the city at present.

The Sao Paulo Tramway, Light & Power Company, the Brazilian concern owned and operated by Canadian capitalists, has increased its dividend rate from nine to ten per cent per annum. This action was taken by the directors at Montreal last week, when a quarterly dividend of two-and-one-half per cent was declared. The history of the Sao Paulo company, from five-and-three-fourths per cent in 1903, has been one of constantly increasing dividends.

In an official statement issued to shareholders, the Dominion Power and Transmission Company, which owns the street railway and controls all the electric suburban lines entering the city of Hamilton, Ont., explains that one of the chief reasons that the payment of dividends on the stock is suspended is on account of the depressing effect that the Ontario government's power project has had on the sale of securities. The company has to spend $500,000 reconstructing the street railway, but found it almost impossible to sell the securities, and dividend payments have been stopped until the amount is accumulated. Mr. Geo. Blanchard, vice-president of the company, an American street-railway expert, has severed his connection with the company.

It is estimated that the interests which are working to have the Mexican Power-Tramway lease put through, control and have proxies for 110,000 shares of the power company's stock.

The city of Brantford, Ont., will vote in January on debentures for the purpose of establishing a municipally-owned light and power plant. W.

IMPORTANT DEVELOPMENTS.

PLANS TO ILLUMINATE STATUE OF LIBERTY IN NEW YORK HARBOR—Chief Engineer Armstrong, of the Singer Building, of New York, has been in Washington to interest congressmen in a plan to light up the statue of the Goddess of Liberty in New York harbor as the Singer tower is lighted. The plan is to have twenty-four powerful searchlights, situated at the base of the statue, trained on the statue during the night.

ELECTRICITY TO LIGHT THE PYRAMIDS OF TEOTIHUACAN—The representatives of the Mexican Light and Power Company have offered to follow the suggestions made by the president of the republic regarding the furnishing of electric energy for lighting and power purposes in the camping grounds and installations established in the pyramids of San Juan Teotihuacan. To that effect a committee of engineers has been appointed to make a survey in the district of Texcoco to learn whether the owners of private properties within that jurisdiction could establish pumping plants for irrigation purposes, and if the water can be economically used from that place, so as to make the establishment of a central supply of electric energy feasible, the company will undertake the work.

NEW YORK, NEW HAVEN & HARTFORD TO START ON $30,000,000 ELECTRIFICATION—Contracts involving $30,000,000 of improvements by the New York, New Haven & Hartford Railroad, have been arranged for. The railroad is to electrify a six-track line from New Rochelle to One Hundred and Twenty-ninth Street. A tunnel will be built under the East River to Astoria, thence to Long Island City, with another East River tunnel and subway to a huge passenger station to be erected on the block bounded by Fourth and Lexington avenues, Thirty-second and Thirty-third streets. The trackage from Astoria to Long Island City may be underground or may be elevated. A connection with the Pennsylvania will be made in Long Island City, according to the report, and a New York, New Haven & Hartford terminal station will be built on the old Park Avenue carbarn site. This would permit passengers from Boston to pass through New York for the West and South without leaving the train.

ELECTRIC LIGHTING.

(Special Correspondence.)

ST. JOHN, N. D.—Horace Bourassea is constructing an electric-light plant at St. John.

RUSHVILLE, NEB.—D. W. Ferree contemplates installing an electric-light plant at Rushville.

MURRAY, IOWA—A special election will be held at Murray to determine upon lighting the streets with electricity. C.

NORWALK, CAL.—J. R. Gordon has been awarded a franchise for an electric-lighting and power system in the town of Norwalk. A.

WEBB CITY, MO.—An explosion badly damaged the plant of the Independent Power Company, at Webb City, killing one employe.

NEZ PERCE, IDA.—E. G. Ousterhaute and J. F. Englehorn, of Nez Perce, are building a power plant with a capacity of 200 horsepower near Orofino, Ida. A.

TACOMA, WASH.—The commissioner of public works of Tacoma is advertising for proposals to furnish a fifty-arc, air-cooled, constant-current transformer. A.

SAN FRANCISCO, CAL.—An additional $500,000 of the Northern California Power Consolidated 5's has been sold and the proceeds are being invested in the development of the plant.

DELHI, IOWA—An electric light plant costing $18,000 will be installed at Delhi. The town has raised $8,000 and outside capital will supply $10,000. Power will be furnished to small factories. C.

SEATTLE, WASH.—The city of Seattle will vote on December 29 on issuing $800,000 four-and-one-half-per-cent lighting bonds, together with two other bond propositions for ratification or redemption.

ALBANY, N. Y.—The Public Service Commission, second district, has authorized the Rockland Light and Power Company, of Nyack, N. Y., to issue $500,000 five-per-cent thirty-year mortgage bonds.

SEATTLE, WASH.—The City Council of Seattle has passed an ordinance adopting plans and specifications for the enlarging and extending of the municipal light and power system at a cost of about $800,000. A.

VILLISCA, IOWA—The Villisca Electric Company has secured a temporary injunction against the city of Villisca to enjoin the granting of a franchise to F. P. Tyler, who proposes to construct a rival electric-light plant.

PLACERVILLE, CAL.—George L. Threlkel, of Placerville, Cal., has appropriated 10,000 miners' inches of water from the North Fork of the American River in El Dorado County, California, for power purposes. A.

LA GRANGE, CAL.—The work of building a thirty-two-mile transmission line from the plant of the La Grange Power Company, near La Grange, to the town of Turlock, has been begun and is to be completed within three months.

FLORA, IND.—Lincoln Hesler, who appeared before the town board in the interest of William B. LaBaw and Guy W. LaBaw, of Veedersburg, who wish to secure a franchise for building an electric-light plant, was successful in having the franchise drafted by the board.

ST. LOUIS, MO.—The proposed artistic electroliers on downtown streets will be illuminated for the first time on Centennial Day, November 2, 1909, if the plans of the Downtown Lighting Association, organized at a meeting of business men with a committee of the Civic League, at the Mercantile Club, do not miscarry. Tom W. Bennett was elected president of the association; Dan C. Nugent, vice-president, and Thomas H. West, Jr., treasurer. Committees for each street in the district are to be appointed by the executive committee, to enlist all the property holders as members of the association and to superintend the erection of electroliers in conformity with the patterns selected by a committee of the association.

PORTLAND, ORE.—The Portland Railway, Light and Power Company has plans nearly completed for a two-story concrete and brick transmission station, fifty by one hundred feet, at First and Jefferson Streets, Portland.

ELLWOOD CITY, PA.—As a result of the action taken in Council Ellwood will not have a municipal electric-light plant. The vote for a bond issue of $12,000 for repairing the old lighting plant was lost by a single ballot.

SEATTLE, WASH.—G. W. Wilson, of Seattle, has plans under way for a power plant to supply the towns of Bothell and Woodinville in the same state. He has filed a notice of appropriation of water from North Creek for power purposes. A.

PRESCOTT, ARIZ.—M. J. Hickey, Robert Brown and Henry T. Andrews have secured a franchise for an electric-light and power system at Prescott. The ordinance also permits of the building and operating of telephone and telegraph lines in the city. A.

GREEN BAY, WIS.—The Northern Hydro-electric Company of Green Bay will shortly let contracts for the construction of a dam and power house at High Falls on the Peshtigo River in Stephenson County, Mich. The company will develop 7,500 horsepower. C.

MOROCCO, IND.—The Morocco electric-light plant, formerly owned by W. J. Harpole and Company, has been sold to J. C. Carpenter, a prominent electric-light man. It is the purpose of the new owner to improve the plant and install modern machinery. S.

FORT WAYNE, IND.—The city has just taken possession of its municipal plant for street lighting and, finding it has surplus power, desires to sell it to private consumers at eight cents a kilowatt, whereas customers of the traction company pay a net rate of ten cents.

TONOPAH, NEV.—The Nevada-California Power Company, which recently completed three units of its plant near Tonopah, Nev., with a capacity of 23,000 horsepower, has completed preliminary surveys for its Manhattan and Round Mountain extensions as far as Central, twelve miles from Manhattan. From that point separate lines will be run to the two camps. A.

SAN FRANCISCO, CAL.—The Northern California Power Company, Consolidated, of San Francisco, recently organized, has given a deed of trust to the Union Trust Company of San Francisco, to secure a bonded indebtedness of $10,000,000. Most of the new bond issue will be used in taking up the floating and bonded indebtedness of the companies merged into the consolidated company. A.

SAN FRANCISCO, CAL.—The board of public works announces that it will award the contract for turbines and pumps for the proposed power stations of the auxiliary fire-protective system and for two fire boats to the Byron Jackson Iron Works, notwithstanding that the company's bid was about $7,000 higher than that of the D'Olier Engineering Company of Philadelphia. The contract will approximate $120,000. A.

ST. ANTHONY, IDA.—The St. Anthony Light and Power Company has begun the work of connecting its plant at that place with the plants at Teton City and Rexburg. Next spring the company will build a hydro-electric plant at its site on the Teton River for the supplying of the three lighting systems. The power plant will develop 3,000 horsepower and, with the necessary buildings, power lines and connections, will cost about $150,000. A.

PORT ORCHARD, WASH.—Members of a new power company are visiting Port Orchard, Bremerton, Charleston and other towns in Kitsap County with a project to light these towns with electricity. The promoters plan to utilize the power of the Dosewallup River on the west side of Hood Canal, equipping a plant costing $250,000. The members of the company made plans to apply for the right to furnish light and power to the navy yard at ten cents per kilowatt-hour.

BOSTON, MASS.—The Minneapolis General Electric Company has sold to Blodget, Merritt & Co. $1,100,000 first mortgage five-per-cent bonds, due December, 1934. The proceeds will be used for retirement of one-year six-per-cent notes, maturing December 16, 1908, and will fund floating indebtedness which represents costs of permanent additions to property during the past two years. This company controls all the electric lighting and commercial power business in Minneapolis.

EDUCATIONAL.

WORCESTER POLYTECHNIC INSTITUTE—The electrical engineering department of Worcester Polytechnic Institute, Worcester, Mass., is adequately described and illustrated in a handsome little pamphlet published by the Institute. The very complete electrical laboratory and electric test-car equipment make this institution one of the best equipped in the country. Prof. Harold B. Smith is at the head of the department.

PERSONAL MENTION.

MR. H. D. MURDOCK, who has been mechanical and electrical engineer of the Indianapolis & Louisville Traction Company for the past year, at Scottsburg, Ind., has been appointed superintendent of the company.

MR. HOWARD R. SHARKEY, who is well known to the electrical trade, has joined the forces of the Diamond Rubber Company of Akron, Ohio, and will handle its wire in the East, with headquarters at 1876 Broadway, New York city.

PROF. ERNEST RUTHERFORD, director of the physical laboratory of the University of Manchester, England, and PROF. GABRIEL LIPPMAN, of the University of Paris, have received the awards of the Nobel Prizes for chemistry and physics, respectively, in recognition of their distinguished work in scientific discoveries.

MR. FRANK J. SLOAT, general manager of the Ohio Traction Company, the largest interurban system in Ohio, has resigned to take up mining operations in California. Mr. Sloat has operated all the Schoepf syndicate's properties in southern Ohio for years, and was formerly president of the Ohio State Interurban Association. S.

MR. LOUIS A. FERGUSON, president of the American Institute of Electrical Engineers, and vice-president of the Commonwealth Edison Company of Chicago, was the speaker of the evening at the December dinner and meeting of the Electrical Engineering Society of the Massachusetts Institute of Technology, Boston, December 9. Mr. Ferguson is a graduate of the Tech class of 1888.

OBITUARY.

MRS. ELIZA McGUIRE HAASE, who died December 8, was the mother of Allen Lee Haase, the well-known representative of the Harvard Electric Company, Chicago.

MR. MYRON T. WILBUR, treasurer of the American District Telegraph Company and of the Western Union Telegraph Company, died on Tuesday, December 8, at his home in New York city, after an illness of ten days. Mr. Wilbur was sixty-two years of age and is survived by Mrs. Wilbur, his widow. He was in every respect a fine man, with a host of warm friends and close acquaintances, who with us will deeply deplore his passing.

NEW MANUFACTURING COMPANIES.

HORNELL, N. Y.—The A. J. Deer Company has been incorporated to manufacture motors, electric novelties, electric machinery, dynamos, etc. Capital, $120,000. Incorporators: A. J. Deer, Buffalo; F. Bartz, F. A. Wygant, Hornell.

ALBANY, N. Y.—The Butler Electric Clutch Company, of Yonkers, has been incorporated with a capital of $50,000. The directors for the first year are as follows: Wm. W. Butler, Martin E. Thew and Clarence Alexander, of Yonkers.

NORFOLK, VA.—The Virginia Auto-Electric Piano Company, of Norfolk, has been incorporated with D. E. Levy, president, and Moe Levy, secretary and treasurer. The capital stock is placed at $5,000 to $15,000, and the company will manufacture pianos.

ROCHESTER, N. Y.—The Iternational Telechronometer Company, Rochester, has been formed to execute electrical work of all kinds. Its capital is $500,000, and incorporators are George S. McMillan, James W. Lewis, Clarence W. McKay, Merton E. Lewis, Rochester, and Victor B. Deyber, Albany.

MINNEAPOLIS, MINN.—The Northern Electrical Company and the Electrical Engineering Company, both of Minneapolis, have been merged, James Richardson, president, and W. E. Stephenson, manager, of the former company, having bought G. W. Hayford's interest in the latter. The officers of the consolidated company are: Morgan Brooks, president; James Richardson, vice-president, and W. E. Stephenson, secretary and treasurer. The business will be continued at 21 Sixth Street. C.

PROPOSALS.

POSTOFFICE AT WARREN, OHIO—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until January 12 for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Postoffice at Warren, Ohio, in accordance with specifications, which may be had from the custodian of site at Warren, or at the office of the Supervising Architect.

STATE CAPITOL OF KENTUCKY—Sealed proposals will be received at the office of the Board of State Capitol Commissioners at Frankfort to January 5 for the manufacture and installation of the electric-light fixtures required in the new State Capitol Building, Frankfort. Plans and specifications for the work may be seen at the offices of the architects, Frank M. Andrews & Company, Cincinnati, Ohio, and Waldorf-Astoria, New York city. Bids must be addressed to Edward M. Drane, secretary Board of State Capitol Commissioners, and must be accompanied by certified check for at least five per cent of the amount of the bid.

ELECTRICAL SECURITIES.

Although the markets have continued irregular, increased activity has been the rule, and the general price movement has been upward. The average price of railroad shares made a new high level for the year and the industrial average also registered a good advance. Public buying was more active, and this is contrary to general expectations. For the first time since election there has been a genuine concession in quarters which were heretofore pessimistic regarding the increasing business revival. The declaration of the first dividend on its preferred stock by the Wisconsin Central, and the increase in the dividend rate of the Western Union, were minor factors in bringing about increased confidence in the financial community.

Dividends have been declared upon the following electrical securities: Reading Traction Company; regular quarterly dividend of seventy-five cents a share, payable January 1 to stock of record December 11. United Gas Improvement Company; regular quarterly dividend of two per cent, payable January 15 to stock of record December 31. Regular quarterly dividend of one-and-one-half per cent on the preferred stock of the Duluth Edison Electric Company, payable on the first day of January, 1909, to stockholders of record at the close of business on December 12. Manhattan Railway Company; regular quarterly dividend of one-and-three-fourths per cent, payable January 1. Union Traction Company, Philadelphia; semi-annual dividend of three per cent, placing the stock on a six per cent per annum basis. The stock has heretofore been on a five per cent per annum basis. The dividend is payable January 1 to stock of record December 10. Semi-annual dividend of $3 per share on the preferred stock of the Columbus Electric Company, payable January 1, 1909, to stock of record December 21, 1908. Canadian General Electric Company, Limited; regular quarterly dividend of one-and-three-fourths per cent on its common stock, payable January 1. Books closed December 14, reopen January 1. Central District and Printing Telegraph Company; regular quarterly dividend of two per cent, payable January 20 to stock of record January 23. Bangor Railway and Electric Company; quarterly dividend of one-and-one-fourth per cent, payable January 1 to holders of record December 20. El Paso Electric Railway; a dividend of three per cent on the preferred, payable January 11 to stock of record December 30. Halifax Electric Tramway; a dividend of one-and-one-half per cent, payable January 2. Lynchburg Traction and Light Company; one-and-one-half per cent, and an extra dividend of one per cent, payable December 15. Portland (Ore.) Railway, Light and Power Company; a dividend of one-and-one-fourth per cent, payable January 2. Sao Paulo Tramway, Light and Power Company; quarterly dividend of two-and-one-half per cent, payable January 2. Union Passenger Railway, Philadelphia; semi-annual dividend of $4.75, payable January 1. West Philadelphia Passenger Railway; semi-annual dividend of $5, payable January 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED DECEMBER 12.

New York:	Closing.
Allis-Chalmers common	16
Allis-Chalmers preferred	52⅜
Brooklyn Rapid Transit	58
American Telephone and Telegraph Company	128¾
General Electric	158¼
Interborough-Metropolitan common	17⅛
Interborough-Metropolitan preferred	41⅛
Kings County Electric	126
Mackay Companies (Postal Telegraph and Cable) common	74¼
Mackay Companies (Postal Telegraph and Cable) preferred	69
Manhattan Elevated	147
Metropolitan Street Railway	31¾
New York and New Jersey Telephone	114
Western Union	68
Westinghouse Manufacturing Company	88
Boston:	Closing.
Edison Electric Illuminating	240
Massachusetts Electric	58½
New England Telephone	127
Western Telephone and Telegraph pref	78
Philadelphia:	Closing.
Electric Company of America	10⅞
Electric Storage Battery common	44¾
Electric Storage Battery preferred	44¾
Philadelphia Electric	11¼
Philadelphia Rapid Transit	22½
United Gas Improvement	92¼
Chicago:	Closing.
Chicago Telephone	129½
Commonwealth Edison	104
Metropolitan Elevated preferred	48¾
National Carbon common	86
National Carbon preferred	113

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

HOLLIS, OKLA.—The Hollis Telephone Company has been incorporated with a capital stock of $20,000. P.

DALLAS, S. D.—The Tripp-Myer Telephone Company has been incorporated with a capital stock of $10,000.

WARSAW, IND.—The Commercial Telephone Company is in the market for material to construct a new circuit, six miles in length. The line is to be completed by January 15. S.

FARGO, N. D.—The agreement for exchanging local and long-distance service in North Dakota between the Independents and the Bell company has resulted in a revision of rates which amounts to an advance. C.

SHIRLEY, IND.—The Farmers' Mutual Telephone Company, of Shirley, has been sold with all rights, property and franchises, to H. N. Rhorer, of Greenfield, Mo. The new owner is an experienced telephone man and says that he will remodel, re-equip and extend the plant. S.

INDEPENDENCE, CAL.—The board of supervisors of Inyo County, California, is advertising for bids for a telephone franchise to connect the towns of Independence, Lone Pine, Keeler, Darwin, Ballarat and Skidoo with a telephone line. Bids will be received until January 5. A.

SAN FRANCISCO, CAL.—J. C. Rohlfs, manager at San Francisco for the marine department of the Standard Oil Company, has arranged to equip the company's steamers Atlas, Asuncion and Maverick and barge 91 with the United Wireless Telegraph Company's system of wireless telegraph apparatus. A.

SEATTLE, WASH.—The Pacific States Telephone and Telegraph Company, of San Francisco, is planning the expenditure of about $600,000 on its system at Seattle. The improvements include a new telephone exchange in the Beacon Hill district, the laying of permanent underground conduits and the placing of other equipment. A.

MINNEAPOLIS, MINN.—Toll coupons for long-distance service, which are sold at a discount, are held to be illegal as being discriminatory, under the state anti-pass law of Minnesota, according to an opinion by the attorney-general's department. The Tri-State Telephone Company refuses to accept the ruling and may not withdraw them without further investigation. C.

HONOLULU, H. I.—Clinton J. Hutchins, of San Francisco, who is manager of the Island Wireless Telegraph Company, of Honolulu, has placed a contract with the Automatic Electric Company, of Chicago, for automatic telephones and will put in a telephone system in Honolulu. The company already holds franchises under which the work can be done. An application has been made to increase the capital stock of the company from $150,000 to $1,000,000, and to change the name to the Hawaiian Telegraph and Telephone Company. The Honolulu system will be operated in connection with the company's inter-island wireless system. Mr. Hutchins' plans also include the building of a $50,000 central exchange and office building on a site recently purchased in Honolulu. A.

ENGINEERING SOCIETIES.

STEVENS ENGINEERING SOCIETY—The American Society of Mechanical Engineers has established its first student section by affiliating with itself the Stevens Engineering Society of Stevens Institute of Technology, Hoboken, N. J. It is believed that other student organizations will be similarly favored. Though these undergraduate associations will retain their personnel and autonomy, it is expected that both the allied societies as well as the American Society of Mechanical Engineers will benefit from this closer contact of the engineer and the engineer-student.

FT. WAYNE ELECTRO TECHNIC CLUB—One of the most profitable meetings of the Electro Technic Club of Ft. Wayne, Ind., organized from among the employes of the Ft. Wayne Electric Company, was held December 1. The principal address was made by Prof. J. W. Esterline of Purdue University on "The Commercial Testing of Raw Material." Professor Esterline confined his discussion of the subject particularly to materials entering into the manufacture of electrical apparatus and cited many instances of the necessity for tests he found in his work as consulting engineer for a umber of Indiana cities in the installation of electric-light and power plants. S.

DATES AHEAD.

American Roentgen-Ray Society. Annual meeting, New York city, December 28-30.

American Association for the Advancement of Science. Annual meeting, Baltimore, Md., December 28-January 2.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

American Association of Electric Motor Manufacturers. Next meeting, January, 1909.

LEGAL NOTES.

Conducted by J. L. Rosenberger, LL.D.

SUFFICIENT FULFILLMENT OF DUTY IN FURNISHING OF CONTROLLER—An electric passenger-carrier fulfills its duty, so far as the controller of an electric car is concerned, the Supreme Court of Minnesota holds, Jenkins vs. St. Paul City Railway Company, 117 Northwestern Reporter, 928, if the controller is shown to have been of standard character, made by a reputable manufacturer, in good condition, and to have been subjected to such inspection as is reasonable and practicable. The carrier is required to inspect with adequate care, but not to dismantle complicated machinery for purposes of inspection. In this case, the plaintiff, a man of at least ordinary intelligence, an instructed and experienced motorman, was injured while operating an electric car at a terminal where the cars turned round a loop. The car ran upon the curve of the loop at full speed and was derailed and capsized. The issue was whether a shock of electricity, passing through the plaintiff from his left hand, on the handle of the controller, and through his foot, resting upon a metallic part of the car, produced temporary paralysis, by reason of which he was deprived of control of his car. The court holds that the presumption of negligence conceded from the happening of the accident was rebutted by affirmative testimony, among other things, as to the safe use of the car for twenty days before and months after the occurrence of the accident, during which the car was shown to have been in the same condition as at the time of the accident, and by facts shown as to its purchase and inspection.

ELECTRIC LIGHT AND POWER COMPANY NOT LIABLE FOR INJURY TO BOY IN HOT-WATER WELL—In an open space adjoining an electric light and power station, and about sixty-two feet from the street, was an alleged defectively-covered hot-water well, into which a boy of thirteen fell. For the purpose of bringing himself within the class of cases decided by the courts imposing a higher degree of care upon persons having upon their premises structures or others things which are calculated to attract children, he said "the machinery, being constantly in motion, is calculated to attract and allure the boys, etc., to see the machinery." But the Supreme Court of North Carolina holds that it was error to overrule a demurrer to the complaint based upon the failure of the plaintiff to allege any facts showing that the company owed him any duty in relation to placing, using, or covering the wells upon its premises. The court says, among other things, Briscoe vs. Henderson Lighting and Power Company, 62 Southeastern Reporter, 600, that one may well use a portion of his private lot as an alley for domestic purposes, or a manufacturing establishment, or, as in this case, an electric-light plant, for uses connected with his or its business, without subjecting it to a public use. Of course, if, so used, its servants or others who are invited or entitled to pass over it are injured by pitfalls or obstructions placed there, the owner of the premises is liable. The present case illustrates the fallacy of the theory of implied invitation. Would it ever occur to any reasonable mind that constructing the building with large windows and doors, placing in it the engines, dynamos, and other machinery, and keeping them constantly in motion, for the purpose of discharging its corporate functions and duties, however attractive to small boys, was an invitation to them to make the premises a playground? To adopt the suggestion carries us too far afield for the practical affairs of life, and violates manifest truth. It must be conceded that the liability for injuries to children by reason of dangerous conditions on one's premises is recognized and enforced in cases in which no such liability accrues to adults. But, in the court's view, the defendant company did not owe any duty to the plaintiff to cover the well at all, as it was under no obligation to anticipate that he would come upon its premises. If, as the court holds, he was an unexpected trespasser, and not within the exception to the general rule, it was his duty to look out for danger, and not the duty of the defendant to provide against danger. If the municipal authorities deem the conditions described as dangerous to the public, they may require the owners to guard or fence the premises. In this way the conditions are met without imposing unreasonable burdens upon property owners.

ELECTRIC RAILWAYS.

(Special Correspondence.)

GREAT FALLS, MONT.—An electric line from Great Falls to Choteau is projected. C.

INDIANAPOLIS, IND.—The Indianapolis Traction and Terminal Company is in the market for about fifty new and modern street cars. S.

TOLEDO, O.—The annual meeting of the Toledo Railways and Light Company will be held in Toledo on January 21. Books close January 9 and reopen January 22.

CHICAGO, ILL.—The Chicago & Northwestern Railroad has contracted for sixty miles of electric-block signaling, to complete the equipment of its double track from Chicago to the Missouri River.

DUBUQUE, IOWA—The name of the Dubuque-Platteville interurban road of Dubuque has been changed to the Dubuque, Iowa & Wisconsin Railway, and it is authoritatively stated that the road will be built. C.

BOSTON, MASS.—The Connecticut Valley Street Railway has filed a petition with the Massachusetts secretary of state asking authority from the Legislature to issue bonds for refunding or paying current indebtedness.

SAN DIEGO, CAL.—The San Diego Electric Railway Company has taken preliminary steps to create a bonded indebtedness of $5,000,000, for the consolidation of existing debts and for betterments and extensions. A.

BILLINGS, MONT.—The business men of Billings have taken up the proposition to build an electric line to Laurel, Mont., and will attempt to secure $100,000 subscriptions to the stock of the Billings & Cook City Railway Company. C.

PHILADELPHIA, PA.—There have been listed on the Philadelphia Stock Exchange $6,966,000 first consolidated mortgage five-per-cent thirty-year bonds of the Fort Wayne & Wabash Valley Traction Company, due March 1, 1934.

NEW YORK, N. Y.—Within the next sixty days the New York Central Railroad Company will begin the work of electrifying the present two tracks of the Harlem division from Wakefield to White Plains, a distance of about twelve miles.

BROWNSTOWN, IND.—The county commissioners have ordered a special election to be held in Brownstown and Jackson townships, January 11, to vote upon the matter of a subsidy in aid of electric lines between Brownstown and Seymour, to connect at the latter place with the Indianapolis & Louisville traction line. S.

GOLDFIELD, NEV.—The Esmeraldo County commissioners have granted a franchise to George Wingfield, L. T. Merwin and Thomas F. Manning of Goldfield for an electric railway through the streets of Goldfield and Columbia; the lines will also be extended to Diamondfield, hauling both passengers and freight. Work must commence within sixty days.

OAKLAND, CAL.—Randall, Trowbridge and Company, of Oakland, Cal., have applied for a fifty-year franchise for an electric-railway system covering the principal streets of the town of Vallejo, on the north side of San Francisco Bay. The application declares that if the franchise is secured work will begin within one year and be finished within two years. A.

MAYSVILLE, IND.—A number of capitalists interested in the construction of an interurban line from Bryan, Ohio, to Fort Wayne, Ind., via Maysville, held a meeting December 8. Messrs. Tenniss and Doan, of Philadelphia, who are backing the project, were present and explained in detail the plans and aims of the company. Springfield Township has voted a $10,000 subsidy in aid of the construction of this road, the work to begin early in the spring. S.

TOLEDO, OHIO—It is expected that within a year an interurban railroad will be in operation between Columbus and Toledo. It is thought the construction will be resumed early in the spring on the middle section known as the Findlay-Marion Line. Findlay business men have agreed to take $100,000 worth of stock, and those of Mt. Blanchard will take $20,000, while another $100,000 has been subscribed by the merchants of Marion. The Findlay-Marion line will connect for Toledo with the Toledo Urban and Interurban at Findlay, and with the Columbus, Delaware & Marion traction line at Marion. H.

DWIGHT, ILL.—In order to meet trolley competition and to determine by a fair trial the results of the operation of a coach on a frequent schedule, the Chicago & Alton Railroad has determined to put in operation a motor-car passenger service between Alton and Dwight, a distance of fifty miles. If this experiment is satisfactory the service will be extended to other points. The equipment to be used is a Strang gas-electric motor car, a counterpart of the car which made the run from the Atlantic to the Pacific coast via Toledo, several years ago. The motor is the invention of W. B. Strang, who built the Detroit & Toledo Shore line. H.

CHICAGO, ILL.—Traffic of the three principal local elevated railroad companies in November shows only a slight change in the direction of improvement, which would indicate there has been some increase in general business of the city. Metropolitan's decrease in its daily average traffic was 10,074 passengers compared with a year ago. In the preceding month the road's decrease by similar comparison was nearly 14,000 passengers a day. South Side's November traffic shows a loss of 2,785 passengers a day compared with a year ago, while in October the decrease was more than 4,000. Northwestern maintains its gain over a year ago, due largely to the fact that the Evanston branch of the road was not in operation a year ago. The November increase, compared with last year, was 10,153 passengers a day; in October the gain was 9,204 passengers.

INDUSTRIAL ITEMS.

THE NERNST LAMP COMPANY, Pittsburg, Pa., shows a number of attractive illustrations of Nernst installations in the current number of *Lux*.

THE BUFFALO SPECIALTY COMPANY, Buffalo, N. Y., is offering an Elgin gold watch as a premium to those who order, on sixty days' time, a sixty-pound drum of electric belt dressing.

THE HILL CLUTCH COMPANY, Cleveland, Ohio, has published a supplemental catalogue describing and listing its friction-clutch pulleys and couplings, together with the necessary accessories and extra parts.

THE STANDARD ROLLER BEARING COMPANY, Philadelphia, Pa., under date of December 1, issues Catalogue 24, which is especially complete in listing the many types of ball and roller bearings manufactured by this company.

THE BABCOCK & WILCOX COMPANY, New York, has purchased from the Rust Boiler Company its patents and plant located at Midland, Pa., and will continue the manufacture at that point of the Rust water-tube boiler.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has arranged pamphlets containing useful and valuable instructions for the installation and operation of its Design E and Design L generators and motors. The instruction booklets are very completely illustrated.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., is distributing a new bulletin devoted to its three-wire generator. This generator has only one slip ring, and no auxiliary apparatus is necessary for its operation. Copies of this bulletin will be furnished to those interested upon request.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, Chicago, Ill., is making extensive improvements in its office and shelving. The business of this company is on the steady increase, and with its added facilities it will be better prepared than ever to make prompt and careful shipments of all orders.

THE MODEL GAS ENGINE WORKS, Peru, Ind., has an instruction pamphlet entitled, "How to Burn Less Coal," in which it is shown that two-thirds of the coal burned under a boiler is uselessly wasted. The use of gas engines is advocated. The Model Gas Engine Works manufacture gas engines and equipment for a number of purposes and operating on a variety of fuels.

THE YALE & TOWNE MANUFACTURING COMPANY, New York, makers of Yale locks, builders' hardware, chain blocks and electric hoists, has just issued its chain block catalogue, describing its line of chain hoists, both hand and electric, and also trolleys, trolley tracks, etc. This is a rather more expensive and carefully considered production than any of the company's previous books.

THE PETTINGELL-ANDREWS COMPANY, Pearl Street and Atlantic Avenue, Boston, Mass., is distributing a handsome booklet devoted to an exposition of its inexpensive and attractive reading lamps. This booklet should be of particular interest at this time in view of the possibility of selecting these goods for the holiday season. The typographical appearance of the booklet is worthy of extra mention, and the cover paper, which was imported from Italy for this production, adds greatly to the attractiveness of this little souvenir.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., manufacturer of New Process pinions and cut gears, is constructing a considerable addition to its present plant. The company is now working its factory nights to meet orders with its present plant and force. The new addition, which is under construction, will consist of two stories and a basement, sixty feet by eighty feet, adjoining the present plant. The building is to be of steel and brick with cement floors and will increase the available floor space by over 13,000 square feet. The cost complete will be about $30,000. The company has machinery on order for delivery during the next two months approximating $12,000. This comprises principally automatic turret lathes, bevel gear planers and grinding machines An additional hardening furnace for treating automobile transmission gears and drive gears will also be installed. The company reports the total of the orders at present on its books to be in excess of any time in its history.

THE NATIONAL METAL MOLDING COMPANY, Pittsburg, Pa., has met the increasing demand for a metal molding, neat in construction and easy to install, with the production of National metal molding. This molding consists of two pieces, a base and capping. The base is furnished with countersunk holes to accommodate screws or bolts to fasten same securely to walls or ceilings. After the base and base fittings are installed and the wires laid in, the capping is "snapped on." Various fittings are supplied. National metal molding, attachments and tools are explained in full in a booklet just issued by the National company.

DOSSERT & COMPANY, 242 West Forty-first Street, New York city, announce that they have received an order from the Chicago City Railway Company for seventy-five special solderless two-way connectors for 1,000,000-circular-mil cable, and also an order for a large quantity of strain clamps for 750,000-circular-mil cable and solderless two-way connectors for 1,500,000-circular-mil cable from Goliatly & Company, Pittsburg, Pa. They have also received orders from the United Electric Light and Power Company of New York city for a large number of standard and special solderless connectors for use in its One-Hundred-and-Forty-sixth Street substation.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, O., manufacturer of Triumph electric light and power machinery, announces the following sales recently made: Greenpoint Metallic Bed Company, Greenpoint, L. I., one 200-kilowatt generator and twenty motors, ranging from ten to thirty horsepower and aggregating 400 horsepower; Rapid Motor Vehicle Company, Pontiac, Mich., one 100-kilowatt engine-type generator; Lake Erie Provision Company, Cleveland, O., one fifty-kilowatt engine-type generator and one seventy-five-kilowatt engine-type generator; Lamb-Fish Lumber Company, Charleston, Miss., one 125-kilowatt engine-type generator; Rehbun Last Company, Cincinnati, O., one 100-kilowatt engine-type generator; Robert Mitchell Furniture Company, Cincinnati, O., one seventy-five-kilowatt engine-type generator.

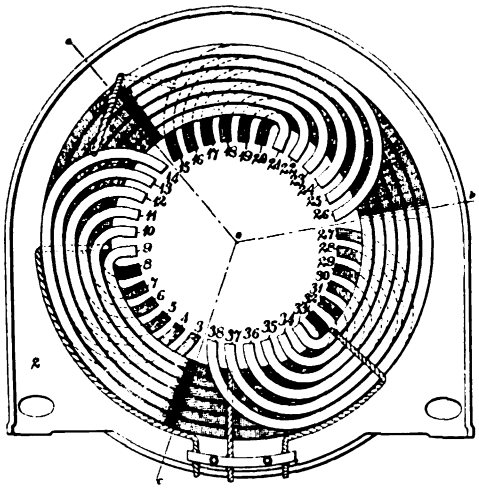
RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) December 8, 1908.

905,827. INGOT-STRIPPER. Henry Aiken, Pittsburg, Pa. Filed September 18, 1905. Has a movable crane carriage, a cylinder and a plunger suspended therefrom and a pump and an auxiliary electric motor mounted thereon.

905,837. ELECTROLYTE. Edward C. Broadwell, Chicago, Ill., assignor to J. W. Meaker, Jr., Chicago, Ill. Filed August 20, 1906. Contains zinc sulphate and zinc naphthalene disulphonate.

905,848. ELECTRIC-MOTOR-CONTROL SYSTEM. William Cooper, Wilkinsburg, and Olof A. Sandborgh, Swissvile, Pa., assignors to Westinghouse Electric and Manufacturing Company. Filed January 3, 1906. In combination with a number of dissimilar electrically-operated car-motor-control systems are means for effecting their concurrent operation.



905,900.—ARRANGEMENT OF END CONNECTORS OF A STATOR WINDING.

905,854. TESTING SYSTEM FOR TELEPHONE LINES. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed June 29, 1903. The connection of a high-resistance testing device with each cord circuit is controlled through contacts of the listening key and supervisory relay.

905,868. COIL SUPPORT FOR DYNAMO-ELECTRIC MACHINES. Israel L. Griffith, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed June 28, 1905. A supporting bracket has a number of divergent arms to engage insulating strips.

905,874. AIR-COOLING DEVICE. George W. Haverstick, St. Louis, Mo. Filed November 29, 1907. Electric fans are placed adjacent the opposite ends of a casing containing troughs arranged horizontally and means for throwing a spray of water into the troughs.

905,875. CAR-TESTING DEVICE. Albert B. Herrick, Ridgewood, N. J. Filed May 31, 1905. An electrical testing device contains instruments for measuring the resistance of a circuit and for measuring its insulation.

905,889. COIL-SUPPORT FOR DYNAMO-ELECTRIC MACHINERY. Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed June 28, 1905. Relates to further details for the device covered by No. 905,868.

905,900. WINDING FOR DYNAMO-ELECTRIC MACHINES. George R. Maxwell, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed June 16, 1905. Renewed April 10, 1908. A number of groups of coils are provided with similar groups of end connectors, the main portions of which are located in parallel planes and overlap each other.

905,905. ELECTRIC CUT-OUT AND HOLDER. Thomas E. Murray, New York, N. Y. Filed March 13, 1908. The holder has two recesses, circuit terminals disposed therein and a cut-out in loop form having its ends constructed to enter the recesses.

905,907. TRANSMITTER BRACKET. Ernest S. McLarn, New York, N. Y., assignor to Western Electric Company, Chicago, Ill. Filed June 10, 1908. The bracket consists of sheet metal provided with bosses, between which the transmitter arm is supported and pivoted.

905,922. ELECTRICAL APPARATUS. Karl C. Randall, Edgewood Park, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed April 5, 1907. A transformer, a circuit interrupter and a protective device are mounted in an oil tank.

905,930. TWO-PHASE ALTERNATING-CURRENT DISTRIBUTION. Herbert S. Russell, Hanwell, and Frederick E. Berry, West Drayton, England. Filed May 6, 1907. A booster transformer has its boosted winding in the common return and its two primary windings connected respectively between the separate phase conductors and the common return.

905,933. ELECTRIC-CIRCUIT MAKING AND BREAKING DEVICE. John Ryan, Columbus, O. Filed June 8, 1907. A rotative shaft carries a number of metallic segments over which ride a number of pivoted metallic arms.

905,934. ELECTRICITY METER. Gustave A. Scheeffer, Indianapolis, Ind. Filed January 15, 1907. An armature formed of three coils is locked and manually interlocked on the armature spindle.

905,935. SPARKER DEVICE. Erich Schietzel, Wilkesbarre, Pa. Filed January 8, 1908. A set of three contacts is carried by a plunger normally engaged by a core of the electromagnet.

905,940. HIGH-TENSION INSULATOR. Guido Semenza, Milan, Italy. Filed February 5, 1906. The top section has a wide, flat rim, below which is another rim and between them an intermediate socket and spigot distance piece.

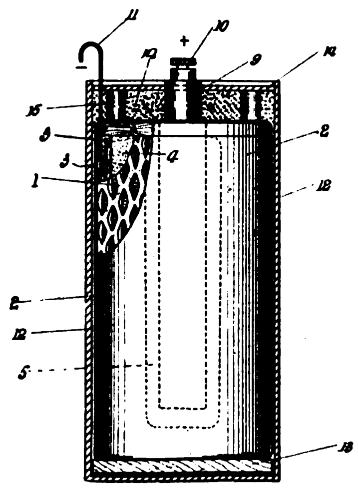
905,952. GALVANIC CELL. Joseph T. Szek, London, England. Filed September 23, 1907. A dry battery contains an expanded sheet-zinc electrode in electrical contact with the casing.

905,964. ELECTRIC-MOTOR SUSPENSION. John E. Webster, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed April 12, 1907. A single-phase car motor is mounted on a coiled spring suspension with a quill enclosing the axle of the truck.

905,966. PROCESS AND APPARATUS FOR TESTING WATTMETERS. Edgar M. Wilkins, Mexico, Mexico. Filed August 12, 1907. Involves a method of arranging a photographic shutter for observing the spot on the disc at predetermined intervals.

905,969. ELECTRIC TERMINAL POST. Asbury G. Wilson, Wilkinsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed October 10, 1907. A pair of spring jaws partially encloses a cylindrical carbon contact.

905,971. SYSTEM FOR ELECTRICAL DISTRIBUTION. Joseph L. Woodbridge, Philadelphia, Pa. Filed November 13, 1907. Associated with a rotary converter is an alternator connected between it and the alternating-current source and developing an electromotive force at right angles to that of the converter.



905,952.—DRY BATTERY.

905,976. TROLLEY-WIRE HANGER. William S. Arnold, Lorain, Ohio. Filed June 18, 1908. The supporting member has a socket portion and hooks adapted to receive a spanner.

905,995. ALTERNATING-CURRENT MOTOR. Ernst Danielson, Stöpsjön, Fogdhyttan, Sweden, assignor to General Electric Company. Filed June 24, 1907. A motor for three-phase operation has a winding connected with two equal phases and a transformer adapted for T-connection with the two phases to produce a balanced three-phase voltage.

905,998. ELECTRIC OUTLET BOX. Conrad J. Dorff, Chicago, Ill., assignor to Frederic Greer, Chicago, Ill. Filed June 22, 1907. Has an opening in which lies a plug, portions of which are bent to overlie the edges of the opening.

906,003. INSULATOR PIN. Charles G. Ette, St. Louis, Mo., assignor to Ette Investment Company, St. Louis, Mo. Filed January 15, 1908. A metallic pin is provided with a screw-threaded head having a longitudinal slot containing a piece of yielding material.

906,011. PRECIPITATING APPARATUS. John E. Greenawalt, Denver, Colo. Filed April 3, 1905. In a series of cells a mass of metal shavings is supported by a perforated false bottom forming the cathode, the anode being suspended on the top in a porous jar.

906,012. RAILWAY SWITCH AND SIGNAL APPARATUS. Lawrence Griffith, Yonkers, N. Y., assignor to Federal Signal Company. Filed September 20, 1905. In an electric apparatus for operating switches and signals there are a number of electrically-governed motion plates and a controlling device therefor.

906,021. CAR FOR BONDING RAILS. Albert B. Herrick, Cleveland, O., assignor to the Electric Railway Improvement Company, Cleveland, O. Filed March 25, 1905. A part of the floor can be lowered to near the rails and carries means for making electrical contact with them.

906,026. DISTRIBUTING-ARM FOR HIGH-TENSION MAGNETOS. Theodore Hubert, New York, N. Y., assignor to Charles F. Splitdorf, New York, N. Y. Filed October 17, 1907. Comprises a block of fibre, an enclosing tube and a post and contact secured to the block.

906,038. TROLLEY-CONTACT. Andrew R. K. Lauder, Schenectady, N. Y., assignor to General Electric Company. Filed March 27, 1908. A long, flat strip of conducting material is supported directly above, but separated from the trolley wire so as to be engaged by the rims of the wheel flanges.

906,055 and 906,056. AXLE-LIGHTING SYSTEM. Alexander McGary, La Grange, Ill., assignor of one-fifth to Charles Gilbert Hawley, Chicago, Ill. Filed August 11, 1905, and October 22, 1906. The generator has two armature windings, one for supplying the light circuit and the other for charging the storage battery.

906,071. MEANS FOR RECORDING METER READINGS. Samuel C. Shaffner, Chicago, Ill. Filed January 7, 1908. A lens and shutter are arranged to admit light on a photographic film when a lever is depressed.

906,081. APPARATUS FOR THE PRODUCTION OF OZONE. Jan Steynis, New York, N. Y. Filed January 24, 1908. There are means for producing the expansion of liquefied gas within hollow electrodes for absorbing the total heat developed by the stream discharges.

906,100. INDICATOR. Edward J. Burke, New York, N. Y. Filed August 1, 1906. Combined with a number of jacks is a normally rotating shaft carrying an indicator normally connected to it and means for disconnecting this when the pointer is directed toward a particular jack.

906,102. ART OF PRODUCING PIGMENTS BY ELECTROLYSIS. Edwin D. Chaplin, Boston, Mass., assignor to International Lead Companies. Filed February 3, 1906. The process of producing white lead consists in electrolytically separating an electrolyte into a solvent of lead and an alkaline hydrate.

906,103. ART OF PRODUCING LEAD SALTS BY ELECTROLYSIS. Edwin D. Chaplin, Boston, Mass., assignor to International Lead Companies. Filed February 3, 1906. Consists in electrolytically forming from ore or bullion as an anode a solution containing soluble salts of lead.

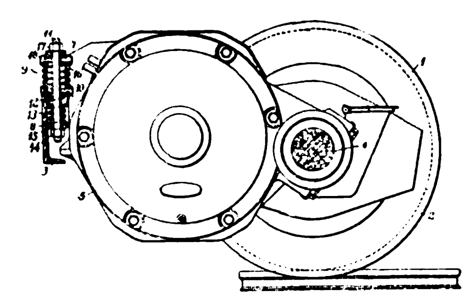
906,104. ELECTROLYTIC APPARATUS. Edwin D. Chaplin, Boston, Mass., assignor to International Lead Companies. Filed February 3, 1906. The apparatus used in the two preceding processes is described.

906,129. ELECTRIC APPARATUS FOR RAILWAY SWITCHES, SIGNALS AND THE LIKE. Lawrence Griffith, Yonkers, N. Y., assignor to Federal Signal Company. Filed April 8, 1903. This is a modification of No. 906,012.

906,160. MACHINE FOR CUTTING OUT MICA BETWEEN SEGMENTS IN COMMUTATORS. Otto F. Reinen, Los Angeles, Cal. Filed September 30, 1907. A cutter is mounted on a bracket so as to move reciprocally in a straight line.

906,161. TROLLEY DEVICE. Frank A. Robbins, Worcester, Mass. Filed November 11, 1907. The trolley harp extends normally at right angles to a trolley wire.

906,166. CAR SIGNAL. William H. Schweizer, Baltimore, Md. Filed October 8, 1907. Depression of a pedal on the platform closes the circuit of a signal over the other platform.



905,964.—ELECTRIC CAR MOTOR SUSPENSION.

906,172. PROCESS OF SMELTING ALUMINUM ORES. Frank J. Tone, Niagara Falls, N. Y., assignor to the Carborundum Company, Niagara Falls, N. Y. Filed September 14, 1907. Consists in making a mixture of aluminum silicate, carbon and a base metalliferous material and subjecting this to electrically-developed heat.

906,173. METHOD OF TREATING ALUMINUM SILICATE. Frank J. Tone, Niagara Falls, N. Y., assignor to the Carborundum Company, Niagara Falls, N. Y. Filed March 17, 1908. This is a modification of the above.

906,211. REGULATION OF THE PERIOD OR INDUCTANCE OF HIGH-FREQUENCY CIRCUITS. Gustave Ferrié, Paris, France. Filed May 8, 1907. The apparatus comprises an annular hollow conductor having a transverse gap, a conductor within this and means for regulating the resistance of the arrangement.

906,238. RAILWAY SIGNAL. Matthew M. Kane, Montgomery, Ala., assignor of one-half to William J. Gardner, Montgomery, Ala. Filed November 2, 1907. An electromagnet controls an armature lever which normally holds a set of signal wings in their "safe" position.

906,274. ELECTRIC INDICATOR. Carl von Peez, Vienna, Austria-Hungary. Filed October 4, 1907. A rotatable indication-carrier has a series of alternately and oppositely positioned teeth engaged by an armature lever under the control of an electromagnet.

906,279. TROLLEY CUT-OUT. Charles C. Phillips, Owensboro, Ky., assignor to the Phillips Automatic Signal Company, Owensboro, Ky. Filed May 9, 1907. A hanger has an arch-shaped member to the ends of which tiltable sections of the working conductor are pivoted.

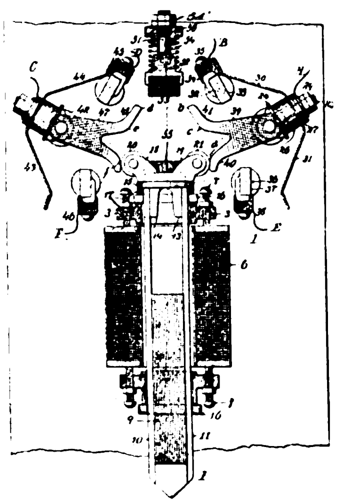
906,286. ELECTRIC-LIGHT-CORD TAKE-UP. Abraham W. Pratt, Eureka, Cal. Filed February 15, 1908. A supporting frame carries a spring-actuated reel.

906,290. SPARK-ADJUSTING STARTING MEANS FOR AUTOMOBILES. Andrew L. Riker, Short Hills, N. J., assignor to the Locomobile Company of America, New York, N. Y. Filed November 4, 1902. A governor changes the relative angular position of a rotary contact and brushes.

906,296. INSULATOR. Charles Rosenberg and Vernon T. Bailey, New York, N. Y. Filed March 18, 1908. A base of insulating material has posts at opposite sides and a socket centrally projecting from it.

906,317. ALTERNATING-CURRENT SWITCH. Frank W. Smith and Louis Larsen, New York, N. Y. Filed May 25, 1907. Combined with an electromagnet is an iron enclosing frame and a longitudinally movable core and means for maintaining equal air gas on the opposite sides of the core.

906,331. ELECTROMAGNETIC VALVE-OPERATING MECHANISM. Jacob B. Struble and Elmer R. Coe, Wilkinsburg, Pa., assignors to the Union Switch and Signal Company, Swissvale, Pa. Filed November 7, 1907. The electromagnet comprises a plunger actuated by a solenoid, a member extending through the plunger, links connected to the plunger and a yoke connected to the links and to this member.



906,317.—ALTERNATING-CURRENT SWITCH.

906,338. PROCESS OF PRODUCING SILICON. Frank J. Tone, Niagara Falls, N. Y., assignor to the Carborundum Company, Niagara Falls, N. Y. Filed September 14, 1907. A method of reducing aluminum silicate consists of forming a mixture of it and carbon and subjecting this to electrically-developed heat sufficient to reduce the silicon and to fuse the alumina.

906,357. THERMOSTAT. Alfred T. Ziegler, Allegheny, Pa. Filed September 24, 1907. There is an electrically-actuated valve in the gas-supply pipe, and electrical connections between the thermostat and the valve.

906,361. ELECTRIC SWITCH. Boyd W. Allen, Boston, Mass. Filed April 6, 1908. Comprises a rotative barrel provided with a number of teeth at different portions of its circumference, a guard and series of switches mounted thereon.

906,370. CONNECTOR FOR ELECTRICAL CONDUCTORS. Charles W. Beck, Rockville Center, N. Y. Filed March 12, 1908. Has two members pivotally connected together and provided with recesses to receive the binding post.

906,386. ROTARY SNAP-SWITCH. Charles A. Clark, Hartford, Conn., assignor to Trumbull Electric Manufacturing Company, Plainville, Conn. Filed October 24, 1907. A special construction is described.

906,405. MEANS FOR ELECTRICAL TRANSMISSION OF DESIGNS, FIGURES AND PHOTOGRAPHS. Guillermo J. de Guillén Garcia, Barcelona, Spain. Filed February 28, 1908. There are provided revolving transmitting and receiving cylinders, a plate of non-conductive material on the latter in contact with a brush in the circuit of the transmitting cylinder.

906,408. TOOL FOR ELECTRIC LAMP SOCKETS. Gilbert W. Goodridge, Bridgeport, Conn., assignor to the Bryant Electric Company, Bridgeport, Conn. Filed May 28, 1908. Has a handle and a circular head externally corrugated to fit within the corrugated flange of a socket cap.

906,411. GUARD FOR INCANDESCENT ELECTRIC LAMPS. William H. Greenwood, Everett, Mass. Filed November 7, 1907. A wire-work cage is secured to the socket by a divided cover, each part of which is pivoted to the top of the cage.

906,448. TERMINAL FOR ELECTRIC WIRES. Bernard Morgan, Newport, R. I. Filed February 6, 1908. A terminal tip is formed of sheet metal and has two wing portions adapted to grip the conductor and two spring clamp portions to engage a binding post.

906,468. PROCESS FOR THE PRODUCTION OF OZONE. Jan Steynis, New York, N. Y. Original application filed January 24, 1908. Divided and this application filed September 3, 1908. This is a modification of No. 906,081.

906,492. SAFETY DEVICE FOR RAILWAY SWITCH AND SIGNAL APPARATUS. Lawrence Griffith, Yonkers, N. Y., assignor to Federal Signal Company. Original application filed November 5, 1904. Divided and this application filed February 20, 1906. This is a modification of Nos. 906,012 and 906,192.

906,498. SHUNT OR ELECTRICAL RESISTANCE. Edward Weston, Newark, N. J. Filed March 15, 1907. A special form of ammeter shunt is described.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired December 15, 1908:

464,959. TELEPHONE. C. Cuttriss, New York, N. Y.

464,979. ELECTRIC SIGNALING APPARATUS. G. E. Miller, Lynn, Mass.

464,986. ELECTRIC CONDUCTOR. W. E. Cehrle, Philadelphia, Pa.

465,034. ELECTRIC CAR BRAKE. E. Verstraete, St. Louis, Mo.

465,078. METHOD OF CONTROLLING ALTERNATING-CURRENT INDUCTION. E. Thomson, Lynn, Mass.

465,089. RIVETING BY ELECTRICITY. E. E. Ries, Baltimore, Md.

465,104. DYNAMO-ELECTRIC MACHINE. W. P. Wiemann, Allegheny, Pa.

465,202. COUPLING FOR ELECTRIC CONDUCTORS. W. C. Preston, Providence, R. I.

465,206. PACKET OR PAD FOR ELECTRIC BATTERIES. L. H. Rogers, Brookline, Mass.

465,218. ADJUSTABLE RHEOSTAT. F. J. Sprague and C. R. Pratt, New York, N. Y.

465,233. COMMUTATOR CONNECTION FOR DYNAMO-ELECTRIC MACHINES. C. O. C. Billberg, Philadelphia, Pa.

465,234. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES OR MOTORS. C. O. C. Billberg, Philadelphia, Pa.

465,278. ELECTRICAL SEWER-GAS INDICATOR. J. J. Lawler, Scranton, Pa.

465,292. ELECTRIC MOTOR SWITCH. E. W. Rice, Jr., Lynn, Mass.

465,359. CONVERTER SYSTEM FOR ELECTRIC RAILWAYS. M. W. Dewey, Syracuse, N. Y.

465,360 and 465,361. ELECTRIC FAN. P. Diehl, Elizabeth, N. J.

465,365. BRACKET FOR SUPPORTING ELECTRIC CONDUCTORS. J. A. Duggan, Quincy, Mass.

465,369. PRODUCTION OF INSULATING COATINGS OR LININGS IN ELECTROLYTIC APPARATUS. L. Grabau, Hanover, Germany.

465,404. SWITCH-ACTUATING MECHANISM FOR ELECTRIC MOTORS. C. G. Armstrong, Chicago, Ill.

465,407. ELECTRIC RAILWAY. G. F. Green, Kalamazoo, Mich.

465,423. ELECTRIC HEATER. W. H. Boles, Syracuse, N. Y.

465,426. ELECTRIC SWITCH AND CASE FOR THE SAME. C. P. Chappell, Providence, R. I.

465,430. ELECTRIC CONNECTOR. W. F. Z. Desant, New York, N. Y.

465,432. ELECTRIC RAILWAY. G. F. Green, Kalamazoo, Mich.

ELECTRICAL REVIEW AND WESTERN ELECTRICIAN

VOL. LIII, No. 26. CHICAGO, SATURDAY, DECEMBER 26, 1908. THREE DOLLARS A YEAR Single Copies Ten Cents.

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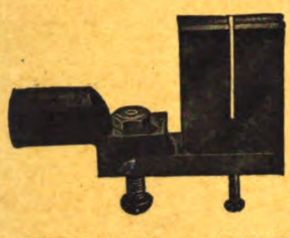

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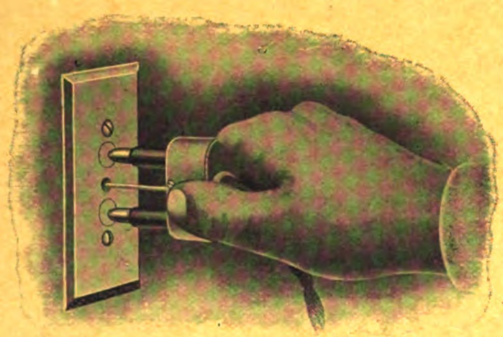

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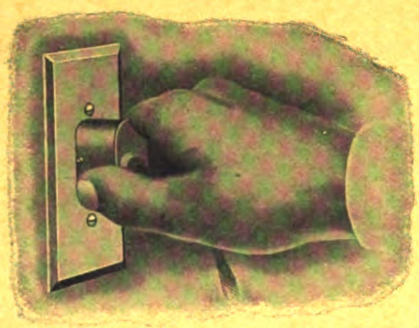

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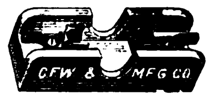

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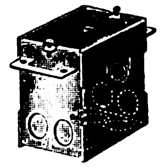

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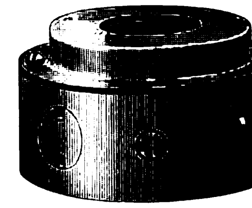

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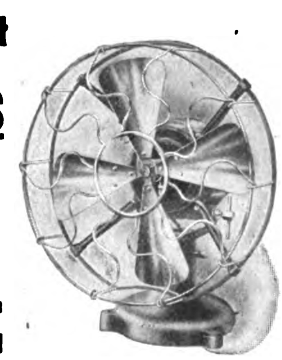

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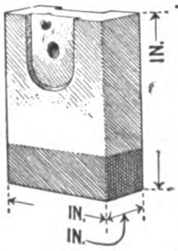

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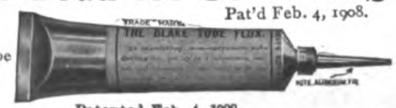

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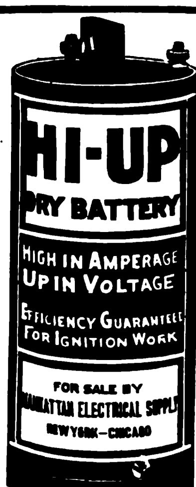

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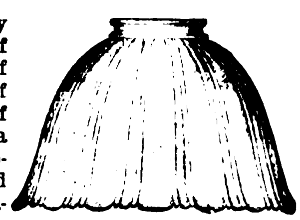
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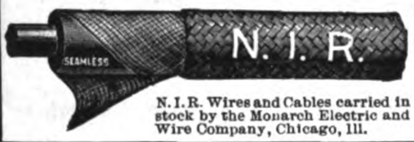

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is unequaled for underground conduit work.

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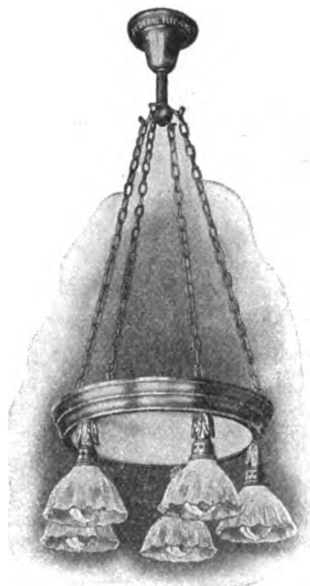

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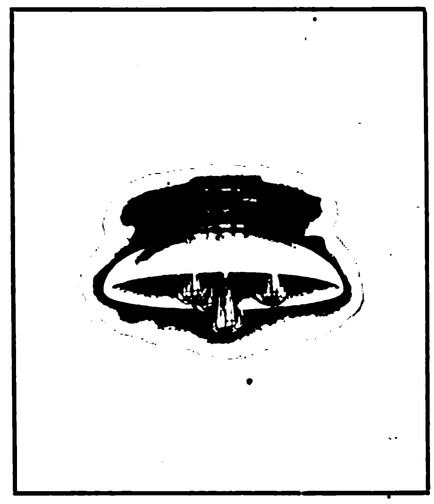
For fine interiors, halls, stores, cafes, etc. Four sizes with diameters 15, 20, 25 and 30 inches. Available with from 3 to 10 lights. This cluster without chain or stem is especially effective for low ceilings.



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Perfect in Design.
3,000 C. P., 550 Watts.
17 Hours' Life.

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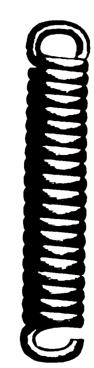

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Type A transformers are the tried and proved kind. They meet the requirements.

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696

The Type K Meter

Type K Single-phase Meter

stands for all that is good in an integrating wattmeter. Thousands of users stand for the type K meter because its good shows in service.

The design is right—it is proved by years of good service, but it is better today than ever because we improve the details to meet new conditions.

The type K meter is always ready for all conditions.

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True in more ways than one.

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See our Exhibit at the Electrical Show, Chicago, January 16 to 30, 1909

755

How many of your lighting customers are using a G. E. Coffee Percolator?

This percolator if used for only ten minutes, once a day, is equivalent to one lamp-hour (16 c. p.).

If you have 1,000 customers, each one using a G. E. Percolator ten minutes each morning, it means exactly the same to you as if they were using 1,000 16 c. p. lamps, burning from 7 to 8 A. M.

Each percolator placed on trial in a residence invariably means a sale. It increases your light load because it is used at least once a day, if not two or three times a day.

This new percolator is one of the best current-using household devices ever placed in the hands of Central Station Solicitors

1½ pints, 4 cups of coffee, 400 watts
3 pints, 8 cups of coffee, 500 watts
4 pints, 11 cups of coffee, 500 watts

Standard finish nickel
Special finishes to order

The Quick-Acting Pump

Sprays hot water on the coffee one minute after applying electric heat to cold water.

Handsome Appearance

The fine nickel finish harmonizes with other table furnishings and the percolator is not out of place in the most luxurious surroundings.

The Popular Price of this Percolator

Makes it appeal to all users of electric light.

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The Switches with the Simple Three-Piece Mechanism.

Descriptive Booklet and Price List on Application

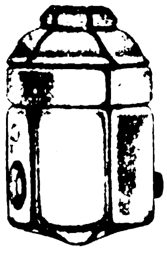
"Revolutionary in its nature."—*Electrical Review.*

"One of the most compact and ingeniously arranged circuit switches that has been produced."—*Electrical World.*

IT may be safely said that the mechanism of the new line of Cutler-Hammer Push-Button Specialties has evoked more enthusiastic commendations from the electrical trade than were ever before called forth by an improvement in switch mechanisms. It is, in fact, the first radical innovation that has been made in years. All other switches are more or less alike in principle and consist of from 30 to 40 separate parts, but here—at last—is something new in principle and so simple in construction that those who have examined it are inclined to believe not only that a great step in advance has been taken, but that the acme of simplicity in switch construction has been reached.

* * *

Imagine a switch mechanism that consists of only *three* moving parts—a mechanism that is snappy and positive in operation and absolutely new in principle. If you can't imagine it ask us to mail our "silent salesman"—a little working model of this new switch mechanism.

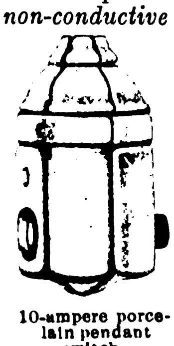


6-ampere porcelain pendant switch.

* * *

Bear in mind that in addition to the simple mechanism these switches and sockets possess a number of other advantages:

For one thing, they are made of porcelain—a *non-corrosive* and *non-conductive* material. This means that they will not tarnish like ordinary metal switches and sockets, nor is the user subjected to the risk of accidental shock while handling them, since all current-carrying parts are effectually insulated by the outer covering of porcelain.



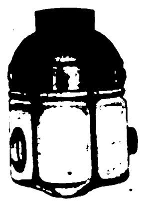
10-ampere porcelain pendant switch.

* * *

All of these devices are *self-indicating,* the position of the button showing whether the circuit is opened or closed.

Liberal space is provided for knotting the flexible cord and the removal of a single screw gives access to the interior of the switch, facilitating the wiring of these devices.

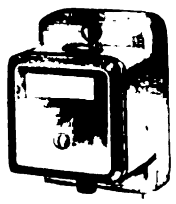
The fire glaze used on the porcelain is practically indestructible, while the choice of colors afforded is such that one can select a shade that will harmonize with almost any surroundings. The standard glazes are *Plain White, Ivory Tint, Wood Brown* and *Neutral Gray.* Special glazes can be furnished to order.



Brass cap pendant switch.

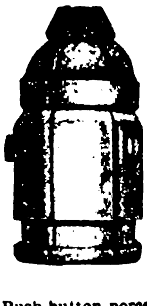
* * *

Two features of the molding switch are worthy of special mention. These switches are made *exactly the same width as standard molding* and are provided with caps designed to hold a small label. Their size makes it possible to install a number of these switches side by side without leaving space between the lines of molding, while their shape permits the capping to be cut off square instead of having to be whittled out to fit the switch, as in the case of round base switches. When assembled in gangs the label holder provides a place for a word or number indicating the circuit controlled by each switch. For use singly, molding and surface switches without label holders can be furnished.



Push-button molding switch with label holder.

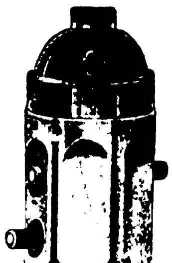
In the case of the lamp socket the substitution of the Push-Button Mechanism for the old-fashioned key commonly used results in a device that is not only more symmetrical in appearance, but which is admirably adapted for use with Tungsten or other lamps possessing a delicate, fragile filament, since the Push-Button Mechanism operates without tilting the lamp out of its normal vertical position or subjecting the filament to sudden jars. This socket has the same working parts as our 6-ampere switches, and therefore opens and closes the circuit with a much quicker and more positive snap than any other socket besides having a much larger current-carrying and breaking capacity.



Push-button porcelain pendant socket.

* * *

In conclusion, particular attention is called to the *two-circuit* pendant switch—the only switch of its kind on the market. A single one of these switches may be used to control two separate circuits in any of the standard clusters, or to control two separate groups of lights, or the switch may be so connected that one push-button controls the lights and the other button some other electrical device—such, for instance, as a fan. Many other applications of this two-circuit switch will readily occur to those familiar with electrical installations.



Two-circuit pendant switch. Porcelain body, brass cap.

* * *

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(2)

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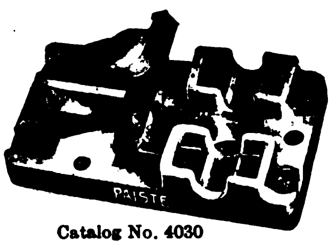

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Electrical Testing Laboratories 80th Street and East End Ave. NEW YORK

ELECTRICAL REVIEW
AND
WESTERN ELECTRICIAN

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CONTENTS.

CONTROL OF WATERPOWER.

A hydroelectric company often finds it of great advantage to control long stretches and many falls on the same river, and all of the power streams in the area served, for both technical and business reasons.

Where a number of waterpowers are developed at separate plants on the same river, each with more or less storage area behind it, the stored water in all of the ponds above a given plant can be made available there by a suitable division of the total load between all of these plants, if they are under a single control.

On a given river, the best reservoir sites are apt to be in long, deep valleys, or in lakes, near the headwaters, and unless at least a large part of the power of the stream is under a common control, it is hard to get effective co-operation for the construction of reservoirs that will benefit all alike, as some hope to obtain the benefit without the expense.

The areas covered by some of the large hydroelectric systems are so great that the power streams crossing them have their sources far apart, in different mountains or lakes, and thus present a variety of conditions, as to periods of maximum and minimum flow, and as to facilities for storage. By the control of waterpowers on several rivers that differ in such respects, it is often practicable to match the low discharge in one with a much higher discharge in another.

Another advantage in the common control of several power streams arises where one has large storage capacity, while there is little or no storage on the others. In a case of this sort, the stored water of one river may be held back for use in one or more dry months, while the other rivers generate most of the energy during the months of ample water. To realize the above advantages it is, of course, necessary that all of the hydroelectric stations be connected to the same transmission system, as is now the common practice.

Coming to the business reasons for a single control of all the large waterpowers that may be devoted to electrical supply in the service area of a hydroelectric system, it is well known that competition between such systems tends to produce rates that are much less than reasonable, and to the financial destruction of the weaker.

With government control of rates the reasons commonly given for competition no longer exist, and both the hydroelectric companies and the public will be benefited by such a combination of waterpowers as will yield the largest amount of service.

Many of the hydroelectric companies have not been slow to see the advantages to be derived from the control of all the waterpowers within their reach, on the same river and on different rivers. As a result, some of these companies own scores of miles of undeveloped rivers with hundreds and even thousands of feet of fall, besides enough developed waterpower to supply present needs.

Thus, one of the hydroelectric systems in Southern California, with seven developed waterpowers on four rivers, includes also about one hundred miles of the Kern River with a total fall of more than 4,000 feet and an estimated capacity of more than 77,000 horsepower. Northern California contains a hydroelectric system that includes no less than six waterpower plants with scores of miles and several thousand feet of fall along four rivers.

Waterpowers on the Hudson, Sacandagua and Schoharie rivers are united in one electric system, and have drainage areas more than one hundred miles apart, in the Catskill and the Adirondack mountains. One electric company owns water rights on the French Broad and Catawba rivers that are estimated to yield 150,000 horsepower, though less than one-half of this capacity has thus far been developed.

In Montana, the waterpowers along nearly fifty miles of the Missouri River, where the fall is 200 feet, have been developed for the three plants of a single electric system. A similar development is to be found on the Spokane River, which falls about 250 feet along the forty miles ending at Spokane, and this forty miles is controlled by an electric company that has thus far developed about one-half of this total fall. On the Muskegon River, the holdings of one electric company cover a sufficient length and fall for the development of nearly 75,000 horsepower.

Montreal is supplied with electric energy from four waterpower stations, two on the St. Lawrence, one on the Richelieu, and one on the St. Maurice River, and three of these stations are owned by the same company. Four hydroelectric plants on two rivers, all under a single ownership, develop electric energy for Manchester, N. H. Springfield, Mass., has electric service from two plants on one river, and Hartford, Conn., has like service from two plants on another. Buffalo is supplied with light and power from three hydroelectric plants at Niagara Falls, two in the United States and one in Canada, designed for an ultimate output of 215,000 electrical horsepower, which thus form the largest generating capacity in the world under a single management.

THE VALUE OF TESTING.

It is hardly realized by inventors and manufacturers who have not yet indulged in accurate and persistent testing of experimental apparatus the great degree to which saving in effort and expenditure could be extended by adopting the laboratory methods of larger organizations. It is safe to say that a large percentage of the new apparatus which has been placed on the market by small manufacturers has failed only because there has not been available the testing apparatus which would have indicated the weak point. A number of devices, excellent as a whole, have become discredited because, in the assembly, there was not available the means to determine that certain elements in the construction, although of apparent perfection when used individually, did not perform satisfactorily when used in connection with other devices.

It is not only with the inventor and manufacturer, however, that the necessary testing has been neglected. Large central stations and street railways have gone on buying without subjecting apparatus to tests other than those given by the manufacturer; and, although these are absolutely trustworthy and entirely cognizant of the guarantee which accompanies all first-class apparatus, they have not demonstrated a weakness which is often entailed due to the rigors of actual service.

The equipping of a laboratory sufficiently complete to undertake tests dealing with all the ramifications employed in actual service in electrical undertakings today would be far beyond the possibilities of all but the larger manufacturing companies, and also beyond the ordinary needs and requirements of most central-station and street-railway companies. It is true, however, and it is quite necessary, that a great deal of testing should be done by the companies themselves, and this can be carried on without very great expense on the part of these companies. Testing of an extraordinary nature, requiring apparatus which is seldom used and which can be secured only at great expense, can be done at the present time by commercial organizations which have been developed for this exclusive purpose. This service is not intended for, nor are these organizations ambitious to monopolize the testing of either the manufacturer or user of electrical apparatus. Where the parties requiring tests have no facilities whatever for testing, all their work can be properly and accurately attended to, but it would appear that the chief function of the testing organizations operated on a commercial scale is to supplement the testing which can ordinarily be carried out in fairly well-equipped laboratories with the tests which require special apparatus and which must be made frequently in order to return any profit on the investment necessary to secure it.

The value of testing on a commercial scale, although demonstrated to be great beyond the most sanguine expectations of its promoters, is not yet realized to the degree it will be when more extended use is made of the facilities of the commercial testing organizations.

THE INDEX TO VOL. LIII.

With this issue the index to Vol. LIII of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN is distributed to our readers. This index includes the issues of the *Electrical Review*, of New York, from July 4 to October 31, and of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN from November 7 to December 26. It will be remembered that the index to the issues of the *Western Electrician*, of Chicago, from July 4 to October 31, was distributed in the October 31 issue of that journal.

It is advisable that care be taken to preserve the index distributed this week, as it is not possible for the publisher to make a general distribution of extra copies.

DRAFTING IN THE SMALL CENTRAL STATION.

In a central station which is too small to afford a regular drafting organization, there is often a tendency to neglect the making and filing of proper drawings covering various changes and improvements in the system. The smaller number of officials and the greater variety of duties impressed upon individuals make it difficult to keep up with the work in the direction of accurate sketches of all noteworthy construction, and hence there is liable to come a time when new work is done more or less by rule of thumb. Without thorough planning, new engineering work is bound to cost more than it normally should, on account of the constant improvement in apparatus by the manufacturers, the alterations of dimensions in new types of equipment, and the necessity of making changes in temporary layouts.

It is therefore decidedly worth while to organize a small drafting department, even in the small station, and a company may well allow the superintendent or manager an extra man for this work. In most cases a corner of the office can be fitted up with the necessary drawing table and board, and the few simple instruments and supplies provided which will make it possible for neat and thorough work to be done within the limits of the requirements. In the smallest companies it is not unusual for the central-station manager to make his own sketches, when any are turned out, but experience shows the desirability of employing a draftsman for such work, with the all-important proviso that the new man be capable of doing other things besides drawing. There is no need of buying an elaborate drawing outfit, but provision for at least a small blue-print frame and the storage of drawings and prints, data, and special reports of a technical nature can be made with little trouble. Such a draftsman can have no better training for general central-station work than these odds and ends of technical and semi-commercial problems. He can be trained to work up operating results and statistics with the slide rule, to check up material and labor costs, accumulate data on power applications and new installations of high-efficiency lamps, and, in general, be a man of all-around usefulness. Work of this kind is excellent training for a young technical graduate, and it does not require expert ability in handling intricate designing problems. Much of the work can be done by drawing in machinery merely in outline, through the use of cardboard templates, tracing more complex equipment, if necessary, by using an incandescent lamp underneath a glass table of temporary character. The plan of numbering and indexing every sketch made is essential to the best results. For the use of the men in the field, a series of standard construction prints of a size that will fit the pocket well, is a great help, and will savé money through its effect in producing symmetrical installations. A given piece of work under a given set of conditions should cost about the same amount of money one time as another, and take about the same time for completion. Every central-station superintendent who administrates a small company can find plenty of work for a draftsman capable of being utilized on tests and investigations, technical records of routine operation, and, in some cases, soliciting. The main point is not so much the employment of another man in the small company for drafting alone, as the better attention to accurate records than now obtains in many cases, combined with a certain flexibility of the organization, which results when a man is available for special duties and not bound down all the time by purely routine work.

THE TELEPHONE AND CHRISTMAS SHOPPING.

The use of the telephone in making purchases is not confined to any particular locality or season, but that some of its possibilities remain to be developed is clearly indicated by the increased application of it this year in connection with the Christmas shopping of the larger cities. In New York in particular the retail stores encouraged holiday shopping by telephone, one house having placed twenty-five instruments on every floor and issued circulars to customers advising them to order in this way. The Boston *Transcript* well says that one of the great expenses in the conduct of the retail trade is the time-cost of the clerk, which stands against the average dollar's sale. The time required to effect a sale is often a long one in proportion to the results. The customer by telephone, like the mail-order customer, knows what he wants and is ready to ask for it. Delay is minimized.

The retail establishment receiving orders by either telephone or mail may accumulate them for systematic attention during the day, at hours when other demands are less pressing, this branch of the trade affording some balance-wheel against the irregularity in the flow of patronage through the doors. The telephone thus improves the load-factor of the establishment. For the thickly-settled districts the telephone occupies a valuable place between the mail order and the personal call; it lacks the recorded exactness of a written order through the post office, but it enables business to be expedited, facilitates the immediate distribution of information, and reduces congestion within the store and on the approaching streets and car lines. With the extension of the telephone habit, this aspect of electric communication is certain to grow to large proportions.

COPPER PRODUCTION IN 1907.

According to reports just issued by the United States Geological Survey, the output of copper, from the record production of 1906, shows a decrease of 48,809,191 pounds, or 5.3 per cent. The production in 1906 was 917,805,682 pounds, according to reports returned by the smelters of the country to the Survey. The smelter output chosen by the Survey as representative of the copper output of the country is made up of the production of blister copper and of furnace-refined, or so-called ingot copper of Michigan, plus the Michigan copper cast into ingots for electrolysis. It does not include the product of any additional distinctly refining process.

Based on reports collected by the field agents of the Survey from all mining companies in the country which produced copper during the year, the output was 847,151,015 pounds. This is 2.5 per cent less than the product of the smelters for the same period.

A Giant Chimney.

The largest and highest chimney in the world has just been completed at the smelting works of the Boston & Montana Consolidated Copper and Silver Mining Company, at Great Falls, Mont., for the dispersal at a great height of large volumes of gases from the copper smelters, says *The Engineering Record*. It is 506 feet high above its foundation, thus overtopping considerably all other chimneys. It rises 500 feet above the grade of the surrounding district and has an internal diameter at the top of fifty feet; it has been designed to remove 4,000,000 cubic feet of gases per minute at an average temperature of 600 degrees F. Owing to the rigid requirement imposed for its construction, including unusual stability against wind pressures, ability to withstand the action of acids formed from the waste gases, and strength to carry sixty feet of additional height with but small increase of the maximum bearing pressure, both its design and construction involved features of unusual interest.

The specifications limited the maximum bearing pressure due to both static load and the wind pressure of a 125-mile gale to twenty-one tons per square foot at any section, and required the construction to be capable of resisting the acid action of the sulphur gases. This practically limited the design to a brick chimney with an acid-proof lining, and as it was specified further that it should be so designed that sixty feet of additional height can be added without raising the maximum bearing pressure above twenty-two tons per square foot, the radial brick construction with perforated blocks was selected as best adapted for securing the degree of stability required. The construction was intrusted to the Alphons Custodis Chimney Construction Company of New York city.

New York Metropolitan Traction Reorganization.

The joint committee headed by John W. Castles, which represents the several committees of security holders of the New York city Metropolitan traction system for the purpose of formulating a plan of reorganization, has retained G. E. Tripp and the firm of Stone & Webster to collect data upon which to formulate such a plan. It is the purpose of the committee, it is stated, to obtain the full information regarding the earning capacity of the several parts of the Metropolitan system with a view of determining along what lines the reorganization should be conducted.

After Lighting Companies.

The Public Service Commission of the First District, state of New York, directed its counsel on December 18 to bring suit for penalties and forfeitures against five light and power companies for failure to file reports asked for. The Commission asked for the reports for the last six months of 1907, and stipulated in the order that they should be filed by November 30 of this year.

The Ball Electric Illuminating Company, the East River Gas Company, the Equity Gas Company, the Long Acre Electric Light and Power Company, and the Richmond Light and Railroad Company failed to obey the order. The penalty for disobedience under the law is a fine of not more than $5,000 a day. The Commission recently ordered similar suits brought against several of the traction companies for a similar failure to obey an order.

The Commission also adopted an order giving the Long Island Railroad ten days in which to reply to the complaint of M. H. Fishburn, who alleged that the company is charging excess fare on its line between Jamaica and the Flatbush Station. The complainant asserts that the ticket office is not open when he takes the train at Morris Park for Flatbush, and that the train conductor collects twenty cents, giving him a rebate check for ten cents.

The Chicago Electric Club.

The Chicago Electric Club has been holding a series of very successful midday luncheon meetings at its headquarters in the Chicago Automobile Club. On December 9, Peter Junkersfeld, of the Commonwealth Edison Company, delivered an address on "Recent Developments in the Edison Plant." On December 16, Philip Fisher, sales manager of the Condit Electrical Manufacturing Company, spoke on "Entertainment as a Feature in Securing Business." On December 23, the subject for the address was "Unfair Competition," by Luther L. Miller, member of the Chicago Bar. On December 30, the address will be delivered by Paul P. Bird, chief smoke inspector for the city of Chicago, on "The Problems Involved in the Smoke Inspection Service."

Columbia University Engineering Society.

At the December meeting of the Electrical Engineering Society of Columbia University held in New York city on December 16, C. F. Scott, of the Westinghouse Electric and Manufacturing Company, lectured on "Power Transmission." The speaker presented the limitations found in the development of various apparatus employed in the transmission of electric power and called attention to the fact that at one time the weak link of the chain lay in the generator, later in the switchboard, and again in the matter of insulation.

Car for Testing Rail Bonds.

A test car for locating faulty rail bonds which is now being used in Vienna, is described by *The Electrician*, London. The equipment consists of a direct-current motor-generator, which transforms the trolley voltage of 500 volts down to five volts, the full-load current at this voltage being 200 to 300 amperes. The poles of the machine are connected, through the axles, which are insulated from each other, to two points on the rail about seven feet apart. The voltage drop on a rail length of three feet is then measured by special contact.

High-Pressure Fire System for Chicago.

Milton J. Foreman, chairman of the Chicago City Council committee on local transportation, announces that plans for a high-pressure fire service, modeled after New York city's system of high-pressure mains, supplied by motor-driven centrifugal pumps, are being rapidly matured. The citizens' joint committee, Thomas R. Hall, chairman, and William Marshall Ellis, secretary, approves Mayor Busse's position that the cost of installation of high-pressure mains be met by special assessment of beneficiaries, and also that the system be installed without waiting for subway construction.

Operation of the Gary Steel Works Begun.

On December 21 active operation of the great steel works at Gary, Ind., was begun by starting the fire in blast furnace No. 12. These works have been building for several years, and when fully completed are to give employment to an aggregate of 25,000 to 30,000 men. Aside from the great size of the plant, it is noted for the very advanced methods to be employed in all departments of steel making, prominent among which is the most extensive use of electrical drive of heavy machinery that has ever been made in the iron and steel industry. Illustrated descriptions of the equipment of the works appeared in the ELECTRICAL REVIEW of October 17 and the WESTERN ELECTRICIAN of October 3, 1908.

Dr. Steinmetz Lectures on "Light and Illumination."

An audience of nearly 500 assembled in Fullerton Hall, Art Institute, Chicago, on the evening of December 17, to listen to an address by Dr. Charles P. Steinmetz. The meeting was held under the auspices of the Chicago Section of the American Institute of Electrical Engineers. President Louis A. Ferguson introduced the speaker, who lectured on "Light and Illumination." Although the address was on the same subject as that made by Dr. Steinmetz in New York a week earlier, which was reported in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of last week, a great many features were dwelt on which had not been brought out in the earlier lecture.

The first part of the address was devoted to a discussion of the development and properties of illuminants, particularly the various types of electric lamps. In the second part, consideration was given to the physiological requirements necessary for good illumination. Throughout the problems of producing and utilizing artificial light effectively were looked at from the speaker's characteristic broad point of view.

Throughout the history of illuminants light has always been produced through the agency of heat. It is becoming generally understood that efficiency of light production increases with increase of temperature. The efficiency is still very low, as at best about ninety per cent of the energy is converted into heat. In electric lamps we can produce light either by sending current through the conductor, as in incandescent lamps, or by forming an arc, i. e., where vapor is the conductor. The latter is the earlier method, although the former seems simpler. The arc lamps were devised over a century ago.

Dr. Steinmetz then traced the general history of incandescent lamps. Carbon is a most refractory substance and stands the highest temperature; therefore it seems best adapted for filaments. The trouble with carbon, however, is that it vaporizes, like all substances more or less, at much below its boiling point. The condensation of the carbon on the inside of the globe (blackening) limits its value. Hence, it can be run up to a temperature of but 1,500 degrees C., or about 2,000 below the boiling point.

Different substances possess the evaporative power in different degrees, as, for instance, water and gasolene, the latter having a much higher vapor tension. So carbon has a relatively high vapor tension, and, therefore, we have now returned to metal filaments. Osmium produces filaments with an efficiency of about one-and-one-half watts per candlepower, but this metal is so rare that its demand for this purpose shortly doubled its price. Tantalum was then tried with fairly good results, and it is quite a common metal, whose vapor tension is small. Likewise with tungsten, the demand has stimulated the supply. Up to nearly its melting point, which is from 2,500 to 3,000 degrees C., its vapor tension is quite low. Once in a while a tungsten lamp blackens; this is due to imperfect vacuum.

Reverting to the improvement of carbon filaments, it should be noted that the bamboo filaments that were first made have a very high vapor tension. The squirted filaments are better in this respect and that which, after being formed, is subjected to gasolene vapor and has a coating of carbon deposited on it has a still lower vapor tension. The so-called metallized filaments are graphitized and have properties of metals to some extent. Another allotropic form of carbon may be found which will run its efficiency up to, or above that, of tungsten. The tungsten lamps have now a higher efficiency than arc lamps, except arcs of high power. The latter have their possibilities for high-intensity illumination.

In the development of the flaming arc there has been produced an illuminant independent of temperature for its efficiency. The frequency of vibrations of different vapors produces various wave-lengths, and therefore, various colors, if these lie within the visible range. The temperature of the vapor changes the color, due to affecting the various wave-lengths differently. For instance, in the mercury arc, as ordinarily used, the predominant vibration produces a bluish-green effect; if the vapor is hotter, the red rays overbalance this and produce a nearly white color; if the vapor is still hotter, a pinkish-red becomes prominent. The metals whose vapors are highly luminescent are mercury, used in the mercury-vapor arc, calcium, used in the flaming arc, and titanium, used in the magnetite arc.

Our hope for higher efficiency in electric illuminants lies, on the one hand, in finding other luminescent bodies or in improving those named, and, on the other hand, it lies in improving the carbon filament, so that we can use it to nearer its boiling point without vaporization, probably in another allotropic form.

However, we want not merely light but rather illumination. The first is the raw material; what we need is the flux of light properly distributed. In some places we desire uniform illumination, as in schoolrooms and on streets; again, we may want concentrated illumination, as on working surfaces for sewing or reading, or mixed illumination with low intensity for general lighting and higher intensity for the special field of vision. The important thing is not the amount of light falling on the illuminated object, but the effective physiological result.

Dr. Steinmetz dwelt at length on the requirements of the eye for good vision. For high brilliancy the eye adapts itself when the pupil contracts to reduce the amount of light admitted, especially if in the direct line of vision. This has led to the development of indirect illumination, to raising direct lights out of the line of sight and to reducing the intrinsic brilliancy. The fatigue of the eye is an important factor to be considered. Excessive illumination is always tiresome. Therefore, we should cut out the excess light. However, high intensity is not necessarily injurious, since the eye is accustomed to the great brightness of daylight, which is hundreds of times that produced by our ordinary illuminants. It will be found that a combined local concentrated and a low general illumination is the best, as it gives a quiet, homelike effect.

The sensitiveness of the eye varies for different colors at different intensities. The white arc is good for low intensity lighting. The flaming arc is not adapted for this, but is good for high intensities where striking effects are wanted. Yellowish light tones down differences in color. Blue or green light makes them more marked. Differences in color and brightness really afford effective means of vision. Shadows are necessary for perfect vision. Diffused or uniform illumination is consequently flat and unsatisfactory. The open arc lamp is the opposite extreme; its shadows are too sharp and intense. In some cases directed lighting is more necessary. In others, diffused lighting. Every case requires a most careful balance between the two types. The proper illumination is, therefore, much more difficult than that of the mere physical production of light flux. Photometric results are misleading, as they give no indication of the physiological stimulation that will be produced in the eye.

Copper Production in 1907.

The production of copper in the United States in 1907, according to reports returned by the smelters of the country to the United States Geological Survey, amounted to 868,996,491 pounds. The production in 1906, compiled on the same basis, was 917,805,682 pounds, and that of 1905 was 888,784,267 pounds. From the record production of 1906 the output for 1907 shows a decrease of 48,809,191 pounds, or 5.3 per cent. This is the largest actual decrease ever recorded, and is the largest relative decrease since 1886, when the percentage of decrease was 5.5. In 1907, for the first time since 1901, the production was smaller than that of the preceding year, and for the first time since 1872 the production was smaller than for the second preceding year.

The smelter output chosen by the Survey as representative of the copper output of the country is made up of the production of blister copper and of furnace-refined or so-called "ingot copper" of Michigan plus the Michigan copper cast into anodes for electrolysis. It thus consists of the final product of the distinctly smelting operations, and does not include the product of any additional distinctly refining process. The figures of smelter production for 1907 are based on direct returns made confidentially to the Geological Survey by all but one of the known smelting companies that handled United States ores, concentrates, or mattes, in 1907.

The quantity of copper given as the output of the mines of the United States in 1907, based on reports collected by field agents of the Geological Survey from all mining companies in the country which produced copper during the year, was 847,151,015 pounds, a quantity 2.5 per cent less than the product of the smelters for the same period. By far the greater portion of the mines' output is treated directly in smelters owned by, or having some connection with, the mining companies, and this large part of the mine production is reported on practically the same basis as the smelter production. But many of the mine returns are based on the actual or estimated recovery from the ore shipped from the mines during the year, whereas the smelter returns indicate the quantity of copper actually turned out at the reduction works in that period. In a state like Montana, therefore, operation of the smelters at full capacity for a few days after the mines had begun to reduce shipments would account for a distinct excess in smelter output over that reported from the mines. This fact—that when curtailment of production had once been decided on, the mines were able to execute the plan more promptly than the smelters—is responsible for the greater part of the difference between mine and smelter production of copper in 1907. In 1906, when mine and smelter production were conducted at practically the same rate, returns from the two sources were in very close correspondence, the mine output being only 0.9 per cent less than the production of the smelters. A second cause of the difference in favor of the smelter figures is the fact that the smelters recover more copper than the mines are paid for. The difference on this account is smaller than that due to other causes, but it is especially important in states like Colorado, where the greater part of the production is from custom ores generally low in copper.

During 1907 copper was produced in twenty-one states and territories, the production of the principal ones being shown in the following table:

State or Territory.	Smelter Returns.		Mine Returns. Pounds.
	Percentage of Total.	Pounds.	
Arizona	29.55	256,778,437	254,879,489
Montana.....	25.81	224,263,789	220,108,792
Michigan...	25.22	219,131,503	217,767,232
Utah.........	7.64	66,418,370	64,256,884
California....	3.88	33,696,602	28,528,020
Tennessee	2.24	19,745,119	18,893,115

These data are abstracted from an advance chapter on the production of copper in 1907, prepared for the annual report of the Geological Survey on the "Mineral Resources of the United States, Calendar Year 1907."

Electrical Equipment of the Singer Tower.

At the 281st meeting of the New York Electrical Society, held in the Singer Building, December 16, Charles G. Armstrong, consulting engineer, addressed the members.

Tower buildings, similar to the Singer, were only made possible by new devices for vertical transportation, said the speaker. The latest device, that used in the Singer tower, is simply an adaptation of the manual hoist, which is the earliest passenger elevator on record. It was found in the convent of St. Catherine on Mt. Sinai, about the sixth century.

Men and material have for many years been hoisted out of mines thousands of feet deep, but the power was applied at the surface of the earth. The first building hoists, or lifts, had their power applied in the basement, because steam was the only available motive power. The introduction of electricity, however, enabled the use of the hoist referred to, which can be placed at the top and makes the system of vertical transportation applicable to any possible height of building.

Mr. Armstrong then described his plan for exterior lighting of the Singer Building, by means of thirty searchlights or projectors, each eighteen inches in diameter. The architectural details and the color scheme of the tower are brought out in an effective manner by this flood of light.

A large number of stereopticon slides were shown, illustrating details of the construction of the building from foundation to flagpole.

The members of the society were greatly interested in the examination of the mechanical plant established in the Singer Building. This is considered one of the most modern and effective for its purpose in the world.

There were over 400 members present, and, notwithstanding the liberal provision of souvenirs made by the Singer Manufacturing Company, many of the visitors had to go away unsupplied. The company, however, will be pleased to send one of these interesting mementoes of the occasion to any member, on application to the company's office, 149 Broadway.

Through the courtesy of the Singer company, the members were divided into parties of thirty, with a guide for each party, and a tour of inspection of the entire building was made. Especial attention was called to the engine room, the main switchboard, the special plant of motor-generators for low-voltage circuits (fifteen volts), the vacuum-cleaning plant, the elevator plant and controlling, dispatching and signaling apparatus, and the searchlight equipment for night illumination of the building. A beautiful view was obtained from the tower. The entire inspection tour occupied about two hours' time.

British Post Office Wireless.

The first Post Office wireless station in England was opened by Postmaster-General Buxton on December 11. It is situated at Bolthead, on the Devonshire coast, and is intended primarily for communication with ships at sea.

Mr. Buxton, in a speech at the opening, intimated that a series of similar offices would be scattered throughout the United Kingdom.

Traffic on the Hudson & Manhattan.

Traffic over the completed section of the Hudson & Manhattan Railroad Company's tunnels, from the Lackawanna station in Hoboken, to Sixth Avenue and Twenty-third Street, Manhattan, has shown a monthly increase of approximately 150,000. In other words, the increase in the average daily travel in November was about 5,000 over the daily average in October, and that month showed the same relative increase over September. While the company will not publish any official figures on actual traffic, says the *Wall Street Journal,* it is conservatively estimated that the company is at present handling passengers at the rate of 20,000,000 a year. Officials of the company estimate that about seventy per cent of the traffic between the Lackawanna terminals and Manhattan is carried through the tunnels.

This section has now been in operation for a period of almost nine months, and the results that have been secured have far exceeded the previous expectations and have caused hearty optimism toward the results that will be obtained when the whole system is completed and in operation. That it meets the demands and requirements of the travel is being demonstrated thoroughly by the workings of this section, and the management feels little doubt but that the system will become the most important mouthpiece in the transportation to and from Manhattan of the four systems, the Pennsylvania, the Erie, the Lackawanna and the New Jersey Central, with its affiliated systems, the Reading and the Baltimore & Ohio. In addition, the interurban travel between the points is expected to be heavy.

The lower tunnels between the Pennsylvania terminal at Montgomery Street, Jersey City, and the Hudson Terminal buildings at Church, Cortland and Fulton Streets, Manhattan, will be completed and in operation by July 1 next, and will really constitute the main avenue of the system's traffic. Work on these sections has been pushed steadily, and the tunnel to Cortland Street will probably be broken through by March 1 next, but the other tube entering under Fulton Street is not so far advanced. The cutting on these tunnels averages twelve feet per day.

The transverse section on the Jersey side connecting the Pennsylvania, the Erie and the Lackawanna terminals will also be completed and in operation by July 1 next, so that the complete circuit will be in operation by that date. Plans have now been made up for the extension from the Pennsylvania Station to the Communipaw Station of the New Jersey Central, which is also the New York terminal of the Reading and Baltimore & Ohio systems.

It is estimated by officials of the Hudson Companies that the recent sale of $5,000,000 six per cent gold notes by that company, in addition to other assets already in hand, will supply sufficient funds to cover the completion of the system, and that no further financing will be required. The Hudson Companies is the constructing factor of the tunnels, having financed and built them, taking in payment $50,000,000 of the four-and-one-half per cent convertible bonds, in addition to stock of the Hudson & Manhattan Railroad Company, which is the operating company. The latter company has outstanding $5,250,000 five per cent non-cumulative preferred and $40,000,000 common stock.

Electrical Preparations for the Alaska-Yukon-Pacific Exposition at Seattle.

After expending in lump sums $910,000 for new cars, $600,000 for new trackage and $275,000 for motor-generators, transformers, high-tension transmission lines, lighting circuits, etc., the Seattle (Wash.) Electric Company, which controls the local street-car and lighting systems, will doubtless make a record in handling the traffic and lighting of the forthcoming Alaska-Yukon-Pacific Exposition. The improvements, new lines, and new power facilities which the company is installing preparatory to the 1909 fair mark a new era in street-railway improvement in the Northwest, and at the close of the exposition Seattle will be equipped with the most efficient service in the history of the city. The present expenditures will leave the car system in excellent shape after the exposition, and will insure prompt and comfortable handling of the crowds at the fair.

Four lines will tap the exposition grounds, two of which are now operating, with one other just completed and work on the fourth begun. Each line is five or six miles in length, and all will be double-tracked, with loop terminals at the grounds. A handsome terminal building and power substation will be installed on the grounds. The company expects to be able to deliver passengers at the grounds at the rate of twelve or fifteen thousand persons an hour, should the occasion demand.

The additional power necessary for these lines, and for lighting the exposition, will be furnished by the great water-power plant at Electron, on the Puyallup River, and by the steam plant at Georgetown. Twenty miles of 13,000-volt transmission line connects this power with the substation on the grounds, where it will be stepped down to 2,300 volts. Two 1,000-kilowatt motor-generators will be located at this station, and two others at substations in the city. The power will be sufficient to handle cars as rapidly as they can be safely moved over the four lines.

A lump order of 140 cars, forty of which have already been delivered, is probably without precedent among western street-car systems. The cars are of the most modern type, and cost when set up at Seattle about $6,500 each. They are manufactured by the St. Louis Car Company, and each car has 150 horsepower in motors, and is capable of developing a speed of thirty miles an hour. Stone & Webster, who control the company, are making the present improvements of the car system in the nature of permanent investments. For the lighting of the exposition the same company has the contract, and is preparing a most elaborate illumination. The substation on the grounds will contain four 1,000-kilowatt transformers, with the necessary regulators and switches. The water front on Lake Washington and the terraced hillsides overlooking the lake, with the wide avenues of the exposition leading down to the shore, will be brightly lighted, and the night scene from the water promises to be effective and inspiring.

American Society of Mechanical Engineers' Meeting.

The next monthly meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, on Tuesday evening, January 12. The paper, by Carl G. Barth, of Philadelphia, upon "The Transmission of Power by Leather Belting," will be illustrated by lantern slides. It will be a comprehensive summing up of the theory and practice of belting, in which conclusions are drawn from the work of Lewis, Bancroft, Bird and others, who have made experiments upon the transmission of power by belting. Valuable charts have been prepared by the author for the solution of belting problems.

Mr. Barth's data have been applied to belting in different plants for many years, giving an unusual opportunity to study the problem in great detail.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER II. (PART III.)—OPERATION OF ALTERNATORS.

In the care and operation of generators certain precautions are very essential to high efficiency. It may not be out of place to incorporate here some suggestions from an instruction book issued by one of the large manufacturers of electric machinery.*

GENERAL CONSIDERATIONS.

1. Leave all switches open when the generator is not running.

2. Keep the generator clean and free from dust. With high-voltage machines a small accumulation of dust on the windings may be the cause of a serious burnout. It is advisable to use compressed air to clean the windings.

3. Small pieces of iron, such as bolts and tools, should be kept away from the generator.

4. Occasionally give the machine a thorough inspection; the higher the voltage, the more often this should be done.

5. Never run a composite-wound alternator with load unless all its brushes are in place, as an unduly high electromotive force will be generated in the open-circuited composite winding, which may puncture the insulation.

COLLECTOR RINGS AND COMMUTATOR.

Precaution should be taken to keep the collector rings clean, smooth and true. To prevent cutting, a little vaseline should be applied occasionally. The commutators of composite-wound generators should be kept smooth by the occasional use of No. 00 sandpaper. The lubricant should be applied to high-voltage generators with a piece of cloth attached to the end of a dry stick. If the commutator gets "out of true" it should be turned down. In the case of revolving-armature generators this can be done without removing the rotating part from its bearings, by the use of a special slide rest and by running the engine slowly, or the commutator may be taken off the shaft and turned down in a lathe.

BRUSHES.

Carbon or soft graphite brushes are preferable and are set perpendicular to the surface of the collecting rings. They fit closely and require almost no attention beyond an occasional renewal and casual inspection from time to time to see that they fit properly.

The copper brushes used to collect the direct current from the commutator of an alternating-current generator with a compensating winding, are arranged as shown in Fig. 57, which shows the correct method of setting the brushes on a commutator with ten segments. On different machines the brushes are set one, three or five segments apart; the operation of the commutator will be the same electrically as long as the brushes are an odd number of segments apart. The brushes nearest the field in one holder should be given a lead of about one-half a commutator segment (S/2) over its companion, while in the other holder the brush at the greatest distance from the field should have an equal load over the other brushes of its set. In the diagram, Fig. 57, the leading brushes touch the commutator at the middle segment, while the trailing brushes are just over the insulation between the segments. The

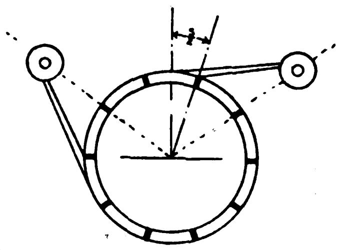


FIG. 57.—POSITION OF BRUSHES FOR COLLECTING DIRECT CURRENT FROM COMMUTATOR OF ALTERNATING-CURRENT GENERATOR.

trailing brushes should be set in position while the commutator is at rest, but the leading brushes may be changed while the machine is in operation. The compounding of a generator may be varied by shifting the brush-holder rocker, and, to a slight extent, by changing the spread of the brushes in each holder. Increasing the spread decreases the compounding, and vice versa. When the rocker arm is shifted to give the proper compounding, all brushes may be made to run sparkless by changing their spread. With a widely-varying inductive load, it is impossible to adjust composite brushes so as to obtain absolutely sparkless operation.

Sparking at the commutator may be due to any of the following causes:

1. Brushes may not be set at the point of commutation. A position can always be found where there is no appreciable sparking, and at this point the brushes should be secured.

2. Brushes may be loose or may not bear sufficiently on the commutator.

3. Brushes may be welded at the end.

4. Brushes may be spread at the end. They should present a narrow surface to the commutator.

5. Commutator may be dirty or oily, or copper dust may have collected on the insulating segments.

6. Commutator may be rough; if so, it should be smoothed off.

7. Generator may be overloaded.

BEARINGS.

The bearings should be kept clean and free from grit. They should be frequently examined to see that the oil supply is properly maintained.

A warm bearing or "hot box" may be due to any of the following causes:

1. Excessive belt tension.
2. Failure of the oil rings to revolve.
3. Rough bearing surface.
4. Improper fitting of the journal boxes.
5. Bent shaft.
6. Use of poor-grade or dirty oil.
7. End thrust, due to magnetic pull, the rotating part being "sucked" into the field because it extends beyond the field poles further at one end than at the other.
8. Bolts in the bearing cap may be too tight.
9. End thrust, due to improper leveling. A bearing may become warm because of excessive pressure exerted by the shoulder of the shaft against the side of the bearing.
10. Excessive side pull, because the rotating part is out of center.

OPENING OF FEEDER CIRCUITS.

If a line fuse blows, or a circuit-breaker opens, first open the switch corresponding to that line and then replace the fuse, or close the breaker; then close the switch. If the circuit opens again, examine the line for a short-circuit.

STARTING.

1. Examine the generator to see that it is in condition and is properly oiled.

2. Start slowly. See that the oil-rings are revolving properly.

3. Bring the machine up to speed, and turn the rheostat so that all the resistance is in the field circuit; then close the field switch.

4. Adjust the rheostat of the exciter for the normal exciting voltage; then gradually raise the alternator to its proper voltage by cutting out the resistance of its field rheostat.

5. Throw on the load.

*Westinghouse Electric and Manufacturing Company.

If the generator has a compensating winding, the brushes on the commutator must next be set at the non-sparking position. Should the current in the self-excited field cause a decrease in the voltage of the machine, it is evident that the separate and self-excited coils are opposing each other. The brushes should then be racked one segment forward or backward to reverse the current in the self-excited field.

CAUSES OF INSUFFICIENT VOLTAGE.

The following causes may prevent alternators from developing their normal electromotive force:

1. The speed of the generator may be below normal.

2. The switchboard instruments may be incorrect.

3. The voltage of the exciter may be low, because its speed is below normal, or its series field is reversed, or part of its shunt field is reversed or short-circuited.

4. The brushes of the exciter may be incorrectly set.

5. A part of the field rheostat or other unnecessary resistance may be in the field circuit.

STATIC SPARKS FROM BELTS.

In dry weather the charges of static electricity that accumulate on the belts may be of high enough potential to discharge to ground, or, if the generator is not grounded, these charges may jump to the armature or field winding and thence to ground, puncturing the insulation. By grounding the frame of the machine there is no danger to insulation.

TO SHUT DOWN.

1. Reduce the field current by means of the field rheostat.

2. Throw off the load by opening the feeder switches.

3. Open the separately excited field circuit.

4. Shut down the driving machine.

5. Clean the generator and put it in condition for the next start.

Canadian Centennial Exposition in 1912.

Western Canada is to hold a Centennial Exposition in 1912. Jefferson Clark, president of the Lewis and Clark Exposition, has been in Winnipeg, Manitoba, interesting business men in the project, upon the invitation of the Canadian Club of that city.

Electrical Trades Society of New York.

The thirteenth annual meeting of the Electrical Trades Society of New York was held at the Electrical Club, 14 Park Place, New York, on December 8. Ten accessions to membership during the year were reported. In his remarks the retiring president, R. B. Corey, after referring to the passing of the financial storm, said:

"Now what I want to bring out is the part played by this association in the saving of the day. Is there anyone who will say that there might not have been a score or more of failures had it not been for the co-operative spirit, part of which demonstrates itself in the existence of this organization? Can you not imagine the darkness and doubt which would have possessed the credit man were there no means of knowing what his fellows in the trade were doing? The most tangible indication of the soundness or weakness of customers, we maintain, is in the long run displayed to those who are close students of the association's bulletins, supplements and other records at the secretary's office. Congratulate yourselves, then, that you are members, and if you are not getting the most value for the least money and more than can be had from subscription to any mercantile agency, ask us why—addressing your inquiry to the secretary's office—and we'll soon tell you.

"At our meeting a year ago it seemed to be the consensus of opinion that customers who had always done fairly well in paying their bills and who were supposedly solvent should be given all necessary assistance in the way of leniency. In many cases our customers twelve months ago could not make collections from people who were ordinarily gilt-edged as to credit and payment. We all had to await the readjustment of credits and financial conditions, which readjustment came right along after the New Year. This leniency extended to creditors seems to have been general on the part of the electrical trade. The failures have been few in the territory of the New York Society, and, in fact, with the exception of some of the southern cities, the electrical trade has stood the strain very well indeed."

The secretary's report showed that out of claims aggregating $301,507 the society secured settlements amounting to $241,306, or eighty per cent. This is an average of $1,296 per member. The number of the separate accounts handled by the society was 2,939, of which 2,521 were settled through its instrumentality. This extra service is free, there being no charges or commissions, the annual dues covering everything.

The following directors were elected to serve for three years: John H. Dale, of the Dale Company; W. H. Roberts, of W. R. Ostrander & Co., and W. B. Wallace, of the Western Electric Company, who with the following will constitute the board of directors for 1909: W. M. Franksen, of the Sawyer-Man Company; G. F. Spencer, of I. P. Frink; A. L. Miller, of John A. Roebling's Sons' Company, and P. M. Haight, of the Sprague Electric Company. Mr. Dale was re-elected to the board of managers of the National Electrical Trades Association.

At a meeting of the directors, held immediately after this meeting of the society, the following officers were chosen for the next year: A. L. Miller, president; P. M. Haight, vice-president; W. H. Roberts, treasurer, and Franz Neilson, secretary.

Pennsylvania Railroad to Use Telephones in Dispatching.

It is understood from an official Pennsylvania Railroad source that in the near future the Pennsylvania will probably substitute telephones for the telegraph in dispatching trains and transacting other business that is now done by telegraph. The substitution, however, will depend entirely on the result of an investigation now being made of the efficiency of the telephone service on other railroads.

Several of the railroads now using the telephone system are reporting favorably on them, and say better and quicker service is obtained and is more economical. The New York division of the Pennsylvania has delegated a committee to investigate. This committee is now on a trip of investigation as far west as Chicago, where it is inquiring into the results attained by the use of telephones on the Chicago & Northwestern Railroad and other roads.

It was said that the Pennsylvania Railroad has already experimented with telephones on the line in Pennsylvania between Glen Loch and Morrisville, sixty miles, with satisfactory results.

Westinghouse Electric.

A certificate has been filed at Harrisburg of the proposed increase in the capital stock of the Westinghouse Electric and Manufacturing Company from $50,000,000 to $80,000,000, and permission to make the increase has been given.

HISTORY OF AXLE LIGHTING.[1]

BY W. L. BLISS.

(Concluded.)

The writer believes that one of the greatest contributions to the art of axle lighting was made by the inventor of the so-called outside suspension. This, as far as the writer is able to determine, was devised by Mr. Kennedy, in conjunction with certain officials of the Pennsylvania Lines West of Pittsburg. However. all of the axle-light companies have profited by the outside suspension, and certainly it has been a boon to the railroad electrician and inspector. The outside suspension made the generator accessible. It enabled a reasonably long belt to be employed, and it has probably come to stay. It was with a good deal of difficulty, however, that the mechanical officials of a great many roads were induced to sanction its application, on the grounds that it had a great many disadvantages, primary among which was that it unbalanced the truck. Theoretically, this is the fact, but practically it causes little, if any, unbalancing, especially on six-wheel trucks.

It would seem that the original method of driving the generator from the axle by means of a belt has prevailed, and that, up to the present time, all forms of gearing have been superseded and supplanted by the simpler form of belt. While the positiveness of direct gearing has its advantages and is absolutely indispensable in the case of street-railway motors, it is not so essential in axle lighting. In the case of a street-railway motor, if anything happens to the motor or to the gearing, the car is instantly brought to rest, and nothing further is done until the damage is repaired. If the mechanism is in such bad condition that it cannot be run rapidly, the car is hauled very slowly back to the repair shop. In the case of an axle generator, quite the reverse is true. If anything happens to the generator, the grinding -up process continues until nothing is left. If a hot bearing develops and the armature shaft binds, the belt forms a mechanical safety fuse between what may be regarded as an almost infinite power and a machine of decidedly finite endurance.

It would appear then, from developments up to date, that the most suitable form of mounting for an axle generator would be one which was, of course, simple and strong in its design, neat and shipshape in appearance, easily applied to the truck, and that, in its application, required no mutilation of the same. Such a mounting should permit the generator to be suspended outside and clear of the truck frame. The supporting bars of the suspension mechanism should be so disposed that the machine is completely accessible and that nothing shall stand in the way of the inspector who is examining or working upon the machine. The mounting and suspension should be such that the generator is at all times held level to prevent oil slopping, and it should be so designed that the shaft of the generator may be brought readily and accurately into parallelism with the axle of the car with a minimum amount of trouble. No better means of transmitting the power from the axle to the generator seems to have been brought forward than the rubber belt joined by means of the Crescent belt fastener. As above stated, the belt is a sort of mechanical safety fuse. Under ordinary weather conditions, it seems to be perfectly able to transmit the power. The great bugbear of snow and ice seems to have melted away before the light and warmth of experience. There are, no doubt, climates in which certain roads operate that are productive of considerable annoyance from snow and ice, but in most parts of the United States the rubber belt operating on large enough pulleys with wide enough faces and maintained at a proper tension by properly-designed tension devices, seems to fill the bill. It is cheap, safe and efficient. We have all heard more or less about driving by means of chains. The chain is necessarily more expensive than the belt. It in no wise has the great advantage of acting as a safety mechanical fuse, and it is a terrible thing when it gets loose and thrashes around. It is doubtful whether a chain can be run without lubrication, and the difficulty of enclosing it in a case that will hold oil is almost insurmountable, and who will bother to oil the individual iinks of a chain every few days? No one.

When it comes to machines of greater capacity than six to eight kilowatts, the rubber belt is probably inadequate as a driving mechanism. There is nothing left, apparently, but direct gearing. The writer designed, built and placed in operation a twenty-five-kilowatt axle generator on a truck of a locomotive tender. The axle was specially prepared. It was provided with a perfectly true gear seat and two polished journals, and the mounting of the machine was exactly like that employed in standard electric-railway service. Mechanically, this arrangement is perfect, or as near perfect as anything will ever be made. The gears were absolutely positive, were protected in a gear case of standard street-railway construction, and the whole machine, being large and heavy, permitted of rugged construction that withstood all the abuse and hammering that it received from the direct connection to the axle. Such a machine is perfectly suitable for head-end systems, but it cannot be operated under the ordinary conditions under which smaller axle machines are handled. So far as driving mechanisms are concerned, the outside suspension with the belt is the most suitable so far developed for small generators up to eight kilowatts capacity, and the standard street-railway mounting and drive, the only thing feasible for machines of larger capacity.

Having discussed the question of the problem of driving the axle generator, we come to the very important feature of taking care of the reversals in direction of car travel. This brings us immediately to the question of the pole changer. Pole changers can apparently be divided into the following classes: Mechanical and electrical. Under the head of mechanical pole changers we find two sub-classes, those having contacts and which momentarily break the circuit, and those which do not open the circuit, but which rely upon shifting the brushes to preserve the polarity. A mechanical pole changer is operated ordinarily from the shaft of the armature. When the armature shaft revolves in one direction the pole changer shifts certain connections so as to establish correct circuit relations corresponding to that direction of rotation, and vice versa. The brush-shifting devices depend upon rotating the brushes through as many degrees of arc as are represented by the pole pitch, plus whatever lead the designer desires to have the brushes take when commutating the current. The mechanical-switching pole changer, as distinguished from the mechanical brush-shifting pole changer, may be operated in any number of ways, all of which require considerable ingenuity to make substantial and efficient. Friction has been employed in a great many of them as the actuating force, but all friction schemes are open to the objection that a certain amount of wear goes on unless means are provided for relieving the friction, and attempts of this kind run into complication. The writer has himself preferred and developed the mechanical pole changer represented by the brush-shifting class.

[1]Abstract of a paper read before the Association of Car Lighting Engineers at the convention in Chicago on November 16.

There are a great many advantages in taking care of the polarity in this manner, and there are certain offsetting disadvantages no more numerous and no more important than the disadvantages that lie in the use of a mechanically-operated switch. There has not been a simple mechanical pole changer designed by anyone, as far as the writer is aware, and the shifting brushes and their associated mechanism are no more complicated than the simplest kind of mechanical pole changer, so that the question of mechanical pole changers cannot be said to have been settled by any standardizing, as is the case in the problem of mounting and driving.

When it comes to electrical pole changers, we find no end of schemes. The earliest American patent on an electrical pole changer appears to have been that taken out by Mr. Danals in 1889. His claim is very broad, but his device does not appear on the face of it operative. The most rational solution of an electrical pole changer, as far as the writer knows, is that offered in the patent of A. H. Whiting, in 1893. The objection to this is that it is necessary to separately excite the field of the generator in order to make the pole changer operative, and in the old Lewis system this was taken care of by a centrifugal switch, which closed and opened the field circuit of the generator directly from the batteries whenever the speed was above or below ten miles per hour, or thereabouts. The Whiting patent shows the essential elements of an electric pole changer, and while numerous variations have been made in the form of electric pole changers, they all depend upon Mr. Whiting's fundamental principle. Pole changers of the electric type necessarily are switching devices, and open and close the circuit.

There are, however, schemes by which the polarity of the generator may be preserved without the use of any switching mechanism or brush shifting whatever. They employ auxiliary machines for the purpose, and run into more or less complication and generally require the field of some machine somewhere in the system to be separately excited from the battery. We have also seen numerous attempts to solve the pole-changer problem by the use of alternators connected up with electrolytic cells and other rectifiers of one kind and another, and numerous other schemes have been proposed, but have not come into commercial use. The writer believes that the pole-changer problem will eventually be solved by the adoption of a mechanical pole changer of the shifting-brush type or a mechanical pole changer of the switching type, or an electrical pole changer of the Whiting type. It would seem that these three are the best forms to work upon and develop.

Coming now to the third part of the axle-light problem, we are confronted with the necessity of providing a means for closing and opening the generator circuit whenever the voltage of the generator shall be just above or just below that of the battery. In the early systems, a favorite means of accomplishing this result was through the instrumentality of a centrifugal switch, which would close and open the circuit at a predetermined speed of the generator. It is quite obvious that such an arrangemnt is impracticable. If the device is made thoroughly positive in its action, it will close and open the circuit mechanically without any regard to the electrical conditions that may exist in the system. In other words, it will connect a dead dynamo to a live battery or a live dynamo to a dead battery, either or both of which experiments have been repeatedly tried without success, so far as the writer is aware. There are certain experiments in railroading which, notwithstanding their fallacy has been thoroughly established, will continue to be made until the end of time. One of these experiments is the connecting of a dead generator to a live battery by those inquisitive people who want to see what will happen when the automatic switch closes, and generally find out. The other experiment is that of making two trains pass in opposite directions on a single track, which has probably been tried quite as many times as the former experiment without any successful records having been obtained. There is practically no prevention for the continuance of these experiments.

It would seem that the right way to operate an automatic switch is electrically. The switch should close at a predetermined voltage, no matter what the speed of the generator may be when this voltage is obtained. If the generator voltage at which the switch closes is equal, or approximately equal, to that of the battery at the time, no harm will result. The electrically-operated automatic switch, so far as the writer is able to ascertain, was first described by J. H. Holmes in a United States patent in 1891. He described accurately the switch that nearly all of the axle-light companies make today, consisting of some kind of magnetic circuit on which two coils or sets of coils act, one being made of fine wire and connected as a shunt to the generator and the other being made of coarse wire connected in series between the generator and the storage battery, as soon as the switch is closed.

Electricians all over the country, and, in fact, all over the world, are practically agreed upon the three problems the writer has endeavored to discuss. We all agree as to the requirements of the suspension and drive. We all agree that the polarity of the generator must be preserved, and that, whether circuit-changing or brush-shifting is employed, it must be accomplished before the speed reaches the critical or cutting-in value. And we are all agreed that the automatic switch, no matter of what form it may be or upon what principles it may act, must connect and disconnect the generator from the storage battery when the voltages bear the right relation. There are two more problems, however, connected with axle lighting upon which there is more diversity of opinion and a still greater diversity in means for accomplishment. The first is the question of regulating the generator; the second is that of maintaining constant lamp voltage.

The problem of regulating the generator depends upon the fundamental equation of the dynamo, which may be expressed as follows: $E = NCS$, where E is the electromotive force of the generator, N the number of lines of force supplied by the field and threading through the armature, C the number of conductors on the armature, and S the number of revolutions per second of the armature. In order to obtain a predetermined value for E, it is necessary that the product of NC and S be made equal to E. This gives us great and, in fact, unlimited latitude in the choice of our factors making up this expression. Confining ourselves to the axle-light problem and machines of from three to eight kilowatts capacity, the product of N and C is fixed by the size of the machine. The speed of the train at which it is desirable to have the generator become operative determines S. In ordinary axle-light work, S is generally made to correspond to between ten and twenty miles per hour, and the gear ratio between the axle pulley and that on the generator is generally made somewhere between two and three. S varies all the way from zero to some high value, and consequently E can vary from zero to a correspondingly high value. As S may be zero on account of the fact that the car must sometimes be at rest, E must sometimes be zero, and, therefore, if light is to be at all times available, a storage battery is absolutely indispensable.

This may seem elementary, but it is well to bear these facts in mind. In order to give E certain values it is necessary to manipulate the factors NC and S in some kind of automatic manner. In spite of everything that can be done, S will vary. Various schemes have been devised whereby S is allowed to vary from zero up to a certain value, and from that point on be held constant. Such schemes are elaborate and difficult to devise, and of necessity involve an automatic change in the gear ratio after a certain value of S has been obtained. C is a fixed quantity in a given machine, and it is very difficult to devise a means whereby it can be varied, although attempts have been made to do so. The easiest factor on the right-hand side of our fundamental equation to manipulate and vary is N, and this means that it is easier to vary the strength of the field of the generator automatically than it is to vary the number of conductors on the armature or control the speed of the same. There are no systems in commercial operation in which C and S are manipulated. N may be varied in but two ways. The magnetomotive force or ampere-turns of the field coil may be varied or the reluctance of the magnetic circuit may be varied. The latter is generally difficult to vary, as the form of the magnetic circuit in a given machine is generally permanent. Here again attempts have been made to vary the form and contour of the field and thus produce changes in the reluctance of the magnetic circuit, but all such schemes require complicated mechanical devices and have not come into general use.

The simplest and most direct method of varying the quantity N is by varying the magnetomotive force or ampere turns of the field. This may be done in an almost infinite variety of ways. Two general methods have been employed. As it is necessary to weaken the field of the generator as the speed increases above the critical value which has already been described, the most ordinary way of accomplishing this is to vary the current flowing through the field coil, or what is the same thing, vary the voltage impressed upon the field coil. The other method is to oppose the magnetomotive force of the original field coil by means of current flowing through a second coil acting differentially with the first. The latter method, known as the differential dynamo, requires no external regulator, but it has the serious disadvantage that it usually results in a great deal of heat being developed inside of the machine, and it requires additional coil space to accommodate the differential winding. These two disadvantages necessitate enlarging a machine for a given output and result in very greatly diminishing the efficiency of the machine as a generator. The differential method has the further disadvantage that it does not produce the regulation in the generator that is required and may be regarded as the crudest kind of regulation. The simplicity of the differential dynamo has attracted a good many inventors and designers, but there are no differential generators in use in axle lighting at the present time, so far as the writer is aware. The method of using an external regulator of some kind for properly varying the strength of the magnetic field of the generator has been adopted by practically all builders of axle-light machinery.

The writer will discard for purposes of present discussion all regulators that employ two sets of storage batteries or those types of regulators that fail to charge all of the cells of the battery uniformly or with the same current. This excludes the double-battery systems and the end-cell schemes of generator regulation.

External generator regulators which vary the strength of the current flowing through the field winding of the generator have been built with a view to accomplishing some particular end. There are regulators in which it is attempted to maintain the generator current constant at all times above operative speed. There are others in which it is attempted to maintain the current charging the battery constant under similar circumstances. There are regulators wherein it is attempted to maintain the generator voltage constant at all speeds above the critical. We may, therefore, divide regulators into three general classes, namely, constant total-current regulators, constant battery-current regulators and constant voltage regulators. Of these three general types of regulator, the constant total-current regulator is by far the easiest to build. There are no reversals of current to provide against and no great accuracy or refinement in regulation is necessary. As long as the current maintained by one of these regulators does not vary more than ten per cent and does not at any time exceed a certain maximum, the regulator may be considered perfect so far as it goes. The total-current regulator has the advantage that at all times the generator is working at practically its maximum capacity and efficiency. It has the great disadvantage, however, that unless fairly well adjusted to its run, batteries used in connection with this regulator will become overcharged and great deterioration of the same will result. Overcharged batteries, however, are probably somewhat in the minority, the honors in this respect having been pretty well carried off by the undercharged batteries. The ill effects of overcharged batteries do not make themselves apparent immediately and are really to be discovered in the expense account later on. Undercharged batteries, on the other hand, make their presence known as a rule by a failure in the light, which is the one great thing to guard against in axle lighting. Undercharging of batteries is probably not as destructive as overcharging, but even undercharging will result in greatly reduced capacity and probably permanent injury to the batteries through sulphation and other causes. The Kennedy, the Newbold, the Moskowitz and the Everett are types of constant total-current regulators.

Battery-current regulators are rather more difficult to construct than total-current regulators, as there is always a reversal of current in the controlling winding to be considered when the battery discharges. This, however, can be provided for by very simple means and need not necessarily be a handicap upon the regulator. The battery-current regulator has the advantage that the amount of charging that will be accomplished on a certain run may be predetermined as the charging current, whether it be constant or whether an average value only be considered, is never interfered with or influenced by the lamp load. As to how much the lamps on a given run will be used is an impossible matter to determine, but with the battery-current regulator the amount of charging and discharging can be pretty accurately predetermined and the regulator set to take care of the run very nicely. The battery-current system of regulation very seldom results in overcharging the battery, and, as above mentioned, may possibly result in undercharging. The battery-current system of regulation also permits of a ready means of lamp regulation without complicating the structure of the apparatus to any great extent. The writer here may be pardoned for referring to the bucker system developed by him, which is the only battery-current system about which he has any exact knowledge. In the bucker system the generator regulation is taken care of by a counter-electromotive force and without very much addition to the apparatus necessary for regulating the generator, a very good lamp regulator, and one almost theoretically perfect, may be added without much expense. The battery-current system of regulation, as exemplified in the bucker, employs the important principle that the varying charging current which takes place with varying speeds is a linear function of the excess-battery voltage required for charging the battery and by properly designing the apparatus a constant lamp voltage can be maintained independent of speed and lamp load, provided the battery remains within the limits of the straight-line portion of the charging curve.

Of course, it is quite possible with any type of regulator to devise some means whereby the charging process may be discontinued after the battery has become fully charged. Such devices, however, are unsatisfactory and have not to any great extent gone into general service. These devices are of necessity sensitive and complicated and their development is not likely to be prosecuted with very much vigor.

Constant-potential regulators for the generator have been and can be made. If constructed upon the voltmeter-relay principle they are, however, apt to be very unsatisfactory. The voltmeter relay is of necessity very delicate and uncertain in its action. Assuming, however, that a satisfactory and reliable voltage regulator for the generator can be obtained, it is somewhat of a question as to what voltage it should be set unless an independent lamp regulator is contemplated. If such a voltage regulator is set high enough to insure the batteries being fully charged, the voltage impressed upon the lamps will be altogether too high. A constant-potential regulator has the advantage that by its use storage batteries are pretty certain to become fully charged and never overcharged. It has the disadvantage, however, that if the batteries are in a very low or exhausted condition the generator is likely to become overloaded when it begins to charge such a set of batteries. It would seem then that the ideal generator regulator should combine the good features of the constant-current regulator and the constant-potential regulator.

It is absolutely essential that the generator voltage be equal to the battery voltage at the time the automatic switch closes, otherwise the fact that the automatic switch has closed will be too publicly advertised. It is also just as essential that the voltage of the generator shall rise high enough to force the full charging current through the storage battery with as little increase in speed above the critical speed as possible. This condition is necessary in order that the charging of the battery may begin to take place as early as possible and be continued as late as possible in order to take maximum advantage of the car's travel. The generator regulator should be so constructed that it will permit the generator to deliver its full current into the storage batteries, if no lights are turned on, at as low a speed as possible above the critical speed. To prevent overloading the generator, the regulator should be so constructed that this current will not be exceeded at any speed or on an exhausted battery or even on a dead short-circuit. As this maximum current is forced through the storage battery, its counter-electromotive force will rise and the voltage of the generator must rise also to continue to force the full maximum current through the storage battery. It is needless to state, the storage battery should be of such a size and capacity as to permit of this action. Just as soon, however, as the storage battery has become fully charged the current from the generator should begin to diminish and produce what is known as taper charge. If, however, while this process of charging is going on, lamps should be turned on, the generator should be able to furnish current immediately for these lamps so that no discharge from the battery shall be necessary, at the same time preserving the electrical conditions in the system so that no further charging of the battery shall take place if it has reached the point of being fully charged. Concisely stated, these conditions may be described as follows: A perfect generator regulator is one that tends to maintain the kilowatt output of the generator at a constant maximum without allowing either factor of the same to exceed a fixed maximum—that is to say, if a generator has a normal capacity of fifty amperes at eighty volts, which would be high enough voltage to charge thirty-two cells of battery connected in series, the regulator should permit the generator at all times to put out fifty amperes if there is anything legitimately entitled to receive this current and to limit the voltage of the generator to eighty volts. Such a regulator would, to the writer's mind, be perfect, and he is quite certain that such a regulator can be made and has been made and put into practical operation.

The means for immediately varying the strength of the current in the field of the generator may be a rheostat or a counter - electromotive force. Rheostats may be made in a variety of forms, but they should be so constructed that their steps are very fine or infinitely small, or else the passing from one step to another will be noticeable in the lamps. Rheostats for this purpose are generally constructed in one of three ways. They are either composed of definite steps or resistance brought out to contact plates or buttons over which a sliding contact passes, or they may be made of carbon disks subjected to varying pressures, or they may be made of the contacting type of which the regulator invented by S. W. Everett is a good example. A counter-electromotive force may also be employed, of which the bucker invented by the writer may be taken as a type. If any of these rheostats or counter-electromotive force devices can be controlled so as to produce the tendency toward maximum constant wattage without the factors of current and electromotive force, which make up this wattage, being allowed to exceed certain maximum values, they may be employed in the construction of an ideal regulator.

If a regulator is built along the lines and according to the requirements as set forth it will operate just as well in a one-car system as in a train-lighting system, and will, without readjustment, take care of any load within limits of capacity that is placed upon it, no matter what form that load may take. The load may be composed of the batteries and lamps on one car, or it may be composed of the batteries on one car and the lamps on a half-dozen other cars, or it may be composed of the lamps on one car and the batteries on another car, and still the regulator will, within the capacity of the generator, perform its functions in an ideal manner and the treatment that the batteries will receive will be in practical accordance with the most up-to-date ideas of storage-battery engineers. Such a regulator requires no readjustment to take care of varying schedules, changes of season or character of load.

The last problem to be considered in axle lighting is that of maintaining the lamp voltage constant. Here there is no room for any diversity of opinion. If a lamp can be found whose candlepower will not vary too widely with a range of twenty per cent variation in voltage and whose life and initial candlepower do not suffer by such variation, then the services of a lamp regulator may be consistently dispensed with. The carbon-filament lamp certainly does not fulfill these conditions. The tungsten lamp more nearly fulfills these conditions than any other lamp that has been devised, but no one will say that a tungsten lamp or any other kind of lamp is not brighter on two-and-one-half volts per cell than it is on two volts per cell. There are some engineers in this association who may be satisfied with the approximate lamp regulation which may be afforded by throwing into circuit fixed resistances, but the writer hardly considers devices of this kind regulators. They are more of the nature of protective devices. It has been a favorite scheme with a great many designers to use the motion of the automatic switch for throwing in such resistance to protect the lamps. It has also been common practice to utilize the initial motion of the rheostat controlling the generator for the same purpose. This, however, is not regulation. It affords a measure of protection to the lamps, but it does not reduce variations in lamp voltage.

To produce or construct a theoretically perfect lamp regulator is by no means an easy task. In the first place, such an instrument must be extremely sensitive and must respond definitely to very slight changes in voltage. Variations in the neighborhood of a half a volt should cause such an instrument to respond definitely and positively. It is almost impossible to make such a device operate directly a lamp regulator whose resistance is to take care of or dissipate twenty volts and thirty or forty amperes. Consequently a lamp regulator to be sensitive and positive is generally furnished with some kind of a relay device which possesses the required sensitiveness and which in turn actuates or controls the mechanism for varying the heavy resistance in the lamp circuit proper. The actual device for taking up the drop in the lamp circuit may be either a rheostat or a counter-electromotive force or an end-cell arrangement. For obvious reasons the last is to be avoided, as the unequal charging and discharging of the various cells in the battery only add another difficulty. The steps of a lamp rheostat should be infinitely small, which practically precludes the use of a rheostat made with definite steps of resistance. The carbon disc rheostat lends itself admirably to this purpose, although it is needless to state that it is open to some objections. A counter-electromotive force may be controlled so as to produce infinitesimal variations in voltage, but here again a certain amount of complication is almost indispensable.

An ideal lamp regulator must be able to maintain constant lamp voltage, while the generator and battery voltage vary from two to two-and-one-half volts per cell, and while the lamp current varies from, say, one-half to fifty amperes. If such a lamp regulator can be devised it can be used with equal advantage in an axle system applied to a single car, or it may be used to control the lamps where the current is furnished from a head-end generator, either of the steam or the axle-driven type, or even where the storage batteries have to be charged at a terminal and the lamps used at the same time, as is often necessary when cars are cleaned at night. The lamp regulator should be carried upon the car. It must be ready at all times to reduce the line voltage to normal lamp voltage. The lamp regulator must be separate and distinct from the generator regulator and the action of one must not depend or reflect upon the action of the other. When the lamp regulator is made thus and the generator regulator as above described, a flexible, universal, interchangeable car and train-lighting system will result.

In thus attempting to outline the history of the development of the various elements comprising an axle-light system and in discussing the problems which confront the engineer and designer in meeting the requirements of such a system, the writer has endeavored to eliminate the description of specific devices either of his own or of other inventors' designs.

Fort Wayne Section, American Institute of Electrical Engineers.

The Fort Wayne Section of the American Institute of Electrical Engineers held its regular monthly meeting December 16 at the Anthony Wayne Club, Fort Wayne, Ind. The meeting was preceded by a dinner served in the club dining room, at which most of the members of the Fort Wayne Section and quite a number of visitors were present.

The regular meeting of the section was addressed by E. A. Barnes, superintendent of the Fort Wayne Electric Works, on "Choice of Power for Manufacturing Industries." The paper dealt with the kinds of power which can be used for manufacturing industries, taking up successively power purchased from central stations, power from gas-producer engines, gas engines and fuel-oil engines, and waterpower. Finally the speaker discussed the relative merits of reciprocating and turbine engines, running condensing and non-condensing, and pointed out the advantages which he claimed for non-condensing engines, asserting that the heat which can be recovered from the exhaust steam makes a saving for the factory which more than counterbalances the saving in coal consumption which can be gained by using condensing engines. Mr. Barnes presented some very interesting figures supporting his claims in this regard. The paper was followed by a lively technical discussion by many of those present who are interested in this work.

At the January meeting L. D. Nordstrum will present a paper on "Some Considerations Involved in the Design of Direct-Current Generators and Motors."

ome Handsome and Serviceable Central-Station Advertising.

The Commonwealth Edison Company, Chicago, Ill., is keeping up its reputation for fine display and attractive service in its publicity department. Among the pieces of literature which are attracting particular attention just now is a return postal-card making a Christmas suggestion of the old-fashioned kind. This postal-card bears an illustration of a beautiful Vienna portable electrolier, and the same device used as a wall lamp.

Another holiday suggestion is entitled "An Electrical Christmas." This reproduces Clement C. Moore's beautiful poem, "The Night Before Christmas," and then, in fine half-tone illustrations, shows the many novelties which might bring happiness to every member of the family in the shape of an electrically-operated utility.

The "Handbook of Central-Station Electric-Light and Power Service" delivers a series of profitable essays on "How to Obtain Electric Service," "Rates for Electricity," "Reading of Meters," "Methods of Figuring Bills," "Lamps," "Heating and Cooking Appliances," "Repair Service," and "Shops."

The beautiful souvenir of the Fisk Street power house, with a handsome cream-colored cover, illuminated with gold-leaf, is one of the most attractive pieces of literature which has been issued by anyone in a long time.

The company's publicity service is under the direction of Dana H. Howard, manager of the advertising department, who is to be congratulated upon this excellent series.

Hawaiian Electrical Notes.

The Honolulu Rapid Transit and Land Company has announced that it will shortly make a number of extensions of its service to connect with the city the various forts and military posts which are being built by the navy and war departments. Surveys have been completed for a line six miles in length to connect with the new naval station at Pearl Harbor, and a branch will also be extended eastward from the city to reach the fortifications about completed at Diamond Head. Another branch will probably be extended into the military reservation at Waikiki Beach.

The territorial superintendent of public works, Marston Campbell, will ask the next Legislature, which meets in February, for appropriations to install a 12,000-horsepower electric plant at the Nuuanu Valley Dam, now nearing completion. The new reservoir will supply water with a 900-foot head, which the superintendent plans to use entirely for power, pumping the domestic supply for the city from artesian wells. The plans also contemplate utilizing as a reservoir the concave crater of Punchbowl Hill, back of the city, which has an elevation of about 400 feet. The electric plant is also designed to light Honolulu.

The Hawaiian Telegraph and Telephone Company is the new name of the wireless-telegraph company, as authorized by the Territorial Treasurer. The company has announced, through its president, C. J. Hutchins, the acquisition of the franchise of the Standard Telephone Company, and a contract with the Automatic Electric Company, of Chicago, for the installation of a new telephone system in Honolulu. The company at the present time operates the very efficient wireless-telegraph system between the islands of the group, and the big Kahuku station, which has established successful wireless communication with the mainland. The purchase of property by the company for exchange purposes was recorded recently, and the statement is given out that an up-to-date telephone central station will be built at once. The new telephone system will be of the automatic type, and the company will install a complete underground system for its wires. The project, it is understood, has been financed through the Metropolitan Trust and Savings Bank, of Los Angeles. The company is at the present time experimenting with wireless telephony between the islands.

Notes on the Electrical Engineering Courses at the "Boston Tech."

As is well known, the Massachusetts Institute of Technology maintains strong undergraduate courses in engineering, but it is not so well known that the Institute is attended by what is probably the largest number of graduate students in any of the engineering schools in the country. There are now 215 graduate students studying at the "Tech." The degrees of these men have been conferred by colleges and engineering schools through the continent.

A notably large number of the young men studying electrical engineering at the Institute come from among these graduate students. Many of these students in the electrical-engineering course have heretofore pursued a course in arts or in general science, and are spending two or three years in completing the electrical-engineering course at the Institute. Others have graduated from other engineering schools and are spending from one to two years in study at the Institute to get its baccalaureate degree in electrical engineering; and a few of particularly high preparation are pursuing advanced study and research for the purpose of obtaining the higher degrees of master of science in electrical engineering or doctor of engineering.

It is probable that the latter students occupied in advanced study and research are enjoying the first regularly organized work in this country leading to the degree of doctor of engineering. That degree has heretofore been conferred by American engineering schools as an honorary distinction, but it has not in this country been recognized among the degrees to be secured by study and research in the schools. Brilliant work has been done by students studying for this degree in the great polytechnic schools at Berlin and Carlsruhe, Germany, and work of this nature at the Massachusetts Institute of Technology bids fair to become popular with students of the highest ability and to be influential in the development of engineering research.

The undergraduate electrical engineering course at the Institute of Technology has a senior class, which is twenty per cent larger this year than last year, and the department will soon be a candidate for larger quarters. The laboratory quarters are large and are impressive in their equipment, but even they are becoming overcrowded, and additional classrooms are much needed. The prospects of entering into larger quarters are bright with the advent of the recently-elected president, Dr. Richard C. Maclaurin.

Brooklyn Edison Section, National Electric Light Association.

The first regular meeting of the Brooklyn Edison Company Section of the National Electric Light Association was held December 14, at the Edison Club rooms, Johnston Building, Brooklyn, N. Y. G. L. Knight, chairman of the Section, presided, and 140 members attended. Although the proceedings were not completed until nearly midnight, the enthusiasm and interest were maintained throughout. After an address of congratulation and encouragement by the chairman, Secretary E. A. Bailey read letters from President W. C. L. Eglin and Assistant Secretary Harriet S. Billings, of the National association, both of whom referred to the first number of the bulletin of the Brooklyn company's Section in terms of praise, President Eglin declaring that this publication set a standard and a pace that it would be difficult for other company sections to excel.

The bulletin, which was distributed to those present, contained, in addition to editorial and news matter of general interest to the members of the Section, the complete text and illustrations of all the papers presented on the occasion.

The first paper of the evening was on "Modern Power Plant Design," by F. W. Harrison and M. J. Shugrue. The paper was illustrated by lantern slides, and the subject was treated under the following headings: The building, coal, steam, electrical energy, switch-house, control board, switches, exciters and connections.

The next paper, entitled "Developments in Incandescent Lamps," was also written and delivered in two sections; the first section, viewing the subject from a manufacturing standpoint, by E. B. Rannells, and the second, on the reasons for higher efficiency, and the commercial bearing of the new developments, by M. S. Seelman, Jr.

The last paper of the evening, entitled "Some Notes on the Friction of Shafting," was written by C. A. Graves, and was a practical discussion embodying some interesting and useful data.

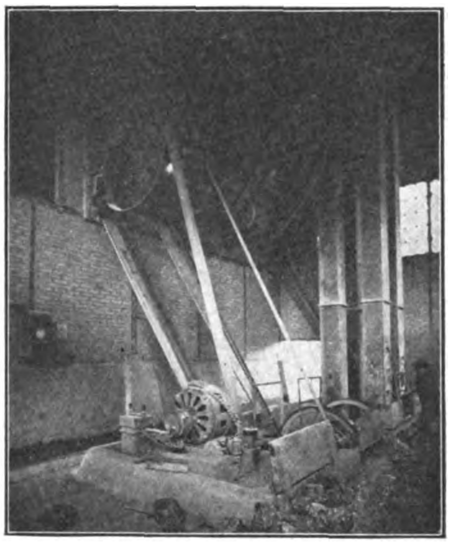
After the reading of the papers was completed, the members took up their discussion in a very spirited and general manner.

The next session will be held in February.

Electric Driving of a German Portland Cement Mill.

BY DR. ALFRED GRADENWITZ.

Portland cement, a combination of lime and slate-holding materials, when stirred with water is known to harden after a given time without any deformation, and is a most valuable material both for the making of mortar and the construction of foundations, etc. The methods of manufacturing Portland cement have been thoroughly modified since the introduction of mechanical operation. Whereas the raw materials formerly were crushed and mixed in stirring tanks in order then to shape the mud into bricks, which after drying were burned in the furnace into clinkers, mechanical operation has now been substituted for hand labor, not only in driving the crushers, crushing rolls, drying drums and grinding mills, but for all the transporting devices used in connection with cement manufacture. The number of hands required is thus reduced considerably and the troublesome production of dust is kept within very low limits by the installation of ventilating fans.

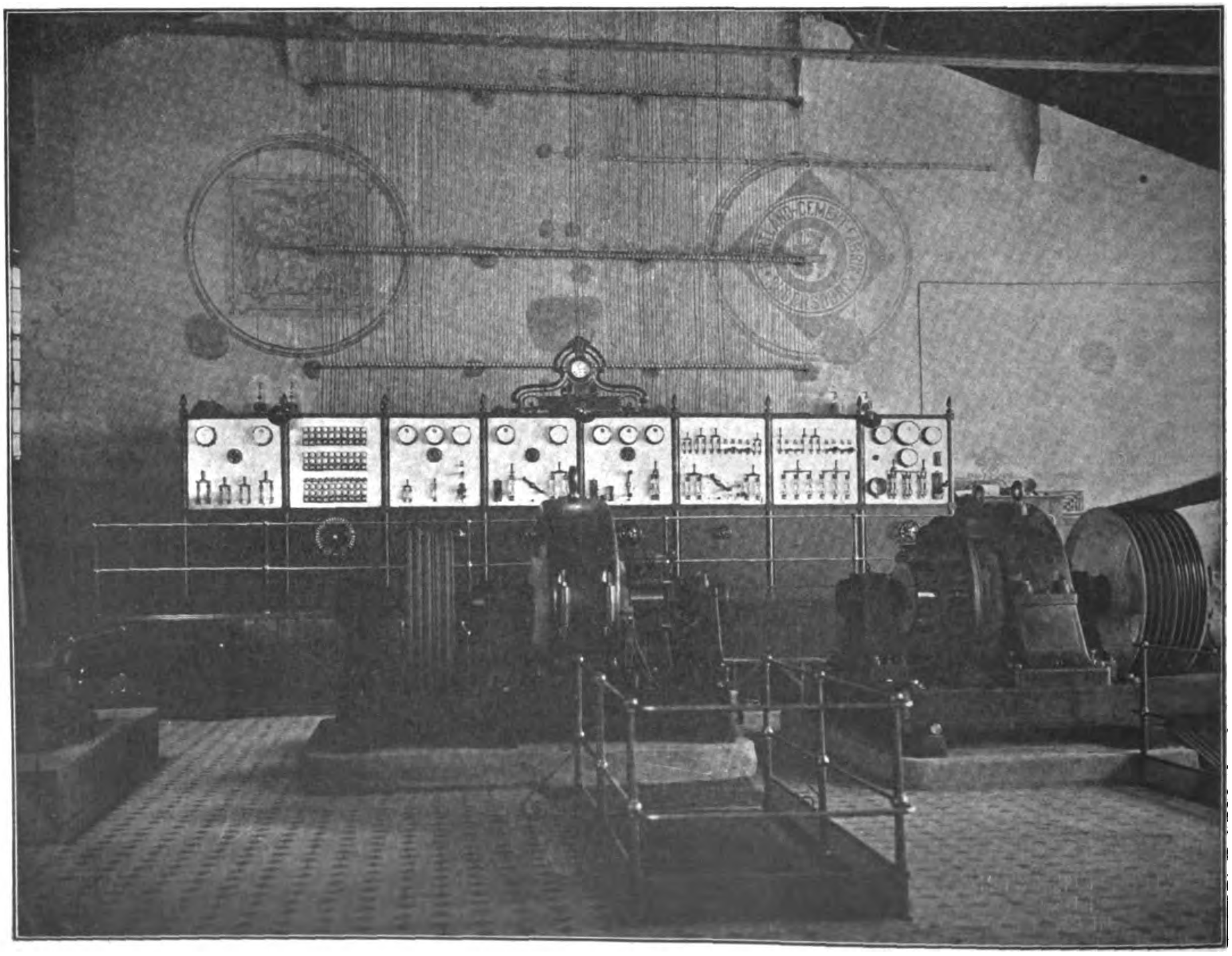


FIFTY-HORSEPOWER MOTOR, DRIVING CRUSHERS AND ELEVATORS.

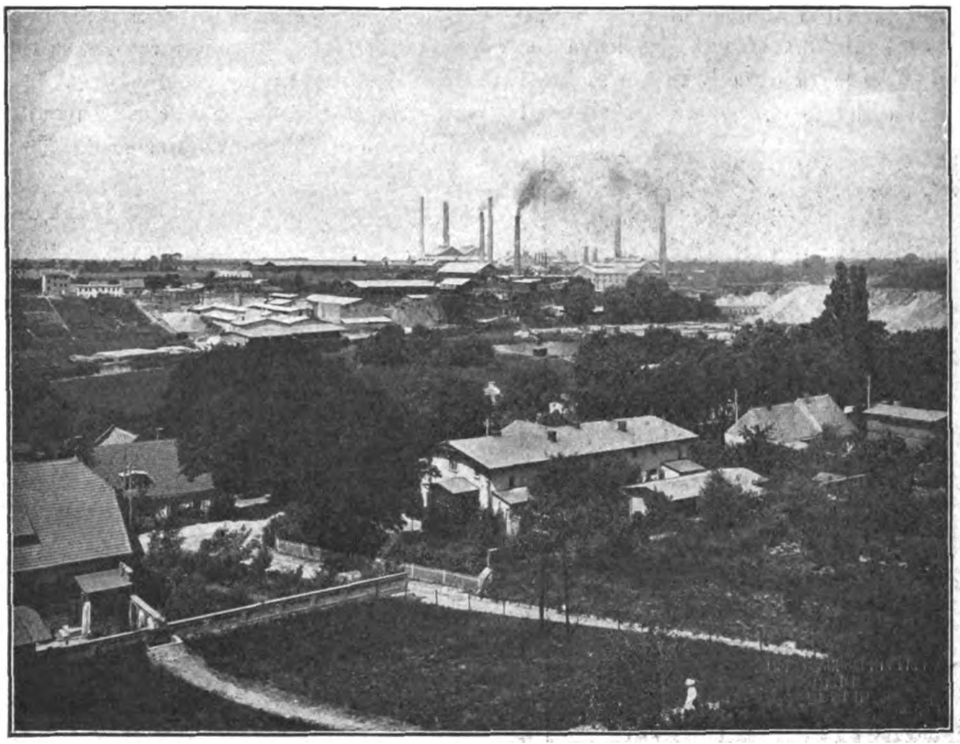
The most interesting point of mechanical operation, however, is the use of rotary kilns in the place of the pit or ring furnaces formerly used, which dispenses with any shaping and transporting work, thus reducing considerably the number of workmen. In fact, the material throughout the regular course of operations never once comes into contact with the shovel of a workman. After being raised to the higher stories by means of elevators, the raw materials (as well as the clinkers) are transported in vibrating chutes in a horizontal direction, whereas the finely ground substances are moved on by worm conveyors.

It will be readily understood that electric motors are specially adapted for the operation of the various kinds of machinery used in connection with this extensive process as well as of the conveyors and ventilating fans, though on account of the low speeds of these machines there is no possibility of using a direct coupling between the machines and motors.

One of the largest and most interesting German cement works in which electric drive has been recently adopted is the Rüdersdorf Portland Cement Fabrik



DIRECT-CURRENT MACHINES AND SWITCHBOARD, RÜDERSDORF PORTLAND CEMENT WORKS.



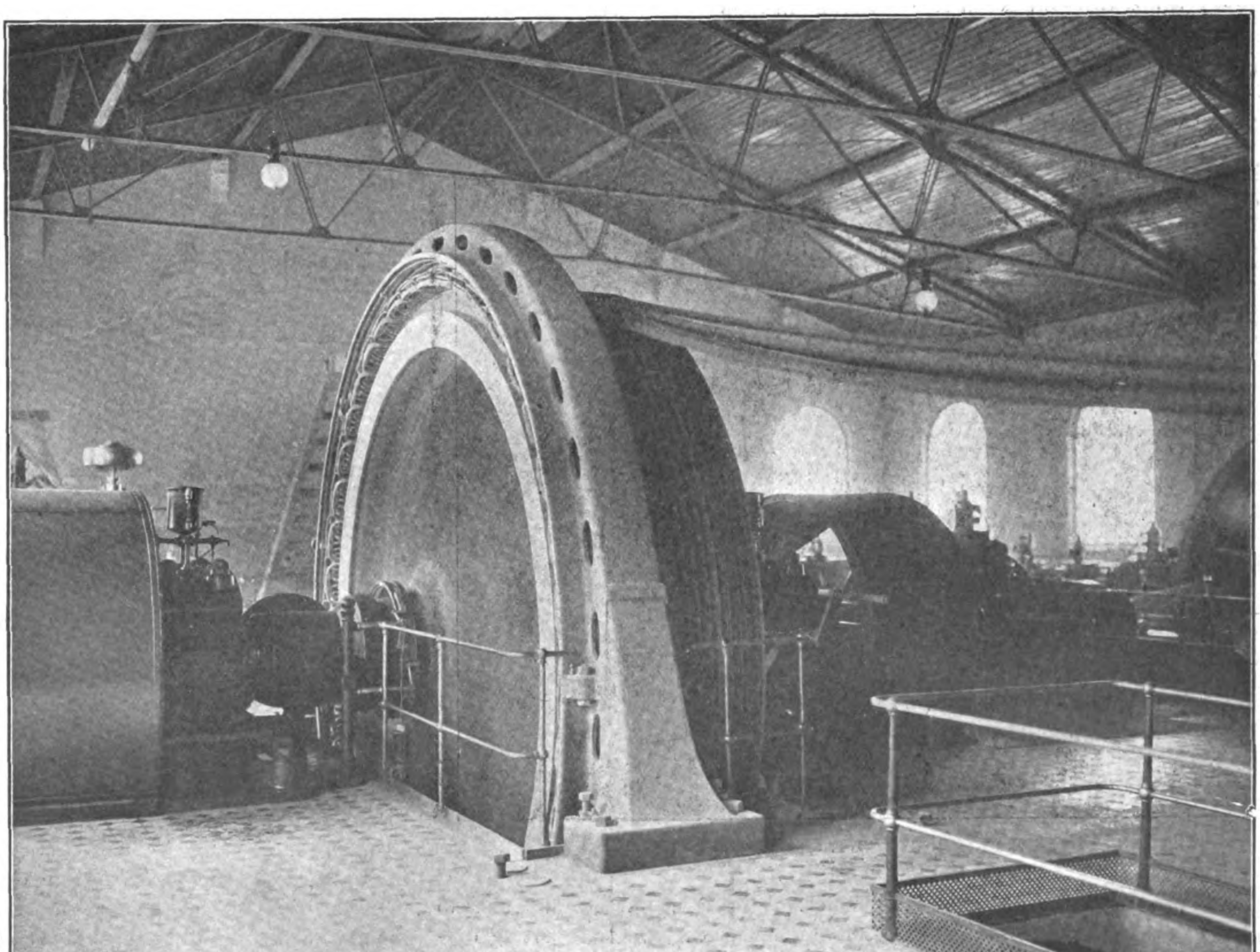
THE RUDERSDORF PORTLAND CEMENT WORKS.

(near Berlin), which has been recently electrified by the Siemens-Schuckert Works.

The equipment comprises a 500-volt polyphase generator of 700-kilovolt-ampere rating coupled to a steam engine, and two direct-current machines of 220 volts and 970 and 610 amperes, respectively. In addition to the supply of power to the factory these generators serve for lighting the works as well as supplying light and power to the neighboring community of Tasdorf. A storage battery is connected in parallel to the direct-current machines. No appreciable influence is exerted on the luminous intensity of the lamps actually in circuit by inserting the motors. The following short description of the manufacturing process will fitly illustrate the various uses of electricity made in this cement plant.

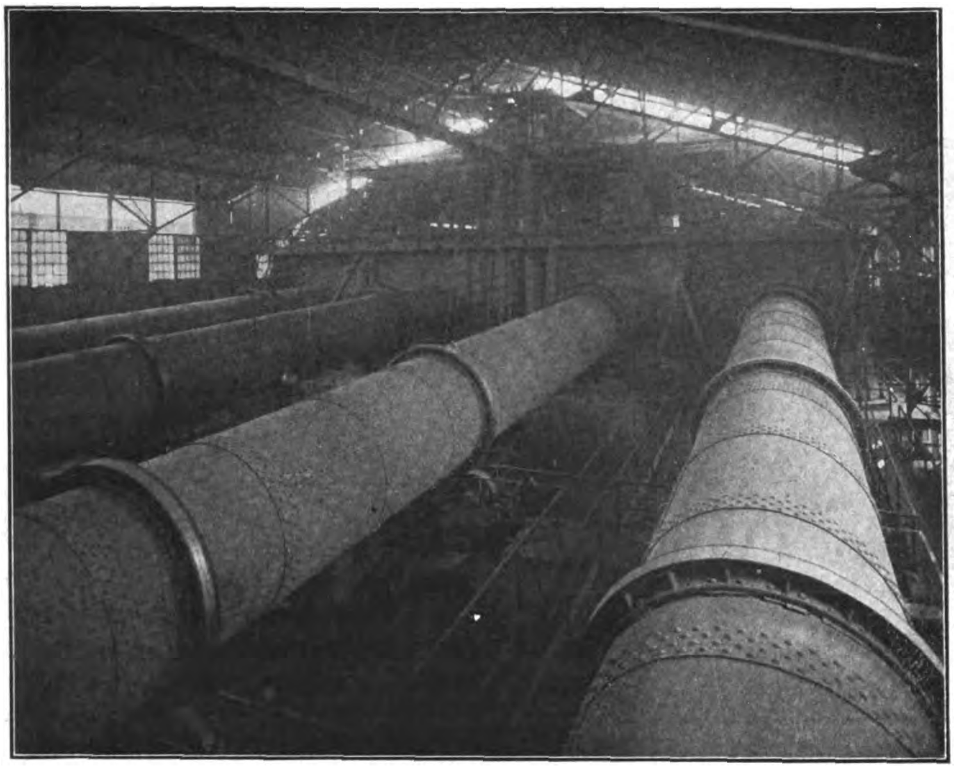
The first part of the operation consists of crushing the limestone in crushers and the slate in crushing rolls. After having been dried in drums the crushed raw material is mixed in predetermined ratios and ground in tube mills driven by two electric motors of 200 horsepower each. From the mills the powdered cement mixture is taken by electrically operated worm conveyors and elevators to the bins and bunkers on top of the four rotary kilns.

These kilns, constructed by the machine

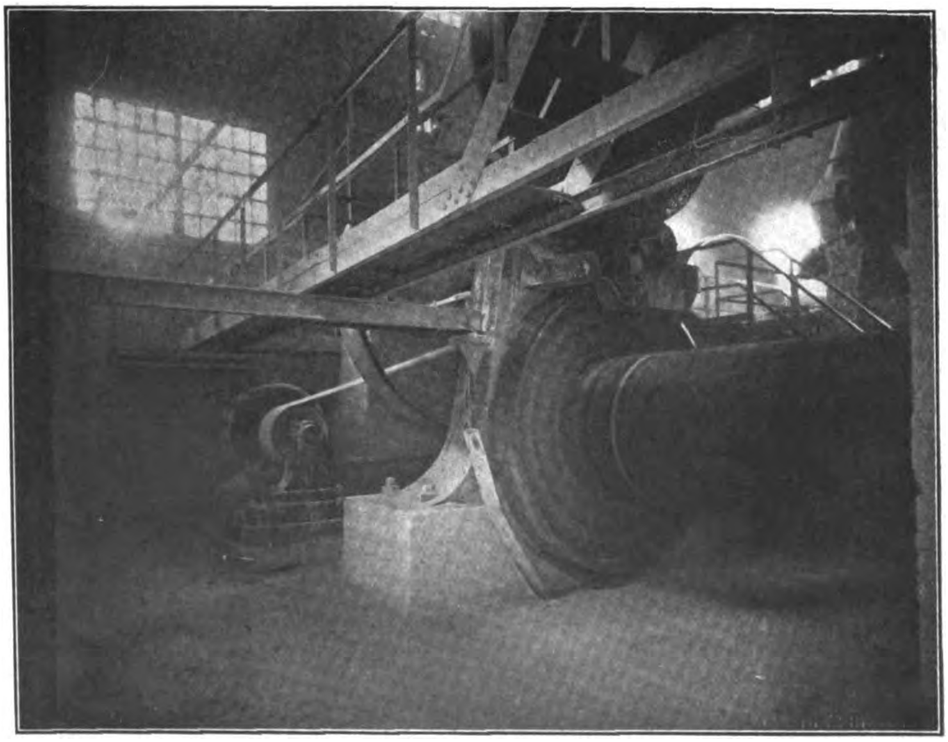


POLYPHASE ALTERNATING-CURRENT GENERATOR, 700 KILOVOLT-AMPERES, 500 VOLTS, : RUDERSDORF PORTLAND CEMENT WORKS.

works of Polysius, Dessau, are practically horizontal tubes twenty-six metres in length and 2.1 metres in diameter, rotating slowly about their axes. A steady supply of the powdered mixture is introduced at the higher end, while the fuel (in the shape of coal dust) is blown in by an air blast at the lower end. The mass is slowly heated to sintering, and during the rotation of the kiln, owing to the inclined position of the tube, moves toward the fire end, situated at a lower level, where the burnt clinkers of nut size leave the drum, to be taken directly to the inclined rotary cooling drums which are situated parallel to the rotary kilns on a lower floor. Each of the four kilns and coolers is operated by a thirty-horsepower electric motor. Electric motors are also used to drive the machinery for transporting, drying and grinding the coal as well as the blowing in of air and coal.



ELECTRICALLY DRIVEN ROTARY :KILNS, RUDERSDORF PORTLAND CEMENT WORKS.



MOTOR DRIVING CEMENT-GRINDING PLANT, :RUDERSDORF PORTLAND CEMENT WORKS.

The finished clinker is taken by vibrating chutes from the rotary coolers to the ball-tube mills to be ground to a fine powder by steel balls. These mills require two motors of 200 horsepower each.

An aggregate of 1,400 horsepower is used for power purposes in the plant described.

Third Avenue (New York) Receivership.

Frederick W. Whitridge, Federal receiver of the Third Avenue Railroad Company, in New York city, in an order signed by Judge Lacombe, is directed to pay William L. Ladd, state receiver of the New York City Railway Company, $42,772, with interest from May 1 last, at the rate of six per cent, the value of coal and other supplies rendered to Whitridge by Adrian H. Joline and Douglas Robinson, former receivers of the Third Avenue Railroad.

Receiver Ladd, in the petition which he presented to the court, valued the property at $51,000. Judge Lacombe, however, on the question of other property involved in the receivership controversy, appointed William L. Turner special master to take testimony and to decide as to its ownership.

New York State Public Service Commission.

The transportation companies reporting to the Public Service Commission for the First District gives the following list of accidents in November, with comparisons:

	Nov., '08	Nov., '07
Total accidents	3,992	4,037
Killed	36	45
Seriously injured	169	198

The total for November is 676 less than for the previous month, and the number of persons injured in getting on and off cars approximates one-half the figures for June and July.

Hell Gate to Be Bridged.

After the Pennsylvania Railroad has advanced farther with its terminal station and other improvements in and about New York city, work will be started on a bridge from Port Morris, a suburb of New York, to Queens County, Long Island. It will be used by the New York Connecting Railroad, a branch of the Pennsylvania system. As planned, the bridge in many respects is to be one of the most remarkable engineering structures ever proposed. With the approaches, it will be three miles long and span the Hell Gate ship channel with an enormous arch 1,000 feet in the clear.

FUEL ECONOMY TESTS AT A LARGE OIL-BURNING ELECTRIC POWER PLANT.

BY C. R. WEYMOUTH.

The writer desires to present the results of various fuel-economy tests at the Redondo plant of the Pacific Light and Power Company, near Los Angeles, Cal., which are of interest, both by reason of steam engines having been used as prime movers and because of the notable economy attained. Owing to the rigorous demands on commercially-operating power stations, an opportunity is seldom afforded to conduct uniform-load tests on a complete plant unit.

The station consists of three main units of 5,000 kilowatts each, the layout being in general on the panel system. For each plant unit there is one McIntosh and Seymour double horizontal and vertical, compound, condensing, automatic engine, size thirty-four and seventy by fifty-six inches, directly connected to an alternator. The rated speed is 100 revolutions per minute. Each engine has two horizontal high-pressure steam cylinders, and two vertical low-pressure cylinders, and is designed to operate at 175 pounds maintained throttle pressure, with 100 degrees F. superheat at the throttle. All steam cut-off valves are under control of the one shaft governor. This engine governor is subject to variation in speed, under the control of a McIntosh and Seymour electrically operated, speed-changing mechanism, situated within the governor and operated from the switchboard gallery.

Directly connected to each engine there is an ATB-sixty-pole, 5,000-kilowatt, 100-revolutions per minute, 18,000-volt, fifty-cycle, three-phase General Electric generator of the fly-wheel type. The revolving field is provided with squirrel-cage winding to prevent hunting. The generator field rheostats are motor-operated, with remote control from the switchboard.

In each plant unit are six Babcock and Wilcox boilers of forged-steel construction, arranged in three batteries of two each. Five boilers are intended for the nominal capacity of the unit, the sixth boiler for reserve. The boilers are twenty-one sections wide, fourteen tubes high, eighteen feet long, with three forty-two-inch drums, each containing a total effective water-heating surface of 6,042 square feet and designed for 200 pounds working steam pressure. Each boiler is equipped with one Babcock and Wilcox forged-steel double-loop superheater.

The boilers are provided with Peabody patent fuel-oil-burning furnaces, having a furnace depth of ten feet from boiler front to face of bridge wall. The burner head is placed at the bridge wall, the flame shooting toward the boiler front. The furnace diverges in the direction of the flame, corresponding to the angle of inclination of boiler tubes. Three burners are used per boiler, and are controlled from the boiler front.

Corresponding to each main generator, there is one seventy-five-kilowatt General Electric exciter, driven by means of a nine and seventeen by twelve-inch Harrisburg tandem compound, non-condensing, piston valve, automatic engine.

There are two Wheeler condensers for each main engine, located in the basement below the operating floor, one condenser being used for each low-pressure cylinder. The exhaust steam is led directly from the low-pressure cylinder into a thirty-inch exhaust main, and after passing through a ninety-degree sweep, drops directly into the condenser. The two condensers on each engine are cross-connected, so that both engines can exhaust into either condenser when the other is undergoing cleaning or repairs. Each condenser contains 5,002 square feet of cooling surface, consisting of three-fourths-inch brass tubes. In addition to the regular cooling surface of each condenser, there is provided in the upper compartment a series of tubes, comprising a Volz heater, through which the condensed water is pumped by the air pump at atmospheric pressure. The feed water is thus heated to within a few degrees of the temperature of the exhaust steam surrounding the upper tubes, thus compensating for the cooling action due to the lower condenser tubes.

Circulating water is supplied by three large engine-driven centrifugal pumps, connected to a common pump-discharge main. Branches from this main supply cooling water to all condensers. The outlets from all condensers connect to a common condenser-discharge main. Each condenser has one Edwards triplex, motor-driven air pump, size sixteen by ten inches.

After passing through the Volz heaters the condensed water is passed through suitably constructed filters for the elimination of the greater part of the entrained cylinder oil. The outlet of the filters is connected to the feed-pump suction main, the supply of water being maintained by an open equalizing hot well, which is also connected to the suction main.

Each unit has one Snow duplex, horizontal, boiler-feed pump, having a compound, non-condensing steam end and an outside center-packed water end. Each unit also contains one auxiliary, Goubert vertical, closed, feed-water heater, of the multiple-flow type, having 1,000 square feet of effective tube-heating surface.

The condensation in the main-engine superheating receiver coils is led to a simple duplex receiver pump. The hot water, at a temperature of about 360 degrees, is returned under boiler pressure to one or more of the boilers in the corresponding unit. The oily drips from receiver bodies are trapped to waste. From the auxiliary measuring tanks, the fuel oil is first pumped through a Goubert closed, multi-flow oil heater, in which the oil is heated to a temperature of approximately 150 degrees F., utilizing the exhaust steam from the oil-feed pump. From the oil heater the oil is led to an oil-pressure main and thence to the oil burners through a suitable system of piping.

An automatic system of regulation was employed for the firing of all boilers in the unit tested, hand firing being used on the remainder of the plant. The automatic system controls the supply of oil to the burners, the supply of steam for atomizing purposes, and the supply of air for combustion. This control is obtained through a steam-pressure regulator which operates a relief valve in the oil-pump discharge line, and is actuated by the variations in steam pressure in the boiler. This means of control causes a variation in the rate of burning oil comparable with the momentary load. With this system, all burner valves may be left wide open, or nearly so, and it follows that the intensity of firing increases or decreases simultaneously in all the boilers.

The supply of steam to burners for atomizing purposes is from a low-pressure steam main, the controlling valves at each of the burners being left wide open or nearly so. The variations in pressure in this main are governed automatically by variations of the oil pressure in the oil main. The regulator used throttles the supply of live steam to the low-pressure main, to produce the desired relationship of oil pressure and steam pressure on the respective burner heads. The supply of air for combustion is automatically regulated by a damper controller, operating a common rock shaft, connected to all

Abstract of a paper presented at the annual meeting of the American Society of Mechanical Engineers at New York on December 2.

boiler-outlet dampers. This regulator opens and closes all boiler dampers synchronously with an increase or decrease of oil pressure in the oil main.

This system is capable of such operation as to control all of its functions completely and automatically. In actual practice, however, it has been found desirable to watch closely the firing of boilers, to make certain that no external conditions, such as clogging of burners, distortion of flames by burners, variation in temperature of fuel oil, as fired, etc., are present to prevent the attainment of the highest possible efficiency. To minimize heat losses due to radiation, all live steam heat-radiating surfaces are covered with non-conducting covering three inches in thickness, and other surfaces are covered in accordance with the dictates of good practice.

OUTLINE OF TESTS.

The data and results given herein are based on the following tests:

a. Official fifteen-day variable-load test on No. 2 plant unit.

b. Uniform-load test at approximately 2,000 kilowatts output No. 2 plant unit.

c. Uniform-load test at approximately 3,000 kilowatts on No. 2 unit.

d. Uniform-load test at approximately 4,000 kilowatts output No. 2 unit.

e. Uniform-load test at approximately 5,000 kilowatts output No. 2 unit.

f. Test complete plant at variable load similar to the official test.

These tests are more fully described under their respective headings.

OFFICIAL FIFTEEN-DAY TEST.

The official test of this station was on No. 2 plant unit, and was made to determine the economy of the plant under contract conditions, as a basis for computing the bonus earned by the contractor, or the penalty due the owner. The result of this official test is now common knowledge, but not all the conditions surrounding the test have been heretofore published; and as the result of the official test on variable load is of interest for comparison with the results of the uniform-load test, herein presented, the writer desires to review the more important conditions attending the official trial. The contract placed the official test under control of a testing committee. The contractor's commercial-load economy guarantee was as follows:

The company guarantees * * * that the "first unit" * * * when operating on commercial-railway load, under ninety days' test, conforming to the conditions herein specified, will develop an average economy of 170 kilowatt-hours per barrel of oil.

The total net output of unit under test for each day will not be less than 60,000 and not more than 78,000 kilowatt-hours.

The main unit under test will be in operation during nineteen-and-one-half consecutive hours per day, and will be shut down four-and-one-half hours per day. The temperature of circulating water entering the condensers will never exceed seventy degrees Fahrenheit.

The power-factor of the electric load will be at all times between eighty and 100 per cent. Total load on 5,000-kilowatt alternator will never exceed 6,000 kilowatts. The load on 5,000-kilowatt generator greater than 5,000 kilowatts will last for an interval not greater than one-half minute duration; and there will be not to exceed ten such intervals during any hour that the plant is under test.

The load on the unit under test will be such as would be produced by the regular and normal working of the railway system to which the power is furnished by the purchaser, and varying within the limits herein described.

The load will not be manipulated so as to be either favorable or unfavorable to the showing of unit under test, within the limits herein specified.

It was optional with the contractor to insist on the operation of the test unit on a separate transmission line. This would have inconvenienced the purchaser, and for operating reasons a compromise was effected, it being agreed to operate the test unit during the official test in accordance with an agreed load curve, subject to certain upper and lower limits.

The control of the load during test was thus left entirely to the purchaser's station operator within the specified limits and subject to such momentary variations as would be imposed on the test unit by the fluctuation in load on purchaser's system. It was thus attempted to generate a total of 72,280 kilowatt-hours per day, with the understanding that should the total kilowatt-hour output up to any hour exceed that shown by the load curve, then, during the remainder of the test period, the load was to be modified to correct for any variation in the total output, so as to maintain the total daily output of the unit uniform and as agreed.

Endurance features having been established, by reason of the long period of operation previous to the test, the period of test was subsequently reduced from ninety to fifteen days. And, owing to certain advantages that might accrue to the contractor, such as superior economy due to shortening of test, the contractor agreed to deduct from the bonus otherwise due the sum of $50,000 in consideration of this reduction of test period.

The economy guaranteed initially included the provision for lighting the unit under test from energy generated by the test unit. Correction for lighting was made by deducting from the total net output of the unit under test an amount of power equivalent to 125 kilowatt-hours per day, and the reported economy is based on the net figure after making this deduction.

During the test the power for operating the air-pump motors, for operating motors connected to circulating pumps used for passing cooling water through engine bearings and guides, for operating electric motor in main engine speed-changing device, and for operating electric motor for controlling switches, was taken from the leads of the main generator in such a way as to compel the wattmeters to indicate only the net useful output of the unit.

It is only fair to state that, owing to the layout of the plant, certain auxiliary apparatus in connection with the plant was installed by the purchaser, power for which was not taken from the unit under test. These auxiliaries, with the exception of the circulating pumps, are not necessarily essential in the guarantee of power; that is, they may or may not be required in a power plant, depending upon local conditions, etc.

During the tests special weighing and receiving tanks were provided for the measurement of the fuel oil required by the unit under test. After weighing, the oil was emptied into a receiving and heating tank, the heating being done by steam from the unit under test, and from there conveyed by gravity to the oil-feed pump used for feeding oil to the burners.

All instruments were accurately calibrated and standardized. For purposes of the tests a total of twelve integrating wattmeters were purchased, and, after calibration in place under conditions of operation, it was finally decided to determine the power output by using one wattmeter in each phase of the generator, there being three reserve wattmeters. Meters were connected in the main winding of the generator between the grounded center of the winding and the winding itself.

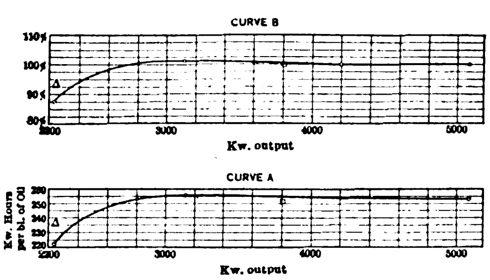
A large corps of assistants and observers was employed during the tests. At one time a total of eighty persons was directly involved. The neutral observers, including the members of the graduating classes in electrical and mechanical engineering of the University of California, were under the direction of the chairman of the testing committee. In all details of the test care and accuracy, in keeping with the importance of the desired results and the amount of bonus money involved, were observed.

UNIFORM LOAD TESTS.

During the uniform-load tests the same general conditions prevailed as during the official trial, except as herein indicated. Though unofficial, the determination of fuel burned and power output during the uniform-load tests was still under control of the testing committee and the same corps of observers, although the wattmeter readings were taken less frequently, as a result of experience during the official trial. The calculated economies given are obtained from the readings made by the neutral observers. It should be stated, however, that the testing committee never completed any official report for these uniform-load tests, as the results of the uniform-load tests were of no consideration in determining the amount of bonus to be paid the contractor.

TABLE SHOWING RESULTS OF VARIABLE AND UNIFORM LOAD TESTS ON ONE 5,000-KILOWATT UNIT, ALSO VARIABLE LOAD TEST ON COMPLETE PLANT, AT REDONDO, CAL.

Designation of Test	Unit	Variable Load Average of 15-Day Tests	2,000-Kw. Load Test (Approximate)	3,000-Kw. Load Test (Approximate)	4,000-Kw. Load Test (Approximate)	5,000-Kw. Load Test (Approximate)	Variable Load Complete Plant Test
Date of starting test	1908	April 18	May 14, 10:30	May 19, 8 a. m.	May 18, 10 a. m.	May 5, 12 noon	May 21, 11 a. m.
Date of stopping test		May 4	May 14, 3:30	May 19, 11 p. m.	May 18, 12 m. n.	May 5, 11 a. m.	May 22, 11 a. m.
Duration of test	Hours	24	5	13	14	23	24
Time of starting fires	......	......	5:10 a. m.	3:00 a. m.	5:10 a. m.	4:35 a. m.	5:05 a. m.
Period of warming boilers	Hours	......	5:20	5:00	4:50	7:25	5:55
Average steam pressure at engine throttles	Lb. per sq. in.	180.03	183.	181.74	180.9	189.3	173.76
Average superheat at engine throttles	Deg. F.	82.46	87.99	92.	96.05	92.78	95.15
Average temperature circulating water inlet	Deg. F.	63.03	61.64	61.41	61.34	62.4	59.33
Average temperature circulating water outlet	Deg. F.	79.15	78.09	79.37	79.02	81.09	82.12
Average vacuum in condenser (Corresponding 30 in. Bar.)	In. Hg.	28.334	28.426	28.343	28.214	27.976	27.784
Average temperature of feed water leaving heater	Deg. F.	146.9	184.3	167.8	155.9	150.7	177.22
Kilowatt output (including lights)	Kw.-hr.	71,615.24	11,225.577	47,126.457	58,745.125	116,899.748	215,262.438
Net kilowatt output, deducting lights	Kw.-hr.	71,490.24	11,199.535	47,048.332	58,665.208	116,781.956	......
Fuel oil as fired (334 lb. to bbl)	Bbl.	303.387	50.01	195.458	244.783	496.910	957.566
Heat units per pound oil as fired	B. t. u.	17,840.	17,938.8	17,920.8	17,965.8	17,838.	17,717.
Sulphur in oil (by weight)	Per cent	2.34	2.17	2.43	2.39	2.49	2.60
Moisture in oil (by weight)	Per cent	2.38	1.82	2.08	1.895	2.70	2.59
Silt in oil (by weight)	Per cent	.14	.138	.14	.113	.10	......
Fuel oil corrected as per contract	Bbl.	282.746	47.219	183.307	230.764	460.884	883.115
Economy (oil corrected as per contract)	Kw.-hr. Bbl.	252.842	237.298	256.664	254.252	253.382	243.758
Economy (oil corrected as per contract)	B. t. u. Kw.-hr.	24,438.	26,039.	24,074.	24,302.	24,386.	25,349.
Economy corrected only for heat units, in oil	B. t. u. Kw.-hr.	25,288.	26,742.	24.857.	25,027.	25,347.	26,320.
Number of boilers in service	No.	5	3	5	5	6	15
Combined efficiency of engine and generator based on separate exciter	Per cent	......	90.2	92.5	94.1	94.75	......



CURVES SHOWING ACTUAL AND RELATIVE FUEL ECONOMY AT FRACTIONAL LOADS, 5000-KW. UNIT.

Curve A Shows Fuel Economy at Various Fractional Loads in Kilowatt Hours per Barrel of Oil. Curve B Shows Relative Fuel Economy at Fractional Loads as Compared with Economy at Rated Load of 5000-kw.

VARIABLE-LOAD TEST OF THE COMPLETE PLANT.

During this test the entire plant was operated under commercial conditions of load, except that an attempt was made to follow on all three units the load curve used during the official test. The circulating pumps were supplied with steam from the various boilers, and all plant auxiliaries, including those omitted from official test, were included in the complete plant test. All these last-named auxiliaries were not in use at all times, however. The output of all units was determined by means of station wattmeters which have since been carefully calibrated by the purchaser, and the correction factors as found applied to the observed readings.

This test did not in any sense do justice to the plant, owing to operating conditions, as explained below, and for this reason the test was protested by the writer and at the time was discarded by the testing committee. The writer has since felt, however, that the result is of interest, and offers it with this explanation.

OPERATING CONDITIONS DURING TESTS.

During all the tests the plant was handled by the regular station operators under the control of the contractor's superintendent of construction.

The load was quite variable, necessitating constant adjustment of auxiliaries, oil burners, dampers, etc. On boilers of No. 2 unit, the automatic system of firing was used during the official test and during uniform-load tests. Control of oil burners and dampers on No. 1 and No. 3 units during the complete-plant test was by hand.

The contractor's experts were present during all tests, and cautioned the operators when necessary. Much credit is due them for the exceptional performance of representative apparatus.

During the official fifteen-day test certain unfavorable conditions predominated, for which no correction has been made in the stated economy. Owing to the accumulation of seaweed in the circulating-water pipe line, and the interruption of flow of circulating water through the condensers, there were intervals when either one or both condensers of the test unit operated at a reduced vacuum, and at other times it was necessary to run the engine non-condensing. Frequent shorts occurred on the lines, and again periods of excessive overload. During the official test, instead of following the comparatively smooth load curve agreed, momentary changes in load were of considerable magnitude. The actual load curves show a marked saw-tooth effect, momentary changes being so violent as to cause unfavorable economy, these variations in load not only affecting the economy of the prime mover, but also the performance of boilers, the continual change in rate of oil firing, air supply, steam supply to burners, etc., making it impossible to secure the best results, although the automatic-firing system employed on No. 2 unit no doubt greatly reduced such losses.

Certain of the uniform-load tests were of comparatively short duration. The results of such tests are therefore subject to slight error. The initial period of starting the uniform-load tests was determined by the testing committee, and while the writer has reluctantly assented to certain of these intervals, it will be self-evident that for certain of these tests the period allowed for warming up boilers before starting of test was not sufficient to eliminate all of the heat storage effect, and is not fully in accordance with the society's rules for conducting such trials. Previous to certain tests the boilers had been down for such lengths of time as to be practically cold. In other cases the boilers had been at stand-by for four or more hours previous to starting fires, except during the 3,000-kilowatt test where the boilers after previous day's run were kept up to steam pressure by intermittent firing. The results, therefore, from this standpoint are slightly unfavorable, the fuel consumption stated involving to some extent the fuel loss due to warming up the boilers.

The test for the 2,000-kilowatt load was made with three instead of five boilers in operation, as is the regular practice at this plant during any prolonged running at such loads. Owing to the short period of the test, it would have been impossible to keep the two idle boilers on the line and fire at intervals during the test in such a manner as to guarantee the same amount of heat storage in the idle boilers at both commencement and end of the test period. The amount of such loss due to stand-by of the idle boilers was therefore determined separately by actual measurement, and the resulting fuel loss is given in the accompanying table, corresponding to which due correction in economy has also been figured. The amount of this correction corresponds to the heat necessary to keep the two idle boilers continuously up to full boiler pressure. It is a fact, however, that the actual stand-by loss was less than this amount, owing to the reduction in the rate of heat radiation which takes place after the boiler has appreciably cooled.

During the uniform load tests it was necessary, owing to peculiar conditions of operation, to lower materially the power-factor of the unit under test in order to control the load on same more readily. Owing to this lowering of the power-factor below the range for which the wattmeters were carefully calibrated, an error was introduced in the readings, manifesting itself in a tendency of the meters to run too slow, thus indicating an output less than actual. Further, owing to the lower power-factor imposed on the main generator, the C^2R and other losses were greater than normal (80 to 100 per cent), causing a falling off in generator efficiency and consequent reduction of fuel economy.

During the complete plant test the head on the circulating pumps was measured and averaged in the neighborhood of thirty-five feet. This excess head is due to the fact that the purchaser met with certain reverses in the installation of the circulating water pipe line, making it necessary to install internal angle iron strengthening ribs. The suction and discharge piping is also subject to certain air leakage and to a considerable accumulation of seaweed both in the main suction line and in the suction line strainers. As a result of this condition, not only were the total head and duty imposed on the circulating pumps during the complete plant test exorbitant, but the quantity of circulating water handled was not quite sufficient for the most economical vacuum requirements when all three units were in operation. During all these tests certain unfavorable conditions existed as to the character of oil burned and the treatment of same preparatory to burning.

OBSERVED DATA.

In the accompanying table is given a summary of the observed data and the calculated results for the various tests, including averages of steam pressure at engine throttles, superheat at engine throttles, condenser vacuums, circulating water temperatures, etc.

FUEL OIL SPECIFICATIONS AND CORRECTIONS.

Certain arbitrary corrections were agreed on in formulating the guarantee of this plant, and the nature of such corrections should be well understood in order to gauge the value of the results herein given and the possible error that may have been introduced by reason of such corrections.

It is well known that with the poorer grades of coal, having excessive quantities of ash, sulphur, moisture and other volatile matter, there is a falling off in the furnace efficiency as compared with the combustion of the better grades of coal; so with crude oil having excessive quantities of moisture, sulphur and silt, or of low specific gravity, there is an appreciable falling off in the furnace efficiency as compared with a grade of crude oil of average quality. It is certain, however, that most of the losses due to foreign matter are less with oil fuel than with coal, but the exact extent of these losses is so far unknown.

During the preliminary negotiations for the Redondo plant the contractor's guarantee of 170 kilowatt-hours per barrel of oil was based on an average quality of Bakersfield crude oil, of known furnace performance, having the following specifications:

Specific gravity, sixteen degrees Baume.

Corresponding weight per barrel, 336 pounds.

Heat units per pound of oil calorimeter test, 18,500.

Moisture limit, one per cent.

Sulphur limit, one-half per cent.

On the day of closing the contract the purchaser insisted on testing the plant with oil secured from the purchaser's near-by wells; and while this oil never had been used during any authentic boiler trials, yet it was known to be of low gravity and low in heat units, to have considerable quantities of both moisture and sulphur, and in general to be a decidedly inferior grade of oil.

After some discussion a compromise was effected whereby the economy guarantee was allowed to remain as stated, the oil specifications being changed to the following:

Minimum specific gravity of oil fourteen degrees Baume.

Maximum specific gravity of oil, eighteen degrees Baume.

Agreed weight per barrel, 334 pounds.

Minimum heat units per pound of oil, 17,000.

Moisture limit, five per cent.

Sulphur limit, two-and-one-half per cent.

Silt, etc., limit, one-half per cent.

It was finally agreed that in addition to correcting on the heat-unit basis a further correction should be made for the presence of sulphur exceeding the limit of one per cent or moisture exceeding one-half per cent, and the purchaser should be penalized by deducting as oil from the weight of oil fired the weight of all moisture in excess of one-half per cent, all sulphur in excess of one per cent and all silt and other foreign matter.

It is a well known fact that oil, low in gravity, requires an excess of steam for preheating in the auxiliary suction tanks, both for the preliminary treatment of the oil in an attempt to remove the excess of moisture and silt by warming and also to enable the oil pressure pumps to lift this oil, under suction without danger of interruption in the pumping of oil to the burners. It is also well known that all crude oils are complex mixtures of various hydrocarbons, that distillation takes place to varying extents at all temperatures, and that the higher the temperature to which the oil is heated in an open tank the greater the loss due to such distillation.

It is further well known that the heavier the oil the greater the amount of heating necessary in the pressure heaters between pumps and burners, where heat is added to facilitate atomization of the oil and to economize in the amount of steam necessary for such atomization. In addition to the general falling off in furnace efficiency, due to the poorer grade of crude oil, there was a further and rather indeterminate loss due to the effect of sulphur and silt, which caused a slight clogging and corrosion of the burners and at times a distortion of the flames. The sulphur fumes from the products of combustion also escaped from the boiler setting, causing a serious annoyance to the firemen and necessitating an excess of air supply to overcome the trouble.

With our present knowledge of the combustion of oil fuel it is impossible to rationalize the results of the Redondo tests so as to determine exactly the true thermal efficiency that would have been attained had an average grade of crude oil been used. During the tests, as will be noted from the values given in the table, the grade of oil used was of very low specific gravity and contained excessive quantities of moisture, sulphur and silt. It is indisputable that an appreciable loss in efficiency resulted from the presence of these foreign substances, but owing to the arbitrary nature of the corrections made the plant economies herein stated may be in error by small percentages, the amount of which must remain indeterminate. This criticism will likewise apply to all similar tests which are not made with a grade of fuel recognized as standard.

As a matter of interest there are included in the table figures showing the plant efficiency, omitting the contract corrections; it must be borne in mind, however, as above stated, that these figures evidently represent a lower economy than would have been obtained with the standard grade of oil specified.

Considerably better economy would be expected in the uniform load tests than was secured in the official test, namely, 252.842 kilowatt-hours per barrel of oil. The actual results were not very much higher, however, for as already explained the period allowed for warming up the boilers before starting certain of the uniform load tests was not sufficient to overcome the loss due to radiation during the lay-over period, and the results were lower than they should be on this account. It should also be borne in mind that in the so-called uniform load tests the actual load varied from time to time, requiring a constant adjustment of oil burners, dampers and auxiliary apparatus, and while the magnitude of these variations was small, yet the variation in load was such as to cause a loss in economy as compared with an absolutely uniform load. The economy obtained at the various uniform loads is plotted in the curve shown. The economy at various fractional loads as compared with the economy at the rated load is also shown in the same diagram.

Inasmuch as the absolute economy at the various uniform loads is probably greater than reported, for reasons pointed out above, and as the correct economy at the uniform load tests would probably be a small but uniform percentage greater throughout all of such tests, it is fair to assume that the relative economies as shown are reasonably accurate, and for this reason the writer considers the curve showing the relationship of economies at various loads to be of greater value than the results of individual tests. There have also been plotted the points corresponding to three in lieu of five boilers, for 2,000-kilowatt load, for both of the above curves, as well as the economy obtained for the official test for the equivalent average load.

In studying these curves it should be borne in mind that the results given indicate the entire falling off in fractional load efficiency for the complete plant, being the multiplied effect due to various losses, such as electrical efficiency of generator, mechanical efficiency of engine, indicated economy of engine, auxiliary performance, and the greater effect at light load of dead load losses, such as heat radiation from exposed piping and other radiating surfaces, and the loss in efficiency of boilers owing to operation at fractional loads. As the total effect of all these losses is relatively small, it is in itself evidence of the high maintained steam economy of the prime mover at very light loads. The combined efficiencies of engine and generator are shown in the table, and as this falling off in efficiency at light loads is quite apparent it offers additional evidence as to the maintained indicated economy of engine at fractional loads.

A falling off in economy would be expected for the complete plant test of all three units as compared with the official test of No. 2 unit for many reasons; among these are the excess of head imposed on circulating pump, the deficiency in quantity of circulating water causing a severe loss of vacuum at intervals, and at the completion of test the operation of the plant non-condensing; the use of energy from the plant to operate a fifty-horsepower motor driving a duplex vacuum pump, necessary to remove air leakage in suction line; the use of energy in pumping water from the plant for operating motor-driven oil pumps in pumping oil from main oil tanks to auxiliary oil tanks; the use of energy from plant in pumping well water from the purchaser's wells to the plant; the energy used for pumping out sumps; the energy used for lighting various surrounding buildings and wharf; the necessity for hand control of firing the boilers of No. 1 and No. 3 units, the automatic system being in use on No. 2 unit only. Considering all of these conditions, the economy for the complete plant is very favorable indeed.

As having a bearing on the economy of the plant, the writer would explain that to conform to the contract load requirements during test, which are designated as the maximum requirements of the plant during commercial operation, and further to economize in the first cost of plant, the main engines were initially selected to have a normal rated capacity of 4,000 kilowatts in lieu of 5,000 kilowatts, the rated capacity of generators. The writer hoped thereby to obtain sufficiently increased economy at the lighter loads to offset the possible loss in economy due to overload. It has been shown that these 4,000-kilowatt engines are capable of carrying overloads in excess of 7,000 kilowatts. It appears, however, that it would have been a decided improvement had larger engines been selected, conforming more nearly to the rating of the generators. Due to the use of superheated steam, high fractional load economy would have been insured, the overload capacity still further increased, and superior economy maintained at loads considerably above rating.

Having no bearing on the economy of the unit, but as a matter of particular note, the writer would state that following the acceptance test on the plant, the engine for the No. 1 unit was operated under various conditions to determine the possibilities in case of an emergency. It was shown that the unit could be operated on either one, two or three as well as four cylinders. The running conditions were smooth and the successful parallel operation of the alternators was easily accomplished under all conditions. It was further possible temporarily to overload the cylinders in use during these special trials to such an extent as to produce in the neighborhood of 1,800 kilowatts per cylinder. The time required to remove a connecting rod in case of an emergency was found to be between one and two hours. It was also found possible to operate the entire engine on one condenser as well as both condensers, causing but a slight reduction in vacuum, the second condenser being available for repairs, etc. In case of difficulty through seaweed in the circulating water the engines were often run for a long time non-condensing.

The writer believes that this type and arrangement of prime mover offers features of flexibility that merit very careful consideration and enables the maintained operation of steam power plants, under both normal and emergency conditions, with a far less percentage of reserve capacity than is permissible with any other type of prime mover. The Redondo plant is today operating without any reserve capacity whatsoever, and since the completion of the work it has regularly operated under all conditions of service desired by the management.

As the maintained economy of any type of prime mover is of great importance, the writer is able to state that the station records so far fail to indicate any considerable falling off in economy as compared with test conditions. On the other hand, it is a matter of record that a complete plant economy has been attained, since operation of plant by purchaser, exceeding that herein reported. During the dry season this year and by reason of the large overload capacity afforded by these engines, the management has been compelled and has been able to operate this station under continuous load far in excess of that for which it was designed. The engines have been operated for long periods at overloads of seventy-five per cent above the rated loads, and during such periods only a slight falling off in economy has resulted, which was less than would be expected on account of the special way in which the engines were rated.

No. 1 and No. 3 units are now being equipped with an automatic system of firing similar to that on No. 2, and it is expected that the station economy will be materially improved thereby.

COMPARISON OF ECONOMY WITH COAL-BURNING PLANTS.

For the purpose of comparing the economies herein reported with those obtained in modern coal-burning stations, the writer has given the fuel consumption reduced to the corresponding British thermal units per kilowatt-hour; these figures are possibly subject to slight error, however, by reason of oil corrections already explained.

COMPARISON WITH TURBINE PERFORMANCE.

To the writer's knowledge, the best turbine performance on the Pacific Coast based on oil fuel is considerably under that found for the Redondo plant.

When comparing these results with economies reported for eastern turbine stations the writer would call attention to the necessity of making due allowance for the variation in the initial temperature of the circulating water. The average temperature obtainable in the vicinity of Los Angeles is from sixty to seventy degrees F., as compared with circulating water temperatures in the neighborhood of the freezing point, obtainable at times in many eastern stations, this lower temperature enabling the attainment of a considerably improved vacuum. Inasmuch as the steam turbine gains largely in apparent economy, due to increase in vacuum, similar reductions should be made in the stated economy of such plants, and correspondingly in the reported fuel consumption.

The writer believes that the performance herein indicated is noteworthy and warrants on the part of designing engineers a far more careful and thorough investigation as to the capabilities of steam engines, when used as prime movers, than is manifested in the practice of late years.

Steady Flames for Atmospheric Nitrogen Extraction.

Almost the reverse of the older form of electric arc employed in the Birkeland-Eyde process of nitrogen extraction from the air, in which a high-tension, alternating-current flame is blown into a veritable disc transversely to a direct-current magnetic field, is the method used by the Badische Anilin und Soda Fabrik, which has a working agreement with the Birkeland-Eyde Company. Long, thread-like arcs are employed to oxidize the nitrogen of the air. The air is blown tangentially so as to circulate spirally around the quietly-burning arc. In some examples of this apparatus recently exhibited the tubes were of glass, coated on the inner periphery by a wire spiral, which was in metallic contact with a knob at the top of the tube. At the bottom of the tube the wire spiral is only separated by a short distance from the other electrode, which is placed in the axis of the tube. When a 3,000-volt supply is applied between the two electrodes a spark jumps across and the arc travels rapidly up the tube. If, now, air is forced in at the bottom through a number of symmetrically-placed tangential nozzles, the arc burns quietly in the axis of the tube without touching the sides, and absorbs about four amperes at 3,000 volts.

The air charged with nitrous gases which leaves the top of the tube gives up some of its heat in raising the temperature of the fresh air about to enter the tube to some 500 degrees Centigrade, and the rest is employed in steam generation. The cooled gas is then mixed with water to form nitric acid, which, after treatment with lime, results in the required manuring material. An experimental installation on these lines was opened in Christiansand (South Norway) in the spring of 1907, with a total power of 2,000 horsepower. Three ovens are at work, with a length of flame of five metres, and each absorbing 600 horsepower. Alternating current of fifty cycles is employed, and the arc burns quietly and reliably.

$6,650,000 Boston Elevated Issue.

An issue of $6,650,000 new stock by the Boston Elevated Road for the construction of the new Cambridge subway and the new elevated road from the North Station to the West Boston Bridge, has been authorized by the Railroad Commission. The stock will be sold at $110 a share.

Phoenix Glass Products.

The Phœnix Glass Company, of New York, Pittsburg and Chicago, has retained the Bureau of Illuminating Engineering, 437 Fifth Avenue, New York city, to act as consulting and designing illuminating engineers in the matter of designing or redesigning glass globes and reflectors manufactured by the company, so that beauty and utility may be blended. Albert J. Marshall, chief engineer of the bureau, will have direct supervision of this work.

As the result of this arrangement, the Phœnix company will be prepared to supply glassware for any class of service and for any illuminant, which will not only be ornamental, but will also give utilitarian results. In carrying out these ideas, the effect of light on the eye will receive very careful consideration. The Phœnix Glass Company, through the bureau, will be pleased to supply technical data regarding its product.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

AMERICAN TELEPHONE.

The report of all the Associated Bell Telephone operating companies (not including the long-distance lines) of the American Telephone and Telegraph Company for the month of October and ten months ended October 31, 1908, compares as follows:

	1908.	1907.
October:		
Telephone rev.	$10,261,800	$ 9,893,300
Oper. and mt. exp.	7,401,000	7,252,100
Net from oper.	$ 2,860,800	$ 2,641,200
Sundry earnings (net)	430,400	383,500
Total net	$ 3,291,200	$ 2,024,700
Interest	621,400	630,400
Balance for divs.	$ 2,669,800	$ 2,394,300
January 1 to October 31:		
Telephone rev.	$99,168,600	$93,893,000
Oper. and mt. exp.	72,515,400	69,413,400
Balance from oper.	$26,653,200	$24,479,600
Sundry earnings (net)	4,296,600	3,806,900
Total net	$30,949,800	$28,286,500
Interest	6,388,400	5,926,900
Balance for divs.	$24,561,400	$22,359,600

The maintenance charges and taxes included in the above expenses for October and ten months, compare as follows:

	1908.	1907.
Month October:		
Maintenance	$ 2,789,800	$ 2,715,700
Taxes	455,400	338,100
Total	$ 3,245,200	$ 3,053,800
January 1 to October 31:		
Maintenance	$27,797,400	$25,826,900
Taxes	4,285,800	3,686,500
Total	$32,983,200	$29,513,400

CHICAGO RAILWAYS.

The Chicago Railways Company reports earnings for the month of September, compared as follows:

	1908.	1907.
September:		
Gross	$960,567	$927,882
Expenses	788,808	618,946
Net	$171,759	$308,936

The state tax, amounting to $176,000 for the year, is included in the above expenses for 1908, against $16,000 in 1907, which was the month's proportion last year. The statement, therefore, is $160,000 better than appears.

October, November and December earnings show a better gross.

KEYSTONE TELEPHONE.

The report of the Keystone Telephone Company, of Philadelphia, for the month of November and five months ended November 30, compares as follows:

	1908.	1907.
November gross	$ 88,377	$ 88,120
Expenses and taxes	42,701	48,080
November net	$ 45,676	$ 40,040
Five months, gross	439,383	437,280
Expenses and taxes	217,455	231,811
Five months, net	$221,928	$205,469

NORTHERN OHIO TRACTION.

The report of the Northern Ohio Traction and Light Company for the month of November and eleven months ended November 30, compares as follows:

	1908.	1907.
November gross	$151,934	$146,123
Expenses	87,976	88,180
November net	$ 63,958	$ 57,943
Charges	44,012	43,351
November surplus	$ 19,946	$ 14,592
Eleven months, gross	1,731,015	1,761,196
Expenses	1,001,277	1,013,466
Eleven months, net	$729,738	$747,730
Charges	479,795	469,881
Eleven months, surplus	$249,943	$277,849

CUMBERLAND TELEPHONE.

The report of the Cumberland Telephone and Telegraph Company for the month of November and eleven months ended November 30, compares as follows:

	1908.	1907.
November gross	$ 535,062	$ 535,794
Expenses	286,931	302,041
November net	$ 248,131	$ 233,753
Charges and taxes	44,638	38,244
November surplus	$ 203,493	$ 195,509
Eleven months, gross	5,606,155	5,395,832
Expenses	3,212,414	3,307,178
Eleven months, net	$2,393,741	$2,088,654
Charges	430,896	430,918
Eleven months, surplus	$1,962,845	$1,657,736

New Monorail System.

Commissioner Bassett, of the Public Service Commission, examined on December 18 the plans of a new monorail system. They were submitted to him by the inventor, E. W. C. Kearney, engineer and managing director of the Kearney High-speed Railway Company, Limited, of London.

It is claimed that if the system were adopted it would result in the construction of subways at less than half the present cost, in absolute safety from near-end collisions, and in a large saving of time in transit.

Wireless Telegraph Rates Abroad.

The international wireless-telegraphy treaty of November 3, 1906, the supplementary agreement, the final protocol and the agreement for executing the provisions of the treaty have, up to the present time, been ratified by Germany, Belgium, Brazil, Bulgaria, Denmark, Spain, Norway, Holland, Roumania, Russia and Sweden. The treaty, the final protocol and the agreement for executing the provisions of the treaty have been ratified by Great Britain, Japan and Mexico, and recently the latter company has also ratified the supplementary agreement. Great Britain in the ratification of the treaty includes Canada, Australia, New Zealand, the Cape Colony, Natal, Transvaal, India, and all the other British colonies and protectorates, with the exception of Newfoundland and the Orange River Colony.

The American Consul-General at Berlin, A. W. Thackera, writes that the charges for wireless-telegraph messages at the German coast stations are as follows:

Besides the regular telegraph rates in Germany of five pfennigs (1.19 cents) a word, minimum price fifty pfennigs (11.9 cents), there is a charge of fifteen pfennigs (3.57 cents) a word, minimum 1.5 marks (35.7 cents), and if the message is sent to a steamer which can be reached from the coast station an additional toll of thirty-five pfennigs (8.33 cents) a word, minimum 3.5 marks (83.5 cents), is charged. These charges can be prepaid at any of the German offices.

Until the international list of wireless-telegraph stations, which is to contain the charges for sending wireless messages, is published, the fee for coast stations outside of Germany, according to information obtained from the Gesellschaft für Drahtlose Telegraphie of Berlin has been fixed at forty-eight pfennigs (11.42 cents) a word, with a minimum of 4.8 marks ($1.14).

Cleveland Tractions.

The three-cent fare in Cleveland for the six months, May 1 to November 1, produced gross earnings of $2,450,609, but a net deficit of $70,915.

The report of the three-cent fares for October will show $406,600 gross earnings, with a deficit of $29,547. This includes attorney fees of $9,000. These figures and those for November and December, which will be completed by January 15, will be considered by Judge Taylor and the receivers as their basis for deciding on the demand for an advance in fares by the stockholders.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

THE MANUFACTURE OF METALLIC LAMP FILAMENTS.

The serial article of Engineer Duschnitz, already noted in these columns, is here continued. A twisting of the filaments in a certain direction frequently takes place during the reduction process by direct current (when they are usually suspended in the reduction chamber in the form of a stirrup) and renders them unfit for use. The Auer Gesellschaft of Berlin has investigated this phenomenon and found that the twisting is due to the influence of the magnetic field of the earth, respectively of the work-room, on the filament through which direct current is flowing. This influence can be prevented by compensating the magnetic field or by magnetically screening the reduction apparatus; that is, surrounding it with iron. The latter method appears to be the most practicable. A twisted filament may be corrected by placing it in such a position that the earth's magnetism affects it in the opposite direction from that exerted in the beginning. Another and unpatented method of making this twisting absolutely impossible is to lengthen the two binding posts, from which the filament is suspended, to the right and left of the filament and line the two shanks with thorium oxide, this for the purpose of preventing the filament from becoming welded to the shanks when it is at white heat and should show a tendency to twist. A special method of glowing the filaments is employed by the Allgemeine Elektrizitaets Gesellschaft. During their reduction in hydrogen or other gases the resistance of the filaments decreases considerably, frequently to one-tenth. Thus the resistance may easily diminish so rapidly that the filament will be melted. To prevent this, the above firm uses resistances of fine iron wire (about 0.1 millimetre) enclosed in tubes filled with hydrogen, in series with the filaments. The energy becoming free on account of the gradually decreasing resistance of the filaments is taken up by these devices, so that the current flowing through the filaments cannot exceed a certain value, and the reduction apparatus can be operated without attention. The glowing is controlled at intervals, preferably by means of an ohmmeter, and continued until the resistance of the filaments has decreased to a certain definite value. Of great importance are devices for bending the filaments. These are too brittle when cold, and have to be brought at least to red heat. In free air the filaments would oxidize when heated, and the bending, therefore, has to be accomplished in a vacuum or an indifferent gas. In the method of the Auer Gesellschaft the difficulties of manipulation are very small. The arrangement consists of a tube-like vessel with a sufficiently large opening at the bottom to permit the introduction of the filaments and necessary tools and their easy manipulation, while a gas that does not affect the heated filament is made to flow through the vessel from the top and prevent the entrance of air. If a gas of low specific gravity, as hydrogen, is chosen, a current of about one litre a second is sufficient. If a heavy gas, as carbonic acid gas, is used, the vessel should be open at the top, but in this case the execution of the work will be more difficult.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), November 19.*

RECENT PROGRESS IN THE STUDY OF ATMOSPHERIC DISCHARGES AND LIGHTNING ARRESTERS.

The effects of excessive tensions in transmission lines due to lightning discharges have been the subject of careful study during the last few years, and the results obtained now permit a judicious choice of lightning arresters. Investigations have been made chiefly of the duration of disturbances due to a lightning discharge, of the value of the resulting tension, the maximum value of the resulting current, the normal frequency of the lightning discharge and the quantity of electricity involved in it. The duration of the disturbances was measured by recording the sparks crossing a gap placed in the circuit on a rapidly-revolving photographic plate, and the average obtained in a great number of tests was one-one-thousandth of a second; the longest noted lasted four-tenths of a second. The duration of a lightning stroke has been stated by some investigators to be as much as half a second, but there must have been an error in their observations, due to the almost simultaneous occurrence of a number of discharges. The maximum value of the over-tension in the line is evidently the result of a direct lightning discharge, and it may assume any value from zero to maximum. Observations and reasoning show that, all other things being equal, the line is subject to the highest tension at the point nearest to the inducing cloud and that it diminishes in both directions from this point. This observation demonstrates the utility of lightning arresters along the line. If the inductance of the line is such that the potential at the insulators remains at sparking value during a time equal to the dielectric retardation, the spark will jump over the insulator and pole to the ground. The discharge current can be calculated according to the usual formula: $I = V\sqrt{\frac{C}{L}}$, C and L representing capacity and inductance of the line per unit of length. This factor is of importance only in its bearing on the internal resistance of the lightning arresters, and it is sufficient to state that they are capable of withstanding an average intensity of 0.3 ampere per volt applied. The frequencies observed varied between 840 and 4,000 cycles per second, the number 3,000 being most frequently observed. In the vicinity of an inducing cloud the frequency reached 1,000,000 cycles per second. In accordance with theory, the discharge waves flow through the line the quicker, the higher the frequency. The quantity of electricity involved is determined by the application of the formula $Q = \sqrt{\frac{Jt}{R}}$, t being the duration of the discharge in a test fuse, J the energy in joules necessary to raise to its melting point one centimetre of the fuse metal, R the resistance in ohm-centimetres of this metal. By examining these results more closely with reference to the construction of protecting devices, it will be found that the characteristic elements of the latter are their sparking potential, the elements on which their discharge current depends, and the elements on which the duration of the discharge is dependent. They must, therefore, meet the following conditions: Their sparking tension must be lower than the voltage the insulators can safely withstand; they must have a small impedance, and they must be sufficiently strong to withstand a prolonged discharge. Of all the types of apparatus known these three requirements are best fulfilled by electrolytic lightning arresters, the construction of which is well known.—*Abstracted and translated from L'Electricien (Paris), November 21.*

THE UTILIZATION OF WIND AS A MOTIVE POWER FOR DYNAMOS.

This problem has attracted the attention of many investigators. Professor La Cour obtained the first practical results in methodical experiments carried on under the auspices of the Danish Government. The plant erected by him in 1904 at Askov has been replaced by a new and improved one. The new windmill has four wings 2.5 metres wide and 7.4 metres long. The axis of the motor is thirteen metres above ground level. The electrical installation comprises two direct-current dynamos of twelve horsepower each, and a storage battery which is charged by the dynamos and supplies current to lamps and motors. The average power obtained is twenty-one horsepower. According to Professor La Cour, the windmill with four wings is the most efficient one. The ends of the wings should turn with a velocity two-and-one-half times greater than that of the wind. The wings should be arranged at right angles to each other and should be provided with transverse adjustable sheets having an inclination of ten to twenty-five degrees. The power of this type of mill can be calculated by means of the formula:

$$P = \frac{Sv^3}{1{,}250},$$

P being the force in horsepower, S the surface of the wings in square metres, and v the velocity of the wind in metres per second. Thus a mill with a wing surface of forty-eight square metres develops eight horsepower at a wind velocity of six metres per second, and sixteen horsepower at a wind velocity of eight metres per second, which is quite common in Denmark. A company for the atmospheric production of electrical energy has been formed in Denmark, and so far has installed some forty plants. When the storage battery is being charged and the tension of the dynamo falls below that of the battery on account of a decrease in the speed of the mill, a device known as the La Cour relay automatically interrupts the circuit to the accumulators, so that they cannot discharge through the dynamo, and closes the circuit again when the tension rises. In England W. O. Horsnail has also studied this subject. He recommends the use of a dynamo with a special winding so calculated that the tension rises only slowly under a great increase of speed. For this purpose a few turns of series winding in a direction opposite to that of the shunt winding may be used. The Oerlikon Company, of Switzerland, has likewise occupied itself with the practical solution of this problem, and has devised a system of connections which makes the operation of the plant entirely automatic, and supervision unnecessary.—*Translated and abstracted from L'Electricien (Paris), November 28.*

THE PRESENT POSITION OF THE VARIOUS TYPES OF INCANDESCENT LAMPS.

Prof. W. Wedding has recently carried out an exhaustive test at Charlottenburg on some 200 lamps of metallized-carbon, tantalum and tungsten-filament types. The lamps were suspended vertically from wall brackets, and vibration avoided as far as possible. Most of the light measurements were made in an Ulbricht globe photometer, one metre in diameter. The accompanying table gives some of the results of these tests, the figures for each group of similar lamps of the same make being averaged.

		Candlepower at Start.			
		Horizontal Hefner C. P.	Spherical Hefner C. P.	Useful Life in Hours.	Average Watt Consumption.
Metallized carbon filament		16.8	13.34	322*	34.2
		52.9	40.2	434	100.7
		24.3	17.8	733	54.7
Tantalum filament.		15.1	11.6	867	27.3
		23.1	17.5	1,552	41.4
		51.0	38.4	1,685	85.7
Tungsten filament	No. 1	26.3	20.0	1,651	27.8
	3	27.9	20.3	665	31.0
	6	28.5	22.8	1,819	36.0
	7	30.3	21.0	669	50.7
	9	35.3	28.7	1,217	38.9
	11	37.5	28.2	1,492	38.5
	14	54.2	40.8	1,014	61.1
	15	54.3	41.2	756	60.2
	16	55.8	44.5	1,111	66.9
	20	99.8	79.2	1,766	110.5
	21	116.5	97.5	413	124.1

*This short life is partly due to the lamps being 107-volt ones run on a 110-volt circuit.

The useful life of the lamp, given in Column 4, is taken to be the number of hours in which the candlepower falls off by twenty per cent, where such a falling off takes place; but where, as in the case of most of the tungsten lamps, this twenty-per-cent reduction is practically never reached, the useful life is taken as the average number of hours, after which the filaments broke and could not be made to connect again. Taking the normal tantalum or carbon lamp as a sixteen-candlepower unit, and the normal tungsten lamp as a twenty-five-candlepower unit, the average consumptions are 34.2 watts, 27.3 watts and thirty-two watts, respectively, in the three classes; or, for lamps of equal candlepower (twenty-five) the figures are 54.7, 41.4 and thirty-two watts.—*Abstracted from the Electrical Review (London), November 27.*

THE CONDENSER EFFECT OF THE TELEPHONE AND MEANS FOR ELIMINATING IT.

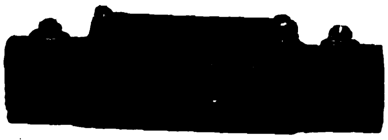
When over-tensions occur in telephone lines, says Prof. W. Peukert in this article, a current passes through the human body, for the telephone must act as a condenser, the copper wire winding forming one of its armatures, the human body the other, and the hard rubber casing of the telephone the dielectric. He has demonstrated his theory by experiments and measurements. Over-tensions in telephone circuits are of frequent occurrence, their chief causes being atmospheric conditions and the presence of high-tension lines, and the current caused to flow through the body might be detrimental to the health of sensitive persons who frequently use the telephone. The effect may be diminished by establishing a special earth connection through a condenser, or by decreasing the capacity of the condenser formed by the telephone and the body. The protection afforded by the former method will be the greater the larger the capacity of the condenser, as the current flowing through the body will then be smaller. This may be done by surrounding the telephone receiver with a metal layer and connecting the same to the ground. The same protection will be afforded by connecting two condensers in series with the binding posts of the telephone and grounding them. A still greater safety will be attained if grounded condensers are also connected to the secondary coil of the microphone transformer. The other method of decreasing the condenser effect is to insulate the human body from the ground. In this case two condensers—telephone and human body, human body and ground—are connected in series, and the current flowing through them is diminished. Both methods may be used in conjunction, but by none of them can the condenser effect be eliminated entirely; it can only be decreased to a certain degree. —*Translated and abstracted from Electrotechnische Zeitschrift (Berlin), November 26.*

INDUSTRIAL SECTION

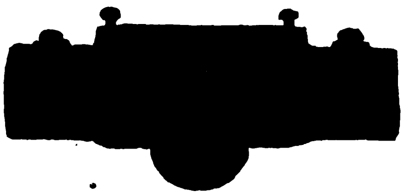
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Paiste Pipe Taplets.

The H. T. Paiste Company, Philadelphia, Pa., has developed an entirely new line of conduit fittings, which has been trade-marked "Pipe Taplets." This line has been designed so as to greatly simplify the work of the wireman, and to carry out the idea of uniformity as far as possible.

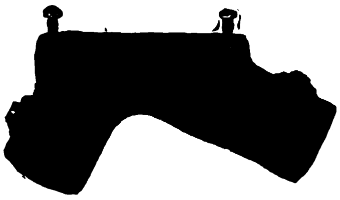


TYPE "C"—ONE-HALF-INCH CONDUIT.

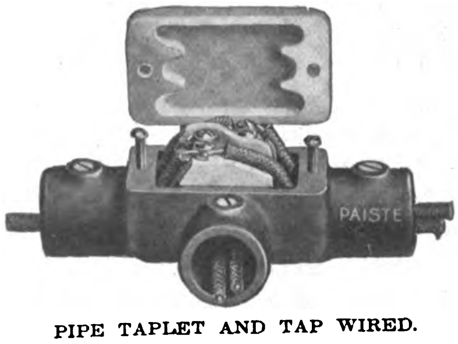


TYPE "T"—ONE-HALF-INCH CONDUIT.

The taplets are uniform, not only with respect to all covers and fittings, but also with all styles of Fielding molding, receptacles and rosettes which are now in daily use, and which are carried in stock by supply men. The pipe taplets are designed with an opening of such shape that the Fieldings can be used, and this common opening applies to the several types for one-half-inch, three-quarters-inch and one-inch conduit.



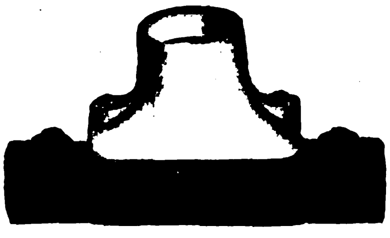
ELBOW FOR ONE-HALF-INCH CONDUIT.



PIPE TAPLET AND TAP WIRED.

The pipe taplet is attached to the conduit by pipe threads located inside the sleeve. There is also a set-screw method of adjusting which enables a line-up of absolute trueness.

The taplets are made in several types, Type C being for use where the lines run straight through; Type E, the end fitting; Type A, for making an end drop; Type B, a side drop, and Type T, for making a branch. In the elbow fitting, however, an entirely new type has been devised. This elbow can be used not only for making a short right-angled turn, but more particularly for a pull outlet. The opening is placed on the outside of the bend, and all inside lines are easy curves with smooth surfaces. This design is such that the wires can be pulled straight through, and then fed through the other arm without abrasion or other injury. The elbows are galvanized inside and out, and are always furnished with necessary soft-rubber gaskets and plain steel covers.



TYPE "C" WITH NO. 50,724 FITTING.

TWO-HOLE PORCELAIN COVER.

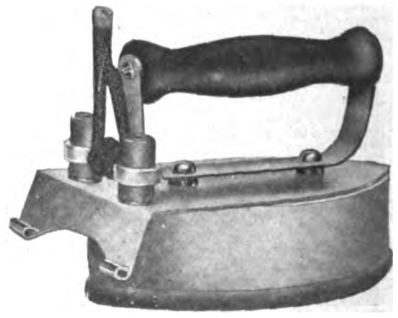
TEN-AMPERE SWITCH ATTACHED TO PIPE TAPLET.

In using these pipe taplets with the standard Fielding receptacles and rosettes, the Fieldings are wired just as is usual with molding. The button part rests on the two inwardly-projecting lugs in the pipe-taplet opening, and the wires are looped up and set under the receptacle set-screws, and the cover fastened on with two brass screws, provided with each pipe taplet.

An additional fitting has been designed that will take care of all types of pipe taplets and snap-switches. This switch fitting is attached to the pipe taplet with long brass screws. A loose yoke piece is fastened loosely to the switch. The switch is set down on the fitting so that this loosely-hanging yoke-piece slips through the rectangular recess, and the whole is turned so that the handle of the switch is square with the pipe taplet. By tightening up the two screws that hold the switch to the yoke, the whole is securely fastened.

The Watson Economical Electric Flat-Iron.

A radical departure from the general type of electric flatiron has been made by the W. N. Durant Company, of Milwaukee, Wis., in its Watson iron, for which much greater efficiency as well as durability is claimed. Instead of using a resistance heating-unit, the iron is used exclusively on alternating-current circuits and employs simply a magnetic coil of fireproof wire embedded in a casting of proper material. The heat is developed by hysteresis in the entire casting body, and, as no part is ever hotter than the working surface, all danger of burning out is entirely eliminated.



THE WATSON ELECTRIC FLATIRON.

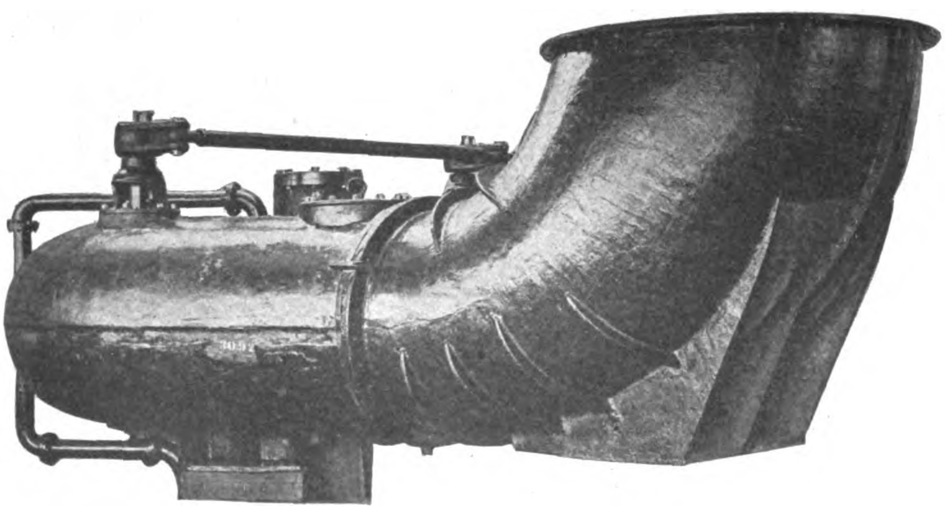
A still greater advantage claimed for this iron is its economy in consumption of current. The six-pound iron, which is the most popular size, consumes less than 450 watts under working conditions, and the seven-and-one-half-pound very little more. Furthermore, the device is so insulated as to have a large heat-storage capacity, and will retain an ironing temperature for a considerable time after disconnection. But four minutes is required to bring the iron to a working heat distributed evenly over the entire bottom surface.

Another distinctive feature is the shape of the iron, which is double-pointed. Practically all the range sadirons in use today are pointed at the back as well as front for the proper handling of fancy articles. The Watson iron, however, is the only electric flatiron which does not have to go back to the old square end in order to accommodate a resistance unit. Owing to the nicety of adjustment possible in the size of the magnetic coil, these irons can be furnished accurately tested out for any circuit from 100 to 120 volts of any frequency. No harm, however, can result from subjecting them to an overload of fifteen per cent.

The handle, connections and finish are very durable and will retain their good appearance through considerable usage. The terminals are a special feature and are provided with a flexible cord so connected that it will not kink or wear. The terminal plug is easily slipped off or on to break or make connection directly back of the handle.

Hydraulic Turbine for Nelson, B. C.

The accompanying illustration shows a 1,250-horsepower hydraulic turbine in course of construction at the Scranton works of the Allis-Chalmers Company.



TWELVE-HUNDRED-AND-FIFTY-HORSEPOWER SINGLE TURBINE FOR THE CITY OF NELSON, B. C.

This turbine has now been installed at the power house of the city of Nelson, B. C.

The turbine and vertical alternator are both of Allis-Chalmers Company's standard design, and, after extensive tests in service, were found to be even more efficient than was claimed for them by the builders. The turbo-generator has a normal capacity of 750 kilowatts, but during the test run, at which the city officials of Nelson were present, this output was increased to 1,340 kilowatts for a period of over forty-five minutes' continuous running, without undue increase in temperature of bearings.

Up to the time of installing this unit the lighting and power loads for the city had been supplied by the West Kootenay Power and Light Company, situated just across the Kootenay River from the new city power plant, the river being the source from which both plants derive power.

The Industrial Instrument Company.

The Industrial Instrument Company was organized by men who have long been engaged in the manufacture of measuring instruments, the leaders being B. B. Bristol, E. H. Bristol and W. E. Goodyear, all of Waterbury, Conn., who were for many years active in the development of the Bristol Company.

The Messrs. Bristol, who were among the original incorporators of the Bristol Company, with several of their co-workers, withdrew from that company last spring, to develop a plan that involves the development of an extensive line of those types of measuring instruments and apparatus, the use of which promotes, directly or indirectly, safety and economy of operation in industrial plants, and oftentimes makes possible operations which, without such instruments or apparatus, would be impossible. It is proposed to concentrate all energies in the development and sale of a harmonious line of apparatus for this one broad economic field.

This plan presents many advantages from the customer's standpoint, in that he is able to secure a certain distinct class of apparatus from one house, knowing that the component parts will harmonize, and that he has obtained a well co-ordinated equipment designed to accomplish a certain result. He is relieved of the inconvenience of securing parts of an equipment from different makers and of the responsibility and forethought necessary to insure their successful operation as a whole.

From the vendor's standpoint, it is, of course, an advantage to have a certain class of customers, whose problems it is possible to study, so that their peculiar requirements in a certain direction may be met to a nicety.

Lastly, manufacturers' efficiency is attained through the use of the same equipment for the production of several closely related articles, rather than the employment of different equipment for each.

The Industrial Instrument Company is a Connecticut corporation, with authorized capital stock of $2,000,000. This company now owns the entire capital stock of the Standard Gauge Manufacturing Company, until recently of Syracuse, N. Y., and of the Standard Electric Time Company, of Waterbury, Conn.

The Standard Gauge Manufacturing Company will be reincorporated in Connecticut. It has purchased a plant at Foxboro, Mass., into which it has moved from its outgrown quarters at Syracuse. The personnel of the organization includes instrument engineers of long experience, so that its engineering staff is capable of meeting successfully demands for apparatus of a special nature for particular conditions, so long as it falls within the company's scope. This engineering staff will continually be engaged in the development of those types of instruments necessary to complete the line planned by it.

The sales end of the business will be carried on by the Industrial Instrument Company, of New York, which has recently been formed for this purpose. This company will handle the entire output of the Standard Gauge Manufacturing Company, and also the industrial branch of the business of the Standard Electric Time Company.

The officers are: President, Bennett B. Bristol, formerly secretary and treasurer of the Bristol Company; vice-president, Walter W. Patrick, until recently manager of the New York office of the Bristol

Company; secretary, Henry P. Dennis, formerly manager of the Chicago office of the Bristol Company; treasurer, Arthur F. Mundy, secretary and general manager of the Standard Gauge Manufacturing Company.

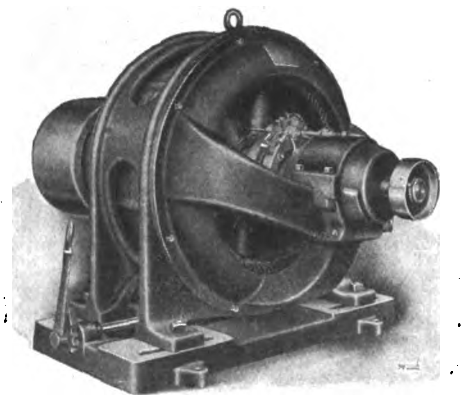
It is the intention of the company to place on the market instruments as fast as they can be perfected and developed to a point where they can be considered worthy of the confidence and support of the engineering world.

The home office will be located at Foxboro, Mass., with sales offices at 50 Church Street, Hudson Terminal, New York, and 752 Monadnock Building, Chicago.

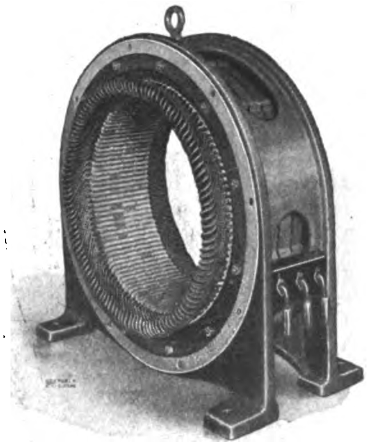
A New Line of Belt-Driven Alternators.

A new line of polyphase belt-driven alternators, known as Form PB, has been developed by the General Electric Company, Schenectady, N. Y., for use in small generating plants and in isolated lighting and power plants, where rapidly increasing inductive loads and consequently low power-factors are encountered. Designed for eighty per cent power-factor service, they will operate, however, with equal success on higher power-factor service.

The Form PB generators, shown in the accompanying illustrations, are arranged for belt drive, and are furnished with pulley and sub-base, the sub-base being provided with a ratchet screw or belt-tightening device. Although it is customary to supply these generators as belted units, they are readily adapted for direct connection to water-wheels by omitting the driving pulley and sub-base and adding a coupling. All generators have on the end opposite the driving end a shaft extension to receive the exciter driving pulley.



FORM PB BELT-DRIVEN ALTERNATOR.



STATOR WINDING AND FRAME.

The armature frame is of rugged construction, so proportioned as to give maximum strength and rigidity with a light and compact structure. Ventilating openings are provided, which allow a free circulation of air around the ends of the windings and through ducts in the laminated core. The armature coils are form-wound, thus allowing a damaged coil to be readily replaced, if necessary.

The field structure consists of laminated pole-pieces dovetailed into a laminated iron spider. The punchings are carefully stacked and riveted together, forming a rotor that will safely withstand high speeds.

Two methods of building the field coil for revolving-field machines are used. For the fifty-kilowatt and seventy-five-kilowatt sizes the wire is wound on spools, which are slipped over the pole-pieces and held in place by the enlarged pole-tips. In the larger sizes, the field coils consist of a single strip of flat copper wound on edge, so that one surface of every turn is exposed to the air. This construction permits thorough and efficient insulation between each turn and insures a low temperature in operation.

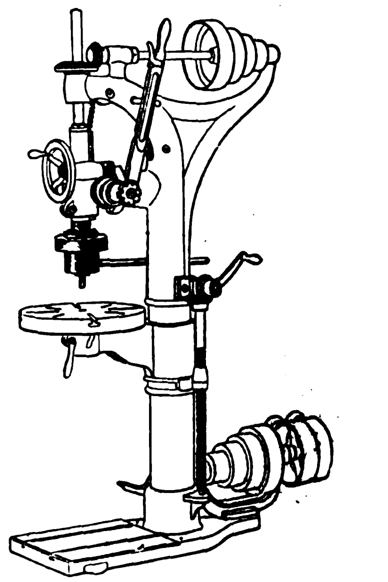
The collector rings for the field are mounted on insulating bushings, located on the shaft, and are exposed to the air on all sides. Two or more carbon brushes are provided for each ring, and no attention is required during operation.

As noted before, these generators have been especially designed for use in isolated plants where mixed lighting and motor loads are the rule rather than the exception. It is practically impossible in such cases to obtain good voltage regulation by hand control, and some form of automatic voltage regulator must be used. For this service the well-known TA regulator, manufactured by the General Electric Company, is recommended. When used in connection with the exciters for the PB alternators, this automatically maintains practically constant voltage at the bus-bars or at the center of distribution, according to adjustment. The exciters have a normal voltage of 125 volts, but are capable of delivering 150 volts continuously. This margin of power enables them to overcome easily the demagnetizing effect of the armature current on circuits of low power-factor.

When intended for operation as synchronous motors, Form PB generators are equipped with an amortisseur or squirrel-cage winding, located in the revolving-field pole-pieces, this winding giving ample starting torque with very low value of starting current. The winding does not in the least affect the operation of the machine as a generator. These generators are at present available with either two or three phase windings and for operation at 240, 480, 600, 1,150 and 2,300 volts. The overload ratings and temperature guarantees are conservative and in accordance with the best engineering practice.

A Triangular Bit for Boring Square Holes.

The problem of boring square holes, or holes of other shapes than round, has long attracted inventors, and is, moreover, of considerable practical interest in view of the wide use of such holes for counter-

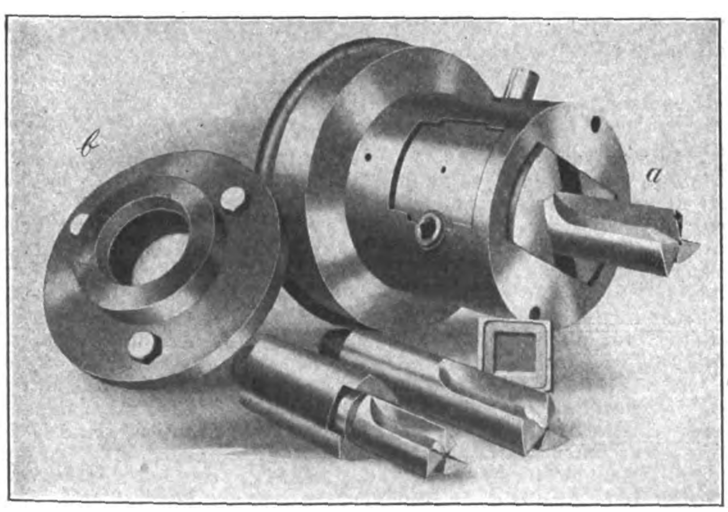


TRIANGULAR BIT AND GUIDES SET UP IN SINGLE-SPINDLE DRILL.

sinking and for keys, wrenches, spanners, hand-wheels, and similar articles. The present methods of making square holes (outside of punching and casting), such as first boring round holes and then working them up by hand or by means of a slotter or shaper, are laborious, expensive and slow.

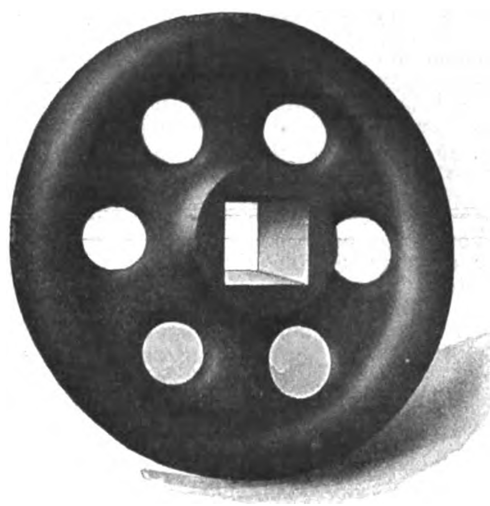
The machine to be described, however, bores square holes with the same facility and with nearly the same speed that the ordinary twist or flat drill will bore a round hole in the same material. At the same time the tool, while not altogether as simple as the flat drill, is not complicated nor expensive, and is easily made or ground in the average machine shop. The only appliance needed for the use of this special tool upon such machines as lathes, drill presses and milling machines, is a special chuck, which constitutes its principal interest from a mechanical standpoint, and which we shall now proceed to describe.

The chuck is really a device of making the three-cornered boring tool or bit travel about in such a way as to strike out a square hole in the work. It consists of a driving part, which is screwed onto the spindle of the machine, a guiding part, which either rides upon the first part, or else is secured permanently to the frame of the machine, and a third part, or socket, into which the shank of the drill is screwed. This third part is caused to rotate by the first part, but has a slight freedom of motion in relation thereto, being guided as to its exact movements by the matrix or frame in the stationary part. Where square holes are to be drilled, the shank of the tool is three-cornered, the sides of the shank being formed by segments of circles struck from opposite corners as centers, the radius of these circles being the same and equal to one of the sides of the square hole which is to be drilled. The guide in the stationary part of the chuck is adjusted to the size of the hole to be drilled, that is, so that the sides of the square opening are just equal to the radius by which the circles used for striking out the sides of the shank are formed.



TRIANGULAR BIT AND CHUCK.

In boring, when one of the sides of the shank is either rolling or sliding upon one of the sides of the square guide, the opposite corner of the shank will be moving in a straight line in contact with the opposite side of the guide. The corresponding corner of the head of the tool would at the same time strike out a straight line in the work. This motion takes place on all four sides of the guide, except for a little space at each corner,



NATURE OF CUT MADE WITH ANGULAR BIT.

the result being that the hole is perfectly square except for a slight rounding at the corners. If it is desired to bore out a complete square with sharp corners, a special tool is employed, having a shank considerably larger than the head of the tool, one corner of the shank being rounded instead of angular. The exact form of this round-cornered shank has been worked out empirically, and a complete set of templets made for the different sizes of tools apt to be required in actual practice. The tools for both the round - cornered and sharp - cornered squares can be ground by means of a special attachment to the ordinary grinding machine.

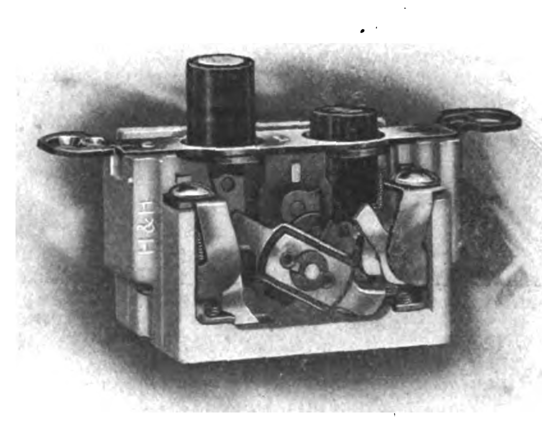
The accompanying illustrations show the arrangement of the special chuck for handling the triangular bit. As is clearly displayed in the first of these views the chuck can be inserted in the stock of a standard single-spindle drill.

This device has recently been put on the market in Germany, where a large number of chucks are in use in the shops of such firms as Friedrich Krupp, Siemens & Halske, etc. It is being introduced in this country by the Radical Angular Drill Company, having offices and showrooms at 114 Liberty Street, New York city, where the machine and samples of its work are now on exhibition.

The H. & H. Shallow Push-Switch.

The accompanying illustrations show the shallow push-switch which has been placed upon the market by the Hart & Hegeman Manufacturing Company, Hartford, Conn. This is made single-pole for ten and five amperes, 125 and 250 volts; in double-pole, ten amperes, 250 volts; in three-way, ten and five amperes, 125 and 250 volts, and in four-way, five and two amperes, 125 and 250 volts.

This shallow push-switch has been developed to meet the demand for a push-switch for shallow partitions, and in order to allow more room for wires in the regular box. Exhaustive tests on the new switch have been made, and the company is confident that the operation of this switch will substantiate its claims for excellence and fitness for the service intended.



H. & H. SHALLOW PUSH-SWITCH.

Current Electrical News

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, DECEMBER 14.—Among the new companies which have been formed in France, I note the Gas and Electric Company, of Villeneuve, which has its headquarters at Paris; Costier et Cie., which is formed for the manufacture of lamp bulbs, also at Paris; Hamille et Cie., an accumulator manufacturing company, at Neuilly, in the suburbs of Paris, also the Compagnie de l'Energie Electrique de l'Aube, at Troyes, and the Société Electrique de la Barousse, which is located at Toulouse. A large company has been formed at Lille, France, known as the Compagnie Generale Boulonnaise d'Electricité.

The report of the Energie Electrique Company for the last fiscal year showed a prosperous state of affairs. This company owns the large system of hydraulic plants and network of power lines in the Mediterranean Alps region, which supplies current for Nice, Monte Carlo, Toulon and Marseilles. The report showed receipts $362,000, which is $47,000 above last year's showing, and expenses $157,000, or $18,000 in excess of last year. The profits for the year are, therefore, $205,000.

Among the recent electric-lighting and power projects in France it may be noted that the municipality of Sainte-Florine has received a proposition for a current supply to be taken from a central station located in the region at Lenyts. The municipality of Nuits-St. Georges will probably adopt an electric-lighting project, which has been presented to it by M. Sarazin. A new company has been formed in the town of Buironfosse, Alsace, in order to secure a power supply for this locality and others in the same region. At Onnaing the rights for the electric-lighting supply have been obtained by M. Vinker.

The main work of the recent telegraphic congress held at Lisbon has been the revision of the international telegraphic regulations, which form part of the St. Petersburg telegraph convention. There has been recently published the revised text of the telegraph regulations, together with the international rates, both European and extra-European, also the present rates of the different cable companies.

The Industrial Society of Mulhausen, Alsace, is to award a number of medals and other prizes for its annual concourse of next year. One of the points relates to a new type of boiler, which must have been in regular working in Alsace for one year past. There is also a medal awarded for a self-stoking boiler, which uses the fuel prevailing in the country. A prize is to be given for a totalizing indicator of the work of a steam engine, also for a producer or blast-furnace gas engine, of at least 250 horsepower, which has advantages over a steam engine. Among the other subjects are a gas producer, an improved smoke consumer, and a mechanical conveyor for furnace slag.

Among the new radio-telegraphic stations may be noted the connection which has lately been opened up between Zanzibar and the Pemba Island.

It is stated that the Siemens-Schuckert electric firm of Germany will go into the manufacture of airships, and is to erect a large factory for this purpose at Nauen. A. DE C.

GREAT BRITAIN.

(Special Correspondence.)

LONDON, DECEMBER 12.—The Post Office authorities have granted licenses for the erection of a number of exchanges in connection with the employment of what is now called the "telewriter," or more familiarly Ritchie's telautograph, which was brought to the public notice here some years ago. The appliance operates to reproduce writing or drawings directly, in the same way that messages can be sent over the telephone. The apparatus has already a fair use in business houses and the idea is to set up exchanges and canvass for subscribers precisely on the lines of a telephone business, royalties being paid to the government for the facilities thus afforded and for the necessary wayleaves.

The Board of Trade has caused a little stir in municipal circles in Bath by prohibiting the sale of the local electrical undertaking to a private company. Curiously enough the Bath undertaking was originally commenced by a company and was purchased by the municipality. Now the latter cannot make it pay and has proposed to transfer it to another company in perpetuity, at a price some $200,000 above the cost to the city. To this, the Board of Trade has refused to consent, holding that it is improper that the undertaking should be burdened with the extra price for a plant which is already eleven years old. It also appears that under the Electric Lighting Acts a local authority cannot lease its electrical powers in perpetuity.

When both the Light Railways and Tramways Association and the Municipal Tramways Association appointed committees to investigate the brake question, the Board of Trade endeavored to bring about a fusion of the two committees and thus avoid the preparation and publication of two reports on the same subject. The two bodies, however, could not come to an agreement and so the investigations went on independently, there being at the same time a little friction, with the result that certain members of the former body resigned. The Tramways and Light Railways Association issued its report a short while ago, and it was duly noted at the time. The second report has now been issued and it arrives at more or less the same conclusions. The chief point, however, is the emphasis placed upon the need for keeping the rails clear of grease. The committee reports in favor of a brake which can be applied either by hand or power by a single lever to both rails and wheels, and reports against having a brake purely for emergency purposes. G.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, DECEMBER 19.—At a meeting of the City Council of Windsor, Ont., for further consideration of the Niagara power scheme of the local government, 1,200 horsepower was fixed on as the amount that the city will be able to use.

The City Council of Brantford, Ont., has asked the Street Railway Company to put up a guarantee of $25,000 that the present lines will be rebuilt within one year and an extension made within two years, before a renewal of the franchise will be granted. The company's rights have lapsed owing to failure to make the improvements as promised by the company.

The Ontario Power Company, of Niagara Falls, is preparing plans for the construction of a new pipe line to increase its capacity of electric power by 65,000 horsepower. The work will be commenced early in the coming spring. This work is made necessary in order to handle the contract with the Hydro-Electric Commission of Ontario. The tunnel will be of steel, lined with concrete, and will be thirty feet in diameter and upward of one mile in length. The work will cost about $750,000 and when completed the company will be able to develop 180,000 horsepower.

A conference of the municipalities of the southwestern peninsula of Ontario was recently held at Windsor to hear Hon. Adam Beck, chairman of the Hydro-Electric Commission, explain the government's Niagara power scheme. At least seventeen municipalities will vote on the electric power by-law on January 4. With the taking of 5,000 horsepower, or more, an estimate was given at $34.90 per horsepower. W.

WESTERN CANADA.

(Special Correspondence.)

WINNIPEG, DECEMBER 19.—The City Council of Edmonton, Alberta, has decided to double the equipment of the municipal street-railway system which operates in Edmonton and the sister city of Strathcona. So far the system has proved a very great success and it is apparent the venture will be as profitable financially as the other public utilities owned by the city.

At the recent municipal elections held in Winnipeg two of the candidates were pledged for the immediate completion of the civic power plant at Point du Bois; the third candidate was opposed to the civic power development, one of the planks of his platform calling for the abandonment of the scheme and favoring the purchase of power from the Winnipeg Electric Company. Approximately 11,000 votes were cast for the three candidates, the anti-power man getting but 129 of that number. W. Sanford Evans was elected over R. A. C. Manning, the other pro-power candidate. The result of the election assures the early completion of the plant, for which tenders are now being called.

The Regina Interurban Tramway Company is the name of a new company seeking incorporation under the laws of the Province of Saskatchewan for the purpose of building electric car lines from Regina to adjacent towns.

At the coming municipal elections at Port Arthur, Ont., the rate-payers will vote on a plebiscite to decide whether the electrical interests owned by the city shall continue in charge of the commissioners or whether an independent board of experts, removed from ward influences, shall be appointed. Among other public utilities the city operates the electric-lighting plant, telephone system and that portion of the street-railway system running in the city limits. J. J. Carrick is mayor.

At the next meeting of the City Council of Calgary, Alberta, Alderman Watson will introduce a motion providing for a sufficient sum of money being set aside for preliminary surveys and estimates for the proposed development of civic power at some site near Galgary, which is yet to be selected.

R. H. Sperling, general superintendent of the British Columbia Electric Street Railroad Company, with headquarters at Vancouver, British Columbia, announces the company is willing to build a line through the municipality of Port Grey providing the company can make a satisfactory arrangement with the authorities.

An official of the Canadian Pacific Railroad Company denies the reports published in a number of daily papers to the effect that the company will at once arrange for the electrification of certain lines in southern British Columbia. He admits the company is always ready to consider any proposition for the reduction of operation expenses, but says the electrification scheme for British Columbia has not been given serious thought as yet.

The Sunny Hill Rural Telephone Company has been incorporated under the laws of Saskatchewan to build a rural telephone system. Address E. J. Wright, Regina, Saskatchewan.

At Dundurn, Saskatchewan, the Dundurn Rural Telephone Company has been incorporated to build several farmers' telephone lines.

The municipal authorities at Birtle, Man., have ordered the instruments for a telephone system and a line is now being built to Solsgirth. Farmers living en route will be connected with the telephone system if they so desire. Address T. W. Thompson.

A company is being formed at Estevan, Sask., to build a telephone line to the Hamar and Ambrose districts. Address H. Yardley, Estevan.

Efforts are being made at Killam, Alb., to organize a company to build a telephone line to the farming districts to the south of that town. Address J. A. Neely, at Killam.

The $350,000 capital of the Regina Interurban Tramway Company, now seeking incorporation with head office at Regina, Sask., has already been subscribed. The company proposes to build a line from Regina to Long Lake and from that point to circle the city. The incorporators are: J. L. R. Parsons, R. R. Barber, C. J. Harris, W. M. Logan, J. F. Frame and J. H. Housser. R.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

PENNSYLVANIA PREPARES FOR MAIN LINE ELECTRIFICATION—Estimates for about $5,000,000 of work along the main line of the Pennsylvania have been asked. The contract to be let will include damming the Juniata River, cutting away part of the mountain to eliminate a big curve and grade and erecting an immense power plant near Lewistown. That this is the first step by the Pennsylvania toward the electrification of the main line is believed generally.

NORTHERN PACIFIC CONSIDERS ELECTRIFICATION OF MOUNTAIN SECTION—Engineers representing the motor-power department of the Northern Pacific Railroad have been in Livingston, Mont., working on a plan to use electricity in carrying trains over the mountains just west of the city. It is stated that the proposition is being investigated and that at an early day electric power is likely to be used in pulling both passenger and freight trains over the mountains. If the plan is adopted the company will construct a large power plant at some point on the Yellowstone River.

ILLINOIS TUNNEL COMPANY WOULD SELL ITS TELEPHONE FRANCHISE TO CHICAGO TELEPHONE COMPANY—Representatives of the Illinois Tunnel Company, which operates the freight tunnels under the city of Chicago and also controls a telephone franchise, serving buildings reached by its tunnels with an automatic telephone service, have appeared before the City Council asking permission to sell its telephone franchise and plant to the Chicago Telephone Company. In accordance with the terms of its contract with the city, the tunnel company will lose its franchise February 8 unless the 20,000 telephones stipulated are installed by that time. Its present subscribers do not total more than one-quarter of this number. The members of the Council have not been disposed to decide upon giving the permission offhand, and have taken the matter under consideration. If, as the Independent telephone interests hope, they are successful in getting into Chicago for toll-line connections or for a city exchange, the present lines of the tunnel company could be used by them to good advantage.

OBITUARY.

MR. C. A. DERTSLER, engineer for the British Columbia Electric Street Railroad Company, was drowned while crossing the Vedder River near Chilliwac, B. C., on a raft. The raft struck a rock in mid-stream and was dashed to pieces. R.

NEW MANUFACTURING COMPANIES.

RACINE, WIS.—The Racine Electrical Manufacturing Company has been incorporated with a capital stock of $25,000.

DENVER, COLO.—The capital stock of the Silver State Electric Company has been filed at $50,000. The incorporators are R. S. Willoughby and M. T. Weber of Denver.

PORTLAND, ME.—The Pemigewasset Electric Company of Portland, general electrical merchandise dealers, has been capitalized at $150,000 by A. G. McPhierson, J. R. Parsons and W. M. Bradley.

FORT SMITH, ARK.—The Pittsburg Supply Company has been incorporated with a capital stock of $50,000 by E. C. Lichty, J. B. Weatherton and P. C. Hendricks, to manufacture electrical supplies and fixtures.

CHICAGO, ILL.—The Electromagnetic Tool Company, organized with a capital of $50,000, has been incorporated by O. R. Barnett, P. H. Truman and L. H. Peck, to manufacture electrical and electromechanical devices.

NEW YORK, N. Y.—The Hardt Electric Company, Manhattan, incorporated for the purpose of manufacturing electrical appliances, with a capital of $50,000, has been formed by R. M. Patterson, G. Link, Jr., and C. Rush, New York city.

NEW YORK, N. Y.—The Monarch Storage Battery Company, of New York city, has been incorporated with a capital stock of $50,000 to manufacture electrical and mechanical appliances. The incorporators are headed by Alexander D. Thornburn, of New York.

CHICAGO, ILL.—The Chicago Engineering and Inspection Company has been incorporated with a capital stock of $2,500 to do a general engineering, electrical and construction business. G. M. Proudfoot, A. R. Leland and J. H. Westover are members of the company.

BROOKLYN, N. Y.—The Borough Gas and Electric Fixture Company, of Brooklyn, has been chartered with a capital of $25,000. The directors are: S. J. Miller, Jennie Miller, A. B. Cohen, Louis Halpert, George Bauer, Hyman Kagel and Bernard Rathberg, of Brooklyn.

BOSTON, MASS.—The National Electric Manufacturing Company of Boston has been incorporated to manufacture and sell electrical apparatus. Its capital is placed at $50,000 and its officers are: President. Starbuck Sprague, No. 21 Bromfield Street; treasurer and clerk, Charles H. Sprague, No. 15 Beacon Street.

DULUTH, MINN.—The Richardson Electric Company has been organized under the revised laws of 1905 of Minnesota, to buy, sell, manufacture, install and deal in electrical apparatus, appliances, machinery, fixtures and supplies of every kind, and to engage in all branches of electrical engineering and construction work for light, heat, power and all other purposes, and to manufacture, purchase, supply, sell and deal in electricity and electric power; also to engage in the manufacture, engineering, construction and equipment of telephone, telegraph, heating, lighting, plumbing, ventilating, electrical and mechanical systems. The incorporators are William P. Bear, Frank Windblade, Axel W. Lindgren, Walter L. Seaton, all of Duluth. The first board of directors is as follows: William P. Bear, president; Frank Windblade, secretary and treasurer; Axel W. Lindgren, vice-president. The capital stock is $50,000, divided into 1,000 shares of $50 each.

NEW PUBLICATIONS.

THE MINNESOTA ENGINEER—The November issue of the quarterly published by the Engineers' Society of the University of Minnesota contains a detailed description of the Hatfield hydroelectric plant of the La Crosse (Wis.) Water Power Company, by Albert J. Hitzker, a senior in the school of electrical engineering.

NAVY DEPARTMENT ANNUALS—The following publications for the fiscal year 1908 have been received from the Navy Department Library: Annual report of the Superintendent of Library and Naval War Records to the Secretary of the Navy; annual report of the Chief of the Bureau of Equipment; annual report of the Chief of the Bureau of Yards and Docks; annual report of the Chief of the Bureau of Ordnance.

CHEMICAL ANALYSES OF COAL—In behalf of the United States Government, which is a large user of coal, the United States Geological Survey in 1907 made a thorough investigation of the Pocahontas and New River coals. The tests were conducted at the Government plant on the grounds of the Jamestown Exposition, near Norfolk, Va., and their especial purpose was to determine the best methods of using the coals economically. The results of these tests are published as Bulletin 362 of the United States Geological Survey, in a pamphlet by John Shober Burrows, entitled "Mine Sampling and Chemical Analyses of Coals Tested at the United States Fuel-Testing Plant, Norfolk, Va., in 1907."

ELECTRICAL SECURITIES.

Generally downward price movements, with an irregular market, were the prevailing speculative and investment conditions last week. Not since election has there been heard so much complaint of the recent advance in prices having discounted growing improvement in trade. The necessity of meeting large end-of-the-year disbursements has caused some anxiety and this has probably had a considerably depressing effect upon optimism. Railroads continue to report improving returns with advances in net well sustained.

Dividends have been declared upon the following electrical securities: Electric Storage Battery Company; regular quarterly dividends of three-fourths of one per cent on the common stock and three-fourths of one per cent on the preferred stock, payable January 2 to stock of record December 23. Cincinnati Gas and Electric Company; regular quarterly dividend of one-and-one-eighth per cent, payable January 1. Cincinnati Street Railway Company; regular quarterly dividend of one-and-one-half per cent, payable January 1. Nebraska Telephone Company; regular quarterly dividend of one-and-one-half per cent, payable January 10 to stock of record December 31. Cumberland Telephone and Telegraph Company; regular quarterly dividend of two per cent, payable January 1 to stock of record December 20. Bell Telephone Company of Canada; regular quarterly dividend of two per cent, payable January 15 to stock of record December 24. American Telephone and Telegraph Company; regular quarterly dividend of two per cent, payable January 15 to stock of record December 31. Tri-City Railway and Light Company; regular quarterly dividend of oneand-one-half per cent on the preferred stock, payable January 2 to stock of record December 22. American Cities Railway and Light Company; regular quarterly dividend of one-and-one-half per cent on the preferred stock, payable January 1 to stock of record December 21. Massachusetts Lighting Companies; regular quarterly dvidend of one-and-one-half per cent, payable January 15 to stock of record January 1. Boston and Worcester Electric Companies; $1 per share on the preferred stock, payable January 1 to stock of record December 26. Capitol Traction Company; quarterly dividend of one-and-one-half per cent, payable January 1. Continental Passenger Railway; semi-annual dividend of $3, payable December 30. Germantown Passenger Railway; quarterly dividend of $1.31¼, payable January 5. Honolulu Rapid Transit and Land Company; quarterly dividend of one per cent on the common and three per cent on the preferred, both payable December 31. Manila Electric Railroad and Light Company; quarterly dividend of one per cent, payable December 31. Massachusetts Electric Companies; preferred stock dividend of $1, payable January 1. Philadelphia Company; quarterly dividend of one-and-one-half per cent, payable February 1 to holders of record January 2. Rochester Railway Company; quarterly dividend of one-and-one-fourth per cent, payable December 31. Stark Electric Railroad; quarterly dividend of three-fourths of one per cent, payable January 1. Toronto Railway Company; quarterly dividend of one-and-one-half per cent, payable January 2.

ELECTRICAL SECURITIES FOR THE WEEK ENDED DECEMBER 12.

New York:	*Closing.*
Allis-Chalmers common	15⅜
Allis-Chalmers preferred	48¾
Brooklyn Rapid Transit	58
American Telephone and Telegraph Company	127¾
General Electric	157½
Interborough-Metropolitan common	18¼
Interborough-Metropolitan preferred	43⅜
Kings County Electric	126
Mackay Companies (Postal Telegraph and Cable) common	73¾
Mackay Companies (Postal Telegraph and Cable) preferred	69
Manhattan Elevated	149⅞
Metropolitan Street Railway	33
New York and New Jersey Telephone	110
Western Union (ex-dividend)	66⅞
Westinghouse Manufacturing Company	86

At a special meeting of the Edison Electric Illuminating Company of Boston, held December 18, stockholders voted to increase the capital from 126,436 to 136,161 shares. This new issue of 9,725 shares will be offered to stockholders of record December 18 for subscription at $215 a share—the price determined by the Massachusetts Gas Commission—on the basis of one new share for each thirteen shares now held. Subscription books close January 15 and subscriptions are payable as follows: One hundred dollars on February 1 and $115 on May 3, 1909. Subscriptions for the new shares of the Edison Company of Boston will be received at the Old Colony Trust Company. Interest at the rate of four per cent per annum will be allowed on the first installment ($100 per share) from February 1 to May 1, 1909. Subscribers may prepay the second installment ($115 per share) on February 1, 1909, in which case interest will be allowed thereon at the rate of four per cent per annum from February 1 to May 1, 1909. Shares not subscribed for will be sold at auction.

For the last month gross earnings of the Brooklyn Rapid Transit have shown a decided improvement over the corresponding days last year. Since December 1 this increase has been running at the rate of $1,000 a day.

For the first three months of the current fiscal year, which began July 1, gross earnings showed a sharp falling off, compared with the same quarter of 1907, the decrease slightly exceeding six per cent. It was not until November 1 that earnings began to break even with last year, and only within three weeks that a noticeable gain has been shown.

It is probable that for the six months, to end the last of this month, the company will show a decrease in gross of about four per cent.

Like many other trolley systems, however, Brooklyn Rapid Transit has been remarkably successful in cutting down its operating expenses during the last six months. The economies effected have been strictly legitimate and have in nowise resulted in scaling down the standard of maintenance. As a result net earnings are on a practical parity with last year.

It is understood that the floating debt of $4,000,000 on June 30, the close of the fiscal year, has been cut down over $1,000,000, and there is a strong probability that it will be cut nearly $2,000,000 more by the close of the fiscal year. The company is in no need of financing and is able to take care of its current construction requirements out of net earnings.

Boston:	*Closing.*
Edison Electric Illuminating	250
Massachusetts Electric	57⅛
New England Telephone	126½
Western Telephone and Telegraph pref.	79
Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	44
Electric Storage Battery preferred	44
Philadelphia Electric	11
Philadelphia Rapid Transit	21¼
United Gas Improvement	91
Chicago:	*Closing.*
Chicago Telephone	127
Commonwealth Edison	106
Metropolitan Elevated preferred	52
National Carbon common	85½
National Carbon preferred	112

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

SABIN, WIS.—The Mill Creek Telephone Company has been incorporated.

HURON, S. D.—F. H. Kent and others have secured a telephone franchise at Huron.

BELLO, TEX.—The Bello Telephone Company has been incorporated by Charles Wild and others.

DISNEY, NEB.—The Spring Ranch Telephone Company has been incorporated with a capital of $5,000.

KALISPELL, MONT.—The farmers near Kalispell are making an effort to have a local telephone system. C.

ESSEX, IOWA—The Farmers' Telephone Company has been incorporated with a capital stock of $15,000.

NEOSHO, MO.—The Farmers' Union Telephone Company has been incorporated by J. B. Graves and others. P.

ADA, OKLA.—The Farmers' Independent Telephone Company has been granted a telephone franchise for Ada.

LADORA, IOWA—The Farmers' Mutual Telephone Company has been incorporated with a capital of $20,000.

CARNEGIE, OKLA.—The Carnegie Telephone Company has been incorporated with a capital stock of $10,000.

LEBANON, WIS.—The Lebanon Telephone Company has been incorporated with a capital stock of $10,000.

LADORA, IOWA—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $20,000.

IPSWICH, S. D.—The Union Township Telephone Company has been incorporated with a capital stock of $10,000.

NEW KENT, VA.—A company with a capital stock of $5,000 has been formed to build a telephone system in New Kent.

CLARINDA, IOWA—The Clarinda and Bethesda Telephone Company has been incorporated with a capital stock of $1,000.

MARSHALLTOWN, IOWA—The Farmers' and Merchants' Telephone Company has been incorporated with a capital stock of $250,000.

COOPERTON, OKLA.—The New State Telephone Company has been incorporated with a capital stock of $25,000 by W. C. Winnsworth and others. P.

ELECTRIC RAILWAYS.

(Special Correspondence.)

SEATTLE, WASH.—W. S. Boody and others have applied for a subway street-railway franchise in Seattle.

GUADALAJARA, MEXICO—The Compania de Tranvias, Luz y Fuerza of Guadalajara, has increased its capital stock from $3,000,000 to $8,500,000. Andres Bermejillo is president. D.

TORREON, MEXICO—The new electric power plant which the Lerdo & Torreon Electric Railway Company is erecting at a cost of $400,000 will soon be finished. The company will also make other extensive improvements. D.

ORIZABA, MEXICO—The Compania Empresa Electrica will, it is reported, expend $300,000 in the construction of a system of electric railways at Orizaba. The company was recently organized and is composed of local capitalists. D.

BUCK, ILL.—The Egyptian Steam and Electric Railway Company of Buck has been incorporated to construct and operate a railway from East St. Louis to Metropolis, Ill. The capital stock is $5,000 and John Edmonds is one of the incorporators.

TACOMA, WASH.—The Cle Elum-Roslyn Railway and Power Company of Cle Elum, incorporated by Frank S. Farquahar and W. E. Farquahar, with a capital stock of $100,000, will construct and operate an electric interurban railway between Roslyn and Cle Elum.

MEXICO CITY, MEXICO—The Mexico Tramways Company has been authorized by the Federal Government to convert its existing mule-car lines to electric traction and operate them as part of ts local electric-railway system. The improvements will be made immediately. D.

BAYONNE, N. J.—Civic organizations of Staten Island and Bayonne are considering a rapid transit scheme whereby it is proposed to construct a surface electric line from Perth Amboy to Port Richmond, then to tunnel the Kill von Kull to the Jersey Central Station in Bayonne, and eventually reach Manhattan by the Hudson River tunnel.

HERMOSILLO, MEXICO—It is reported that the branch line of the Sonora Railroad, which runs from La Union to Hermosillo, is to be sold to a local company and that it will be converted to electric traction. Negotiations have not yet progressed to a point when a definite announcement of the sale of the road can be made, but it is said that there is little doubt that the transaction will be consummated. The branch line runs up the canyon of the Sonora River and is said to be unprofitable as now operated. D.

LANCASTER, PA.—The property of the Philadelphia, Coatesville & Lancaster Electric Railway Company, which has defaulted payment on the interest of its first mortgage bonds for $600,000, recently due, will be sold on December 30. It is understood that this is a step in the acquirement of the franchise by the Conestoga Traction Company, which operates the trolley system of Lancaster County, and that as soon as it gets a title to it it will extend its Christiana line through to Parkersburg, to connect with the line to Philadelphia.

LITTLE ROCK, ARK.—A charter has been granted to the Helena, Parkin and Northern Railway Company, which proposes to build a line of railway, fifty miles in length, through St. Francis, Cross and Poinsett counties. The line begins at Whitmore, in St. Francis County, and extends to Marked Tree, in Poinsett County. The capital stock of the company is $350,000, of which amount $100,000 has been subscribed. It is reported that everything is in readiness to begin work at once. The incorporators are headed by T. E. Hare.

MEXICO CITY, MEXICO—The Arizona Mercantile Transportation and Smelter Company, which operates mines and smelters at Silver Reef, Ariz., has taken preliminary steps to obtain a concession from the Mexican government for building a railroad across a section of Mexican territory to reach St. George's Bay, a proposed deep-water harbor situated in the extreme upper end of the Gulf of California. The project is an ambitious one and contemplates the building of an electric railway 160 miles long, to run from Maricopa, Ariz., across the lower part of that territory and into Mexico to the prospective deep-water terminus. The company's plans also include the establishment of extensive port facilities at St. George's Bay, making it the outlet for the export traffic of a large section of the Southwest. D.

GUADALAJARA, MEXICO—The preliminary survey for the proposed electric railway which the Soledad Development Company is to build to the Mezquital del Oro mining district, in the state of Zacatecas, is nearly finished, and it is declared by the promoters of the enterprise that the construction of the line will soon begin. Application has been made to the government of the state of Jalisco for a concession for that part of the line that is to run through that state, and similar application will be made to the government of the state of Zacatecas for the remaining portion. The line will be about seventy-five miles long and will traverse a territory that is thickly populated. A hydroelectric plant will be installed on the Santiago River, and power for the line will be obtained from that source. The particular object of the proposed road is to afford a transportation outlet for the Mezquital del Oro mining district. D.

MEXICO CITY, MEXICO—It was given out by Dr. F. S. Pearson, president of the Mexico Tramways Company, on the occasion of his recent visit, that a general programme of improvements for the local system of electric street railway has been discussed with the government officials and arrangements completed to expend, within the next three years, about $5,000,000 gold. This sum is to be used principally in the construction of new lines in different parts of the city and in adding equipment for both passenger and freight service. D.

PERSONAL MENTION.

MR. A. B. DU PONT, former president of the Municipal Street Railway Company of Cleveland, O., has been retained by the company as consulting electrical engineer.

MR. A. G. PERRY has been appointed manager at North Vancouver, B. C., for the British Columbia Electric Street Railroad Company in place of W. B. Bunbury, who has resigned. R.

MR. WALTER E. HOLLOWAY, after twenty years' service with the Safety Insulated Wire and Cable Company, of New York city, will leave the position of general purchasing agent for the company, January 1, to enter into business for himself.

MR. W. R. BONHAM has been appointed sales manager for Cook County, Illinois, for the Electro-Dynamic Company, Bayonne, N. J., representing this company's full line of special and standard inter-pole motors. Mr. Bonham's headquarters are in the Monadnock Building, Chicago.

MR. HERBERT E. STONE has just become connected with the Dearborn Drug and Chemical Works as manager of sales in the eastern department, with headquarters in New York city. Mr. Stone was formerly president of the N. A. S. E., and recently manager of the Pittsburg office of the Chapman Valve Company.

MR. S. M. MANIFOLD, York, Pa., has removed to Morristown, N. J., accepting a position as general manager of the Morris County Traction Company, which connects the cities of Morristown, New Brunswick, Elizabeth and Orange. Mr. Manifold is a well-known and able railway man and was at one time general manager of the York Railways Company. O.

MR. W. D'A. RYAN, illuminating engineer for the General Electric Company, delivered a lecture on "Light and Illumination" on December 11 at the Memorial Hall, Minneapolis, Minn., under the auspices of the Minneapolis Electric Club. His address treated of illumination in general, describing and illustrating in particular the color values of the different illuminants and the effects of wall colorings.

MR. WILSON S. HOWELL, general manager of the Electrical Testing Laboratories of New York city, was a recent visitor to Chicago, in conference with the many interests with which this progressive enterprise is identified. So greatly has the work of the laboratories been extended, the value of scientific testing being conceded, that the possibility of further extension is being considered by those in charge of the work.

MR. FRANK J. DUFFY, manager of the Beaumont (Texas) Traction Company for several years, will leave Beaumont to make his headquarters in Natchez, Miss. The Natchez Street railway and lighting plant, the Jennings, La., lighting plant and the Beaumont Street railway are all under the same control, and Mr. Duffy will have general supervision over the Beaumont property in the future, but will resign active management. Mr. M. B. Rhoads of Key West, Fla., will succeed Mr. Duffy at Beaumont.

MR. KINGSLEY L. MARTIN, of Brooklyn, N. Y., has been appointed chief engineer of the Bridge Department of New York city, in place of Colin M. Ingersoll, resigned. Mr. Martin's salary will be $10,000 a year. At the request of Mayor McClellan and Bridge Commissioner Stevenson, Mr. Ingersoll has agreed to remain with the Bridge Department in the capacity of consulting engineer. Mr. Martin was selected for the position of chief engineer because of the record he has made as engineer in charge of the Brooklyn and Williamsburg Bridges. He was born in Brooklyn in 1869, and is a son of C. C. Martin, formerly chief engineer and superintendent of the Brooklyn Bridge. He was educated in the Polytechnic Institute, of Brooklyn, and was graduated with the degree of M. E. from Stevens Institute of Technology. After serving for a short time on the engineering corps of the East River Bridge Company, Mr. Martin was appointed assistant engineer of the Brooklyn Bridge. He had charge of terminal reconstruction on the Brooklyn side, and of much of the railroad work, the local road at that time being operated by the city. He was made assistant engineer on the Williamsburg Bridge in 1896, and was connected with the Manhattan foundation and anchorage work. He was later appointed resident engineer in charge of construction work, including all the mill, shop and field work.

ELECTRIC LIGHTING.

(Special Correspondence.)

ALVIN, TEX.—E. B. Hill has secured a twenty-five-year electric-light franchise at Alvin.

MACON, GA.—The city is considering the erection of an electric-light plant in Vineville.

TENAHA, TEX.—Lemuel Hill has been granted a franchise for installing an electric-light plant.

VILLISCA, IOWA—F. P. Tyler has been granted an electric-light and power franchise at Villisca. P.

RYAN, OKLA.—A vote is to be taken on the issuance of bonds for an electric-light plant for Ryan.

DANVILLE, ARK.—The Danville Electric Company has been incorporated with a capital stock of $10,000.

TACOMA, WASH.—On December 26 Tacoma will vote on a proposition to issue bonds for a power plant. P.

MINCO, OKLA.—The city of Minco will vote on the issuance of bonds for the construction of an electric-light plant.

KEARNEY, NEB.—The Kearney Water and Electric Power Company has been incorporated with a capital stock of $310,000.

BERGEN, N. Y.—At a village election held in Bergen it was decided to issue bonds for $6,000 for an electric-lighting system.

EMPORIA, KAN.—The Emporia Electrical and Gas Lighting Company has been incorporated with a capital stock of $100,000. P.

KEARNEY, NEB.—The Kearney Water and Electric Power Company has been incorporated with a capital stock of $310,000. P.

NASHVILLE, ARK.—J. C. Stephenson has a contract for furnishing Nashville with electric light, and a plant will be installed at once. P.

ELBERTON, GA.—The city is considering improvements to its electric-light plant, including raising of dam and installation of larger dynamo.

EUFAULA, OKLA.—The pioneer Electric and Power Company has been incorporated with a capital of $9,500, by C. E. Foley and others.

WORDEN, ILL.—A special election was held in Worden to vote on the issuance of $12,000 in bonds to build a municipal electric-light plant.

MT. AYR, IOWA—The town of Mt. Ayr is the last county seat of Iowa to install electric lights. A $20,000 power plant is now nearing completion.

FARWELL, MICH.—The election on the proposition to bond the village for $3,000 for the erection of an electric-light plant carried by sixty-two to nineteen votes.

LOS ANGELES, CAL.—The Burrows Wave Power and Electric Company has been organized with a capital of $75,000, by E. E. Beazley, H. C. Scheurer and John H. Forsythe.

BRUCE, WIS.—The new $15,000 municipal hydroelectric plant built for the town of Bruce by the Central Construction Company of Oshkosh has been successfully started up.

LEESVILLE, S. C.—The Brodie Light and Power Company has been incorporated with $10,000 capital stock by Furman E. Brodie and Claudia E. Brodie, both of Leesville, and C. P. Quattlebaum, Conway, S. C.

NORCROSS, GA.—The city is having specifications prepared for an electric-light plant and will want bids on machinery. Five thousand dollars in bonds was recently reported voted. T. E. Johnson is mayor.

CARMI, ILL.—The plant of the Olney Electric Light and Power Company has burned, leaving the city in darkness for at least a month. The loss is $24,000, with $17,000 insurance. The cause of the fire is unknown.

MARINETTE, WIS.—The Iron Mountain Electric Light Company has taken action to purchase the Twin Falls waterpower plant on the Menominee River. It will be developed at a cost of $50,000 and the power will be transmitted to Iron Mountain to light that city.

MARENGO, ILL.—Fred A. Rispen, who held the lease and management of the city electric-light plant for a term of years, has made an assignment, declaring that its operation was a losing undertaking. Following his affidavit he was appointed to manage the plant for the city for a time.

LYNCHBURG, VA.—Virginia and Northern capitalists propose the organization of a company, probably capitalized at $1,000,000, to build a waterpower electric plant on Staunton River, twenty-five miles south of Lynchburg. The plan includes the construction of a concrete dam costing $350,000 and the transmission of electricity to Lynchburg and other cities.

CHARLOTTE, N. C.—B. H. Hardaway of Columbus, Ga., has been awarded the contract by the Southern Power Company, a $10,000,000 concern of Charlotte, to build a dam across Broad River at Ninety-nine Islands, S. C., for a 16,000-horsepower electrical plant. The contract price was $650,000. This dam will be the largest structure of its kind in the South.

KILBOURN, WIS.—The Southern Wisconsin Power Company has agreed to give the village 133 horsepower free of charge for twelve hours each day, for all time, to move the village plant to higher ground or fill where it now stands, to install pumps of sufficient capacity and connect the mains. This will, it is believed, end the fight between the company and the village.

JEFFERSON COUNTY, W. VA.—Fred H. Stith of Lexington, N. C., plans the organization of corporation to develop waterpower and build electric plant for transmitting by electricity a minimum of 1,000 horsepower from property on the Potomac River in Jefferson County. Surveys are now being made. About $300,000 is to be expended and the establishment of Portland cement plant is also proposed.

LEGAL NOTES.

Conducted by J. L. Rosenberger, LL.B.

ELECTRIC-LIGHT STATION A MANUFACTORY—Is or is not an electric-light station, with the usual equipment of boilers, engines, and dynamos, a manufactory, within the meaning of a restrictive covenant and "scheme" intended to exclude manufactories from a residence district? This was the important question in the case of Scrymser vs. Seabright Electric Light Company, 70 Atlantic Reporter, 977. In deciding it, the Court of Chancery of New Jersey says that, in its judgment, it is useless to go into speculative questions as to the nature of electricity or the nature of the product, if there be a product, of the electric plant in question. At different periods in the history of electrical discovery very different views have been entertained on this subject. At one time this plant might have been regarded as a manufactory of a "fluid." More recently it might be deemed to be turning out electrons or ions. This electric-light station, with the necessary incidents attending its operation, is, in the court's judgment, as clearly a manufactory, within the meaning of this protective covenant, as it is a manufactory within the meaning of the mechanic's lien law. It may be conceded that when this particular covenant was framed and building "scheme" was promulgated, about thirty-five years ago, the "manufacture" of electricity in electric-light stations was unknown. But in view of the annoyance and discomforts which it was the intention of the scheme to exclude from the large residential district in question, no distinction can be drawn between manufacturing businesses which were in existence when the scheme was promulgated, and manufacturing businesses which might thereafter come into existence.

DEMAND OF SPECIAL PRIVILEGES NOT FAVORED—While a telephone line was being constructed by a mutual company it became apparent that one wire would be inadequate for the service, and another wire was placed along the same route to the home of one of the subscribers for stock in the company. Both wires were run to his telephone, where a switch belonging to him was installed by which he was enabled to use either wire. The then president of the company testified that he agreed to put in the switch with the understanding that if the board of directors disapproved of it the party should take it out. The board of directors disapproved of it and ordered the switch disconnected. But the party reconnected it and threatened to do so as often as disconnection should be made. In a suit to enjoin the party from thus interfering with the line, the Supreme Court of Nebraska affirms a judgment in the company's favor. The Supreme Court commissioners, who prepared the opinion in the case, say, Red Line Mutual Telephone Company vs. Pharris, 117 Northwestern Reporter, 995, that they cannot see any particular reason why special privilege, if it might be called such, should be given to the defendant. The other patrons of the company paid the same amount as he did and were connected directly with but one line. At most, the contract was that adequate means of communication with the patrons of the company should be given to the defendant. The contract would not permit him perpetually to maintain his switch. Conceding that the contract contemplated but one line, it was not violated by the construction of two wires along the line, even though for convenience the wires were given different names and were connected at a central office when desired. The demoralizing effect of the defendant's maintenance of the switch was not a matter of conjecture, but was apparent from the evidence in the case, as one witness testified that it tended to make the line inefficient, hard feelings, trouble and discord on the line. The proper and businesslike conduct of the affairs of the company seemed to demand that this switch be removed, and with the company's purpose to remove it the courts would not interfere, but, necessity demanding it, would render assistance.

PROPOSALS.

POST OFFICE AT POUGHKEEPSIE, N. Y.—An electric system of a rather elaborate nature has been planned for the United States Post Office at Poughkeepsie, N. Y. Postmaster Sherrill has received the complete specifications from the office of the Supervising Architect at Washington, and is inviting bids for the installation.

POSTOFFICES AT MURFREESBORO, TENN., AND GAINESVILLE, FLA.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until January 9 for the construction (complete) of the United States postoffices at Murfreesboro, Tenn., and Gainesville, Fla., in accordance with specifications which may be had at the office of the respective postmasters and at the office of the Supervising Architect.

POST OFFICE AT ANDERSON, S. C.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until January 23, for the construction complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office and Court House at Anderson, S. C., in accordance with specifications, which may be obtained from the custodian of site at Anderson or at the office of the Supervising Architect.

DATES AHEAD.

American Roentgen-Ray Society. Annual meeting, New York city, December 28-30.

American Association for the Advancement of Science. Annual meeting, Baltimore, Md., December 28-January 2.

Western Society of Engineers. Next meeting, Chicago, Ill., January 5, 1909.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

American Association of Electric Motor Manufacturers. Next meeting, January, 1909.

INDUSTRIAL ITEMS.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., dresses *Trumbull Cheer* for December in Christmas colors. This issue has some shop notes which will interest.

THE OHIO BRASS COMPANY, Mansfield, Ohio, in a supplement to its general catalogue No. 7, shows new improvements in overhead line material, mine hangers, car equipment, specialties, etc.

THE GREGORY ELECTRIC COMPANY, Chicago, Ill., is distributing a comprehensive bargain sheet of apparatus carried in stock at its works. The list includes everything from miscellaneous supplies to steam engines and alternators.

THE NEW YORK INSULATED WIRE COMPANY, New York, N. Y., has placed on the desks of its friends calendar blotters with a few lines describing the manufacture and advantages of its rubber products for electrical insulation.

F. B. BADT & COMPANY, Monadnock Block, Chicago, electrical engineers and experts, who are the western agents for Weston instruments and Ward Leonard rheostats, have also been appointed western sales agents for "Polar" flaming-arc lamps.

THE ELECTRIC CONTROLLER AND MANUFACTURING COMPANY, Cleveland, Ohio, describes motor-control matters on those pages of its monthly, *Common Sense*, for December, which are not devoted to the epigrammatical writings of David Gibson.

THE NATIONAL BRAKE AND ELECTRIC COMPANY, Milwaukee, Wis., has a handsome illustrated bulletin, No. 386, explaining the advantages and economies of compressed air for industrial service, and describing compressors and controlling apparatus for motor-driven stationary and portable installations.

HARVEY HUBBELL, INCORPORATED, Bridgeport, Conn., has brought out a new ceiling socket equipped with the pull-switch feature, listed as Hubbell ceiling socket No. 35,032. The fixture is designed primarily for the tungsten lamp, and will sustain successfully the weight of the heaviest lamp and shade.

THE BUFFALO FORGE COMPANY, Buffalo, N. Y., describes the Buffalo fan system of heating, ventilating, humidifying and drying, in a handsome book it issues as Catalogue 197. A large part of the book is devoted to some very useful data on the heating and ventilating of public, industrial and other large buildings.

THE AMERICAN CONDUIT MANUFACTURING COMPANY, Pittsburg, Pa., announces that it has completed a large addition to its factory, which is equipped with up-to-date machinery, and is making thorough preparations to manufacture an improved flexible, non-metallic conduit. Patents are being taken out to cover these improvements.

THE MOHAWK ELECTRIC COMPANY, Albany, N. Y., manufacturers of Rollinson electrical specialties, issues a catalogue describing its alternating and direct-current bell ringers, designed to take the place of batteries in providing a low-voltage current supply for the operation of signal apparatus, deriving power from commercial current mains.

THE WORCESTER ELECTRIC MANUFACTURING COMPANY, Worcester, Mass., in its catalogue No. 8 describes its line of knife switches, switchboards, panel boards and fuse blocks for light, power and railway service on both direct and alternating-current circuits. The lists are complete with illustrations, dimensions and prices.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., devotes its leaflet No. 148 to Northern motors for hoisting service. These motors are compact, simple, rugged and economical. The company's standard spherical motor is described in Bulletin No. 50, and Northern box-type motors are illustrated in Bulletin No. 32.

THE AMERICAN STEAM GAUGE AND VALVE MANUFACTURING COMPANY, 208-220 Camden Street, Boston, Mass., has issued its 1908 illustrated catalogue of gauges, valves, indicators and kindred appliances for governing, indicating, measuring, recording and controlling steam, water, air, gas, oil, ammonia and all other pressures.

THE SPRAGUE ELECTRIC COMPANY, 527-531 West Thirty-fourth Street, New York city, is sending out literature relating to the Sprague electric shovel. The manufacturer declares that this shovel can be used on mono-rails, bridge cranes or gantrys, on stiff-leg derricks, unloading towers, etc. By its use the second man required with a steam rig is entirely dispensed with.

THE J. L. SCHUREMAN COMPANY, Chicago, has prepared a convenient filing form for its bulletin pages, which allows the sheets to be added from time to time following the introduction of new controlling devices. On the pages already available are listed Schureman self-starters, drum-type reversing switches, elevator controllers, pump starters and motor controllers.

THE PACIFIC ELECTRIC HEATING COMPANY, Ontario, Cal., in the November issue of its little monthly, *Hot Points*, announces that the branch office formerly maintained by the company in Chicago has developed into a complete factory, which is located at 63-65 West Washington Street, and invites its customers and friends to call and inspect the plant at their convenience.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, is sending to its friends, the central-station operators, some "hard facts" and some interesting data on the saving effected by the use of tungsten lamps on lighting circuits. The moral of the striking folder is to the effect that economy at the illuminant means proportionately greater capacity of a given generating outfit.

THE PETTINGELL-ANDREWS COMPANY, Boston, Mass., has published an interesting article devoted to "The Theft of Current—How to Prevent It, and How to Simplify the Testing of Meters." This article is reproduced in a handsome booklet, and should be of great interest to contractors and central-station operators. Copies will be furnished to those interested upon request.

THE MINNEAPOLIS ELECTRIC EQUIPMENT COMPANY, Minneapolis, Minn., in its "Red Book of Bargains—Everything Electrical," lists a large variety of electrical apparatus actually in stock at the works and ready for immediate shipment. Included in the catalogue are all kinds of motors, generators, transformers, switchboards, electric lighting fixtures and supplies, and measuring instruments.

THE WESTERN ELECTRIC COMPANY, New York city, has issued a price list of "Galvaduct" conduit, couplings and elbows. This product, used in interior conduit work, has an enameled interior which presents a smooth raceway for electrical conductors, and an electro-chemically galvanized exterior which cannot be defaced. "Galvaduct" can be imbedded in concrete without the fear of any injurious effects.

THE GOLD CAR HEATING AND LIGHTING COMPANY, New York city, announces that the interference relating to electric heaters having junction boxes, between an application of James F. McElroy, and the patent granted to Edward E. Gold, No. 850,924, dated April 23, 1907, has been decided by the Patent Office in favor of Edward E. Gold, by reason of an abandonment by McElroy of his claim of priority.

THE FRANKLIN ELECTRIC MANUFACTURING COMPANY, Hartford, Conn., describes "Femco" tungsten and carbon-incandescent lamps and "Femco" reflectors, in bulletin No. 8. To quote the bulletin: "From the Goddess of Liberty guarding the portals of the new world to the greatest floating dry-dock in the world—the Dewey, at Manila—Uncle Sam is using 'Femcos.' There must be a reason. There is, and it's this: The 'Femco' offers a guaranteed uniform quality, prompt delivery and unfailing courtesy."

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., through its Chicago manager, R. M. Van Vleet, advises that owing to the increase in business in both controller and specialty departments, it has been found necessary to secure larger local offices and that two additions have been made to Mr. Van Vleet's force: Horace L. Dawson as an engineering aid, and F. G. Horle as a member of the sales force.

THE K. McLENNAN COMPANY, Chicago, the well-known manufacturers of Gale's commutator compound, report a constantly increasing demand for their products. As is well known this compound is extensively used by dynamo and motor users, not only in the United States, but in almost every portion of the civilized globe. The company will submit samples and full particulars to anyone who may not be familiar with this product.

QUEEN & COMPANY, INC., Philadelphia, Pa., issue a three-leaf folder descriptive of their portable voltmeters and ammeters, the list being complete with code, range of scale, sensibility and price. The instruments listed are of the permanent magnet type, moving coil system, for direct-current only. They are the result of many years' experience in making high-grade scientific and testing instruments. The accuracy of calibration is one-fifth of one per cent.

THE ELECTRIC SUCTION SWEEPER COMPANY, New Berlin, O., is distributing some literature describing and illustrating its electrical suction sweeper. This apparatus is a combined sweeper and vacuum cleaner and is handled as easily as an ordinary carpet-sweeper. Attachments are provided which remove dust or dirt from under stationary or heavy articles, and also from elevated objects, such as pictures, moldings, wall coverings and upholstered furniture.

THE ELECTRIC GOODS MANUFACTURING COMPANY, Boston, Mass., has issued a telephone section of its nineteenth edition catalogue, in which it describes and illustrates the extensive and practical line of telephone apparatus of its manufacture. The convenient styles of equipment admit a wide range of choice and meet many special needs. This catalogue is especially arranged to help the architect and contractor in the work of specifying and ordering, related subjects being near at hand.

THE HORNBERGER TRANSFORMER COMPANY, Lafayette, Ind., has prepared a bulletin and price list of its standard lighting transformers, which are made up to sizes with a capacity of 200 kilowatts. Silicon-alloy steel is exclusively used in the manufacture of the modified type of these apparatus. As this improved steel was used in these transformers almost two years ago, the manufacturers feel that their pioneer experience with the material has been of great service in securing refinement of design.

THE UNION ELECTRIC LIGHT AND POWER COMPANY, St. Louis, Mo., has prepared a really handsome bulletin to be sent to its local customers, describing and illustrating in detail the varied line of electrical heating devices that are now on the market. Specifications and price are given in each case. The company maintains a continuous electrical exhibition of these devices at its show rooms, Tenth and St. Charles Streets, and also offers customers a free trial of any piece of apparatus in their homes.

GEORGE W. JACKSON, INC., Chicago, has brought out a souvenir booklet of its disposal station department that is of unusual typographical excellence and technical and popular interest. The methods of carrying off city waste, excavation spoil, refuse and snow from the congested downtown district of Chicago by means of the freight tunnel system and river scows are described and illustrated and will prove an absorbing chapter for one who is interested in the great and peculiar problems undertaken by this corporation.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has compiled a practical guide for transformer testing which is simply written and diagrammed so as to be of service to the practical central-station operator. The guide contains accurate directions for making the usual insulation, copper-loss, core-loss, impedance, ratio, polarity, heat and regulation tests, as well as an amount of useful data in connection with these determinations. Bulletin No. 1109 illustrates the line of engine-driven multiphase alternators manufactured by the Fort Wayne Electric Works.

THE AMERICAN BOILER ECONOMY COMPANY, North American Building, Philadelphia, has prepared a handsomely executed treatise describing the Copes boiler-feed regulator. In turn, the several advantages to be gained by automatic regulation are taken up, such as protection to the boiler, protection to the engine or turbine, saving of cylinder oil, lessened friction and wear in the engine, higher efficiency of super-heaters, higher efficiency of engines and turbines, and greater economy from exhaust steam feed-water heaters and fuel economizers. The engineering considerations of these points are brought out fully, bull's-eye charts from recording thermometers being shown, for instance, to demonstrate the fuel-saving realized by holding the feed always equal to the evaporation. In addition there are numerous illustrations showing installations of Copes regulators, also the manner of operation and construction of the regulator and of the Copes pump governor employed to insure a constant excess of pressure in the feed line. This appliance is especially valuable in large plants where the water level must be maintained in a great number of boilers and should be of interest to consulting, designing and managing engineers.

THE COMMONWEALTH EDISON COMPANY, Chicago, maintains its repair shops at 76 Market Street, which are said to be one of the largest and best-equipped repair shops in the world. The company is in a position to handle any kind of repair work, whether mechanical or electrical. The completeness of the equipment, it is stated, guarantees lowest costs, while the facilities for turning out work quickly are exceptonal. Temporary motors will be installed, when required, so that the service will not be interrupted. Repair work of any kind will be called for and delivered without extra charge.

J. B. TAYLOR & COMPANY, New York, have been incorporated under the laws of the state of Delaware, with a capital stock of $500,000, for the purpose of entering the field of engineering, construction, reorganization and the financing of street railway, steam railroads, water works, gas, electric light and organization propositions. The company has offices in the Hudson Terminal Building. Taylor & Company have already secured a contract to build the Sanoody Valley Railroad, connecting with the Mobile & Ohio Railroad at Sucarnochee, Miss., and are organizing a capable engineering and construction force.

THE STANDARD ROLLER BEARING COMPANY, Philadelphia, Pa., is distributing an illuminative list of the extensive floor spaces occupied by its various departments. The company believes that its broad experience in supplying over a million bearings of various types, for all classes of work, has resulted in the accumulation of much data of inestimable value, from which it is enabled to design bearings for all loads and speeds. Manufacturing over fifty types of ball and roller bearings, all having their proper uses, the company is naturally well equipped to recommend the proper bearing for any specific condition or purpose.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., in the December number of *Graphite* illustrates the use of graphite points on lighting rods protecting tall chimneys. The tip is made with a pointed graphite pencil, one inch in diameter and five inches in length, set into a cap to fit standard pipe. A hole drilled part way up the axis of the graphite rod receives the copper conductor cable, which is held in place by a set-screw. The Alphons Custodis Chimney Construction Company, which has been using these tips, reports that not a single chimney thus protected has been damaged by lightning, although there are numerous records of similar but unprotected structures sustaining severe injury.

THE CENTRAL ELECTRIC COMPANY, Chicago, is distributing a circular on "Combat" ignition batteries for automobile and gas-engine service. The circular contains a full description of the battery construction, and also gives directions for charging from the regular lighting circuits. It is asserted that corrosion at the binding posts is made impossible by the arrangement of the terminals. The company is also distributing several new fliers on condulet and box receptacles to fit the various makes of boxes now on the market. In the new design it is declared that the amount of breakage is minimized and furthermore that the contacts are of capacity to withstand extremely heavy overloads.

THE AMERICAN BATTERY COMPANY, Chicago, Ill., has published a sixteen-page booklet describing American electrolytic rectifiers. The construction, use and maintenance of the rectifiers are subjects treated at length in several pages. American rectifiers are made in a variety of styles and sizes designed to meet the demand for a low-price converter for making use of an alternating-current supply for the charging of storage batteries of from one to fifty cells of any capacity up to 300 ampere-hours. They may be profitably used in the charging of storage batteries of the ignition type for electric vehicles, storage batteries for dentists' and physicians' use, for telephone, telegraph and signal work, and for many other applications.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., in bulletin No. 4630 lists and describes its direct-current portable type DP instruments, which have been designed for laboratory and general testing purposes. These instruments are constructed to be well protected from mechanical injury and from the effect of stray fields. The indications of the pointer are rendered dead-beat. This line of instruments comprises ammeters, voltmeters, milammeters and millivoltmeters. General Electric bulletin No. 4629 is devoted to automobile accessories manufactured by the company. The apparatus illustrated consists of charging panels of various types, automobile instruments and incandescent lamps, motor-generator sets, automobile motors and controllers, battery-charging rheostats, low-tension magnetos, air-compressor outfits, etc.

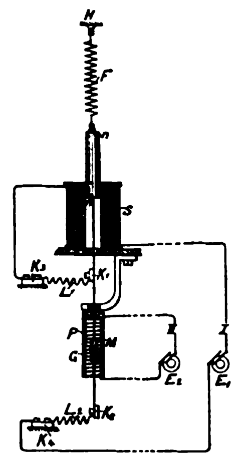
RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) December 15, 1908.

906,509. ELECTRIC WATER VALVE. George P. Carroll, Bridgeport, Conn. Filed March 25, 1907. The port is automatically held open by an electromagnet when power is on the line.

906,513. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed November 11, 1903. Relates to a special arrangement of supervisory and cut-off relays.

906,523. SELECTIVE MECHANICAL OPERATOR. Edwin R. Gill, Yonkers, N. Y. Filed March 12, 1906. A machine element intended to be brought to a predetermined position has a main impelling device adapted to move step by step by means of a magnet and its armature.



906,550.—NERNST LAMP.

906,550. ELECTRICAL INCANDESCENT LAMP. Walther Nernst, Göttingen, Germany, assignor to Nernst Lamp Company, Pittsburg, Pa. Filed October 20, 1897. The heating coil for a Nernst lamp is described.

906,556. VULCANIZER. Frank C. Perkins, Buffalo, N. Y., assignor of one-half to Ferdinand E. Finsterbach, Buffalo, N. Y. Filed October 9, 1907. A heating chamber has a removable wall with inner and outer sockets secured to it, the inner socket receiving an incandescent lamp and the outer socket a plug for the feed wires.

906,576. ELECTRIC CONTROLLER. Clarence L. Taylor, Alliance, Ohio, assignor to The Morgan Engineering Company, Alliance, Ohio. Filed February 21, 1908. In combination with a casing containing oil is a contact drum, a set of contact fingers and operating mechanism, all supported by and removable with the hinged cover.

906,582. AUTOMATIC TRAIN STOPPER. Charles D. Tisdale, Randolph, Mass.; Frank L. Tisdale, administrator of said Charles D. Tisdale, deceased. Filed May 16, 1907. A locomotive has a brush fixed to its pilot and adapted to engage a fixed track contact, a battery being grounded on the wheels and an electric motor adapted to operate the air-brake valve.

906,599. MAGNET SHIELD. Charles E. F. Ahlm, Cleveland, Ohio, assignor to Electric Controller and Supply Company. Filed January 13, 1908. A lifting magnet with an inner and an outer pole has a magnetizing winding between the poles and an annular shield for retaining the winding.

906,602. PRIVATE-BRANCH-EXCHANGE TELEPHONE SYSTEM. Frank Arens, Cincinnati, Ohio. Filed December 28, 1907. In combination with the cord mains is a shunt circuit controlled by the relays.

906,615. REPAIRING AND TESTING MEANS FOR CONTACTLESS THERMAL PROTECTORS. Frank B. Cook, Chicago, Ill. Filed July 28, 1905. A repairing tool comprises a handle, a metallic contact strip and a lever pivoted on an insulating support and provided with a thumb-piece adapted to be depressed.

906,618. PERFORATOR FOR PREPARING TELEGRAPHIC TRANSMITTING TAPES. Patrick B. Delany, South Orange, N. J., assignor to The Telepost Company of Maine, Augusta, Me. Filed April 16, 1902. An electromagnetic perforator consists of a key, a pole-changer magnet controlled thereby, a differentially-wound polarized relay and punch magnets controlled by the relay and pole changer.

906,636. RAILWAY SAFETY SYSTEM. Janko Kovacevic, Youngstown, Ohio. Filed October 14, 1907. The railway is equipped with three parallel contact strips controlling a signal on the locomotive.

906,649. SHOAL-WATER ALARM. Patrick McCarthy, Cleveland, Ohio. Filed June 1, 1908. The ship carries a drag cable with an inclined blade at its free end and an electric alarm to indicate when the device is in contact with the bottom.

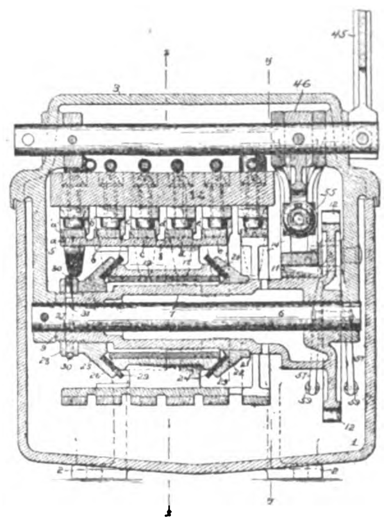
906,659. COMBINATION PUMP AND COMPRESSOR SYSTEM. Walter J. Richards, Milwaukee, Wis., assignor to The National Brake and Electric Company, Milwaukee, Wis. Filed July 9, 1908. A motor drives either one of two pumps through a pair of magnetic clutches.

906,669. ELECTROLYTIC APPARATUS FOR USE IN THE MANUFACTURE OF BLEACHING LIQUORS. Alfred Vogelsang, Dresden, Germany. Filed March 5, 1907. A number of compartments are situated one above another in a stair-like manner, an electrode between two successive compartments extending upwardly and forming a wall for the compartment next above it.

906,682. ELECTRIC FURNACE. Kristian Birkeland, Christiania, Norway. Filed January 5, 1907. A long electric furnace has distanced electrodes to produce a long arc and electromagnetic means to distort the arc into a helix.

906,726. APPARATUS FOR DETINNING TIN SCRAP. Meredith Leitch, Elizabeth, N. J., assignor to Metal Process Company. Filed February 28, 1907. In combination with a stationary cathode and an anode is a tank for the electrolyte and a hydraulic plunger for lowering and raising it.

906,729. IGNITION TIMER FOR INTERNAL-COMBUSTION ENGINES. Francis C. Mason and Guy L. Sintz, Grand Rapids, Mich., assignors to Norman W. Chamberlin, Grand Rapids, Mich. Filed October 26, 1906. A rotative shaft carries a tubular head and a yoke with a contact.



906,576.—ELECTRIC CONTROLLER.

906,738. SNAP-SWITCH. Johann G. Peterson, Hartford, Conn., assignor to The Arrow Electric Company, Hartford, Conn. Filed April 10, 1908. The actuating mechanism has a pole-carrying plate with integral arms upturned from diametrically opposite edges and perforated pole plates slipped upon the arms.

906,739. ELECTRIC-SWITCH RECEPTACLE. Johann G. Peterson, Hartford, Conn., assignor to The Arrow Electric Company, Hartford, Conn. Filed September 16, 1908. Describes the construction and method of mounting the cover for the receptacle.

906,740. PUSH-BUTTON ELECTRIC SWITCH. Johann G. Peterson, Hartford, Conn. Assignor to the Arrow Electric Company, Hartford, Conn. Filed September 16, 1908. A two-button oscillating switch.

906,749. APPARATUS FOR OPERATING WINDOWS. Wilson B. Strong, Easthampton, Mass. Filed December 5, 1907. Comprises two electric motors with a winding drum secured upon each shaft, a cord wound upon each drum and adapted for connection with each sash.

906,762. PUSH-BUTTON. Henry Wilhelm, New York, N. Y. Filed November 30, 1907. The button passes through a cap that fits over a cup.

906,787. INSULATOR PIN. Charles G. Ette, St. Louis, Mo., assignor to Ette Investment Company, St. Louis, Mo. Filed May 4, 1908. A metallic pin is provided at its lower end with an integral tongue that is adapted to be bent into engagement with the cross-arm.

906,799 and 906,800. LOCK AND BLOCK-SIGNAL SYSTEM. Robert J. Hewett, Westfield, N. J., assignor to The Hall Signal Company. Filed January 10, 1908. A circuit connecting signaling stations has circuit-breakers interposed in it and controlled by the traffic and means acting automatically to lock a manual controlling member and transmit a relese when the circuit has been closed.

906,861. ELECTRICAL BLOCK-SIGNALING SYSTEM FOR RAILWAYS. George H. Brown, Belfast, Ireland. Filed September 20, 1907. There are in combination conductors on the track, audible and visible electrical signaling devices on the engine and similar devices in each signal cabin.

906,926 and 906,927. ELECTRICAL APPARATUS FOR TIMING CLOCKS AND WATCHES. Wilson E. Porter, New Haven, Conn., assignor to New Haven Clock Company, New Haven, Conn. Filed April 27, 1908. A timing mechanism is located in an electric circuit and provided with a rated pointer driven in unison with the master clock.

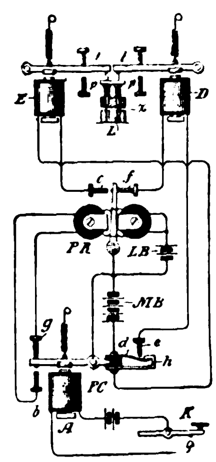
906,928. METHOD OF MAKING DYNAMO BRUSHES. Georg Preuss, Charlottenburg, Germany. Filed July 31, 1906. Pure graphite is moistened with nitric acid and afterward heated, the graphite forms resulting being provided electrically with a metal coating and then formed and pressed into brushes.

906,939. ELECTRICALLY-OPERATED GUN CONTROL. James B. Ryan, Hoboken, N. J., assignor to Stephen A. Farrell, Brooklyn, N. Y. Filed February 3, 1908. There are means controllable by the undesirable motions of a vessel for reversing the motor and another mechanism similarly controlled for varying the energy supplied to the motor.

906,984. RETRIEVING MECHANISM FOR TROLLEY POLES. Martin L. Addington, Indianapolis, Ind., assignor of one-third to John E. Hafner, Indianapolis, Ind. Filed March 3, 1908. A rotary drum has separate cords attached thereto to simultaneously wind and unwind respectively and an automatically actuated motor connected with one of the cords.

906,990. ELECTRICAL HEATING APPARATUS. Clifford D. Babcock, New York, N. Y., assignor to United Wireless Telegraph Company, New York, N. Y. Filed July 24, 1907. Comprises a number of bare uninsulated coils arranged one above the other in a vessel.

906,991. OSCILLATION DETECTOR. Clifford D. Babcock, New York, N. Y., assignor to United Wireless Telegraph Company, New York, N. Y. Filed October 2, 1907. Consists of a thermo-electric couple and a local circuit in combination with means for converting the energy of the oscillations into heat and thereby elevating the temperature of the couple.



906,618.—ELECTROMAGNETIC TELEGRAPHIC-TAPE PERFORATOR.

906,994. TROLLEY. Frederick C. Bauer, Sr., and Frederick C. Bauer, Jr., Camden, N. J. Filed May 1, 1908. The wheel has a central groove with deep spiral grooves on either side.

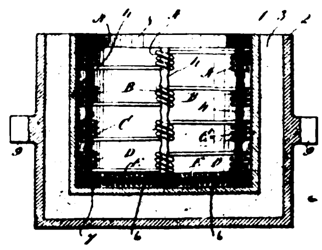
907,002. SPARK PLUG. Henry L. Brownback, Norristown, Pa. Filed January 15, 1908. A shell is formed with a fixed arm projecting within and a number of sparking points projecting in opposite directions from the terminus of the arms.

907,061. METHOD OF DETINNING TIN SCRAP. Meredith Leitch, Springfield, Mass., assignor to Metal Process Company, New York, N. Y. Original application filed February 28, 1907. Divided and this application filed September 19, 1908. The method consists in drawing [redacted]lyte out of the bath from beneath the surface and returning it to the bath at a point below the surface.

907,062. TELEPHONE DROP. Tiodolf Lidberg, Chicago, Ill., assignor to Swedish-American Telephone Company, Chicago, Ill. Filed November 26, 1906. An armature and latching mechanism is secured to the stationary part and a removable electromagnet is arranged for insertion or withdrawal relative to the support.

907,083. RAIL BOND. Edwin H. McHenry, New Haven, Conn., assignor of one-fourth to Charles H. Morrison, New Haven, Conn. Filed March 16, 1908. Consists of a spring steel core provided with a coating of copper.

907,088. ELECTRIC TIME-SWITCH. Ole P. Noisom and Carl J. Lindewald, South Bend, Ind.; said Lindewald assignor of one-half to said Noisom. Filed January 27, 1908. Comprises a switching element movable in a circular path with a step-by-step movement.



906,990.—ELECTRIC HEATER.

907,098. PUSH-BUTTON SWITCH. George B. Thomas, Bridgeport, Conn., assignor to The Perkins Electric Switch Manufacturing Company, Bridgeport, Conn. Filed June 5, 1908. A switch has two push-buttons and an oscillating operating lever with connecting links pendent from ends thereof.

907,106. THREE-POSITION MOTOR SIGNAL. Clarence W. Coleman, Westfield, N. J., assignor to The Hall Signal Company. Filed September 27, 1907. Electrically-operated locking and releasing means consist of a step pivotally mounted on the signal actuating member.

907,108. INSULATOR FOR CIRCUIT-BREAKERS. Leonard L. Elden, Dorchester, Mass., assignor to Sears B. Condit, Jr., Boston, Mass. Original application filed June 20, 1901. Divided and this application filed December 2, 1903. An oil switch has an oil well removably suspended in position to submerge the electrodes in all their operative movements.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired December 22, 1908:

465,444. ELECTRIC SWITCH. H. Barton, London, England.

465,469. ELECTRIC-RAILWAY TROLLEY. C. S. Foster, Whitesborough, N. Y.

465,511. ELECTRIC SNAP SWITCH. Wm. S. Andrews, New York, N. Y.

465,512. RHEOSTAT. W. S. Andrews and A. K. Warren, New York, N. Y.

465,514. ELECTRIC ARC LAMP. H. P. Ball, Brooklyn, N. Y.

465,525. ELECTROLYTIC APPARATUS FOR TREATING METALS. E. S. Hayden, Waterbury, Conn.

465,592. GEARING FOR ELECTRIC MOTOR CARS. O. F. Evans, Columbus, Ohio.

465,594. SYSTEM OF ELECTRICAL DISTRIBUTION. F. O. La Roche, Philadelphia, Pa.

465,602. ELECTRIC CIRCUIT-CLOSER FOR BURGLAR ALARMS. Wm. C. Thompson, Minneapolis, Minn.

465,613. ELECTRIC RAILWAY. Wm. H. Applegate, Atlantic, Iowa.

465,618. ELECTRIC SWITCH. G. E. Painter, Baltimore, Md.

465,648. COMBINED SIGNAL AND TELEPHONE SYSTEM. T. W. O'Brien, Wilkes-Barre, Pa.

465,685. ELECTRIC ARC LAMP. H. C. Waldecker, Austin, Minn.

465,805. MEANS FOR TURNING ON AND OFF ELECTRIC CURRENTS. T. C. Smith and B. D. Acker, Philadelphia, Pa.

465,806. ELECTRIC-RAILWAY TROLLEY. F. J. Sprague and P. F. O'Shaughnessy, New York, N. Y.

465,808. DYNAMO-ELECTRIC MACHINE. R. Thury, Geneva, Switzerland.

465,809. ELECTRICAL TESTING INSTRUMENT. R. Varley, Jr., Englewood, N. J.

POSITIONS WANTED

The rate for "Positions Wanted" advertisements of forty words or less is one dollar an insertion; additional words two cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical Review and Western Electrician, 507 Marquette Building, Chicago, or 13-21 Park Row, New York.

POSITION WANTED—As chief engineer in electric-lighting and power plant up to 5,000 horsepower, or superintendent of smaller plant; can refer to the best men in the steam and mechanical engineering field; 36 years old, married; don't drink; steam turbine experience; a money saver and can prove it. Wm. Westerfield, Box 764, Lincoln, Neb.

POSITION WANTED—Technical graduate with large experience in installing and maintenance wants position as manager of lighting or street-railway plant in city of not less than 15,000. Best references. A business getter. Box 1036, care of Electrical Review and Western Electrician, Chicago.

HELP WANTED

The rate for "Help Wanted" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical Review and Western Electrician, 507 Marquette Building, Chicago, or 13-21 Park Row, New York.

WANTED—A thoroughly competent electrician by a modern electric light and power plant, 1,000 kilowatts capacity, in southern city. Want a thorough and practical worker, familiar with every detail of line construction and inside and outside wiring. Must be able and willing to supervise, also do work, and able to take care of transformers, meters, motors and arc lamps, and see that customers' service and all lines and properties of the company outside of power house are kept in first-class condition. Must be reliable and of good character and habits. Good opportunity for advancement for right man. Give experience and references. Address No. 1031, care of Electrical Review and Western Electrician, Chicago.

WANTED— Inspection engineer, to take charge of men in inspection and testing of the product of the shop of a direct-current dynamo and motor factory. Must be well educated, experienced and capable of instructing. Address Box 1033, care of Electrical Review and Western Electrician, Chicago.

PROPOSALS

The rate for "Proposal" advertisements is 15 cents per line, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

APPLICATION FOR BIDS TO LIGHT THE CITY OF OLNEY—Sealed bids will be received up to noon, Tuesday, January 12, 1909, for furnishing the city of Olney, Ill., with fourteen or more arc lights of 2,000-candlepower each and 114 or more incandescents, 40-candlepower each, for a period of ten years. Also for supplying commercial and resident lighting for the inhabitants of the city.

The bidder whose bid is accepted, to receive a ten-year franchise.

Successful bidder to furnish a good and sufficient bond in the sum of $5,000 for the faithful compliance with the terms of the contract within nine months from the time the contract is let.

The city reserves the right to reject any and all bids.

Bids to be mailed to:

Phil K. Wilson, mayor, or N. L. Crout, or S. C. Wilson, Olney Ill., Fire and Light Committee.

MISCELLANEOUS

The rate for "Miscellaneous" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical Review and Western Electrician, 507 Marquette Building, Chicago, or 13-21 Park Row, New York.

WANTED TO LEASE—(By a successful manager) A central station plant in a good town of 2,000 to 10,000 population, located somewhere in this great Mississippi valley. Will lease for a long term or will manage same on salary. Address 1035, care of Electrical Review and Western Electrician, Chicago, Ill.

ALPHABETICAL INDEX TO ADVERTISERS.

CLASSIFIED INDEX TO ADVERTISEMENTS.

AIR-COMPRESSORS
- Allis-Chalmers Co.
- Emerson Electric Mfg. Co.

ALARMS, BURGLAR
- Electric Goods Mfg. Co.
- Holtzer-Cabot Electric Co.
- Manhattan Electrical Supply Co.
- Partrick, Carter & Wilkins Co.

ALARMS, HIGH AND LOW
- Electric Goods Mfg. Co.
- Partrick, Carter & Wilkins Co.

ALARMS, FIRE
- Electric Goods Mfg. Co.
- Partrick, Carter & Wilkins Co.

ALCOHOL, DENATURED
- Continental Natural Gas Alcohol Co.

ALTERNATORS
- Allis-Chalmers Co.
- Crocker-Wheeler Co.
- Fort Wayne Electric Works.
- General Electric Co.
- Western Electric Co.
- Westinghouse Electric & Mfg. Co.

ANCHORS, GUY
- Doubleday-Hill Electric Co.
- Wyckoff Pipe & Creosoting Co.

ANCHOR, SCREW
- Star Expansion Bolt Co.

ANNUNCIATORS
- Central Electric Co.
- Doubleday-Hill Electric Co.
- Electric Goods Mfg. Co.
- Holtzer-Cabot Electric Co.
- Manhattan Electrical Supply Co.
- Ostrander & Co., W. R.
- Partrick, Carter & Wilkins Co.
- Stanley & Patterson
- Wesco Supply Co.
- Western Electric Co.

ARCHITECTURAL ENGINEERS
- Dodge & Day

ARMATURE TAPES
- Dunton Co., M. W.

ASBESTOS PRODUCTS
- Johns-Manville Co., H. W.

ATTACHMENT PLUGS
- Electric Goods Mfg. Co.
- Hubbell Inc., Harvey

BATTERIES, PRIMARY
- Bissell Co., The F.
- Burnley Battery & Mfg. Co.
- Central Electric Co.
- Doubleday-Hill Electric Co.
- Edison Mfg. Co.
- Electric Goods Mfg. Co.
- Holtzer-Cabot Electric Co.
- Lawrence Electric Co., F. D.
- Leclanche Battery Co.
- Manhattan Electrical Supply Co.
- Wesco Supply Co.
- Western Electric Co.

BATTERIES, STORAGE
- American Battery Co.
- Doubleday-Hill Electric Co.
- Electric Storage Battery Co.
- General Storage Battery Co.
- Gould Storage Battery Co.
- National Battery Co.
- Westinghouse Machine Co.
- Willard Storage Battery Co.

BELLS
- Central Electric Co.
- Electric Goods Mfg. Co.
- Holtzer-Cabot Electric Co.
- Manhattan Electrical Supply Co.
- Ostrander & Co., W. R.
- Partrick, Carter & Wilkins Co.
- Wesco Supply Co.
- Western Electric Co.

BELT DRESSING
- Dixon Crucible Co., Joseph
- Leather Preserver Mfg. Co.

BELTING
- Leather Preserver Mfg. Co.
- Shultz Belting Co.

BENDERS, CONDUIT
- Fibre Conduit Co.

BLOWERS
- Emerson Electric Mfg. Co.

BOILER FRONTS AND CASTINGS
- Minn. Steel & Machy. Co.

BOILERS
- Babcock & Wilcox Co., The
- Minn. Steel & Machy. Co.
- Morgan Smith Co., S.
- Westinghouse, Church, Kerr & Co.

BOLTS,EXPANSION,TOGGLE AND HANGER
- Peirce Specialty Co.
- Star Expansion Bolt Co.
- Wrigley Co., Thos.

BOND TESTERS
- Lord Electric Co.

BOOKS, TECHNICAL
- Electrical Review Pub. Co.
- Van Nostrand Co., D.

BOOSTERS
- Allis-Chalmers Co.
- Crocker-Wheeler Co.
- Ridgway Dynamo & Engine Co.
- Western Electric Co.

BOXES, FLOOR
- Zenco Electrical Supply Co.

BOXES, JUNCTION
- Bossert Elect. Const. Co.
- Chase-Shawmut Co.

BRACKETS
- Peirce Specialty Co.

BREAK ARMS
- Peirce Specialty Co.

BRIDGES
- American Bridge Co. of New York

BRIDLE RINGS
- Bissell Co., The F.
- Star Expansion Bolt Co.

BRUSHES, DYNAMO
- American Carbon & Battery Co.
- Central Electric Co.
- Dixon Crucible Co., Joseph
- Holmes Fibre Graphite Co.,
- Le Valley Vitae Carbon Brush Co.
- Speer Carbon Co.

BULBS, INCANDESCENT LAMP
- Lippincott Glass Co., The

BUSHINGS
- Bossert Electric Construction Co.
- Chase-Shawmut Co.
- Federal Electric Co.

CABLE CONNECTORS
- Dossert & Co.
- Matthews & Bro., W. N.

CABLE HANGERS
- Bissell Co., The F.
- Chase-Shawmut Co.
- Peirce Specialty Co.
- Standard Underground Cable Co.
- Star Expansion Bolt Co.
- Wesco Supply Co.
- Western Electric Co.

CABLE TROLLEYS
- Bissell Co., The F.

CABLING MACHINES
- New England Butt Co.

CAR HEATERS, ELECTRIC
- Simplex Electric Heating Co.

CARBONS
- Chicago Carbon Co.
- National Carbon Co.
- Reisinger, Hugo.

CARBON BRUSHES
- American Carbon & Battery Co.
- Central Electric Co.
- LeValley Vitae Carbon Brush Co.
- Speer Carbon Co.
- Wesco Supply Co.

CASTINGS
- Jeffrey Mfg. Co.
- Minn. Steel & Machy. Co.
- New England Butt Co.
- Phosphor-Bronze Smelting Co., Ltd.

CATCHERS AND RETRIEVERS, TROLLEY
- Lord Electric Co.

CEMENT, CABLE TRANSFORMER
- Massachusetts Chemical Co.

CIRCUIT-BREAKER
- Cutler-Hammer Mfg. Co.
- Cutter Electrical Mfg. Co.
- Doubleday-Hill Electric Co.
- Fort Wayne Electric Works
- General Electric Co.
- Roller-Smith Co.
- Ward Leonard Electric Co.
- Western Electric Co.
- Westinghouse Electric & Mfg. Co.

CLAMPS, GROUND CONNECTION
- Chase-Shawmut Co.

CLEATS
- Blake Signal & Mfg. Co.
- Pass & Seymour, Inc.

CLIMBERS
- Klein & Sons, Mathias

CLUSTERS
- Benjamin Electric Mfg. Co.
- Dale Co.
- Federal Electric Co.
- Holophane Co.
- Tungstolier Co.

CLUTCHES
- Minneapolis Steel & Machinery Co.

COAL-HANDLING MACHINERY
- Jeffrey Mfg. Co., The

COAL MINING MACHINERY
- Allis-Chalmers Co.
- General Electric Co.
- Jeffrey Mfg. Co., The
- Westinghouse Electric & Mfg. Co

COILS
- Belden Mfg. Co.

COILS, CHOKE
- Lord Electric Co.

COILS, INDUCTION
- Electric Goods Mfg. Co.
- Ostrander & Co. W. R.

COILS, KICK
- Lord Electric Co.

COILS AND MAGNETS
- Western Electric Co.

COLOR CAPS
- Solar Electric Co.

COLORING, LAMP
- Electric Motor & Equipment Co.

COMMUTATOR LUBRICANT
- Dixon Crucible Co., Joseph
- McLennan & Co., K.

COMPOUNDS, BOILER
- Dearborn Drug & Chem. Wks.

COMPOUND, INS. AND SPLICING
- Massachusetts Chemical Co.
- Minerallac Co.
- Standard Paint Co., The

COMPRESSED AIR AND VACUUM PLANTS
- General Compressed Air & Vacuum Machinery Co.

CONDENSERS, ELECTRIC
- Marshall, William

CONDENSERS, STEAM
- Allis-Chalmers Co.
- Minn. Steel & Machy. Co.

CONDUITS
- American Circular Loom Co.
- American Conduit Co.
- American Vitrified Conduit Co.
- Camp Co., H. B.
- Doubleday-Hill Electric Co.
- Fibre Conduit Co.
- Gilpin, V. C.
- Johns-Manville Co., H. W.
- McRoy Clay Works
- National Conduit & Cable Co.
- National Metal Molding Co.
- Wyckoff Pipe & Creosoting Co.

CONDUIT BENDERS
- Fibre Conduit Co., The

CONDUIT BOXES
- Marshall Electric Mfg. Co.

CONDUIT RODS
- Bissell Co., The F.
- Doubleday-Hill Electric Co.

CONDUIT SYSTEMS
- Gest, G. M.

CONSTRUCTION
- Ahlm, C. E. F.
- Arnold Co., The
- Bates, Putman A.
- Byllesby & Co., H. M.
- Dodge & Day
- Fergus & Co., W. L.
- Iron City Eng. Co.
- Kelly Eng. Co., John F.
- New England Engineering Co.
- White & Co., J. G.

CONSTRUCTION SUPPLIES
- Bissell Co., The F.
- Brady, T. H.

CONTACTS, GROUND LIGHTNING
- Lord Electric Co.

CONTROLLERS
- Allis-Chalmers Co.
- Crocker-Wheeler Co.
- Cutler-Hammer Mfg. Co.
- Electric Controller & Mfg. Co.
- Schureman Co., J. L.
- Simplex Electric Heating Co.
- Ward Leonard Electric Co.

CONVEYING DEVICES
- Darley Engineering Co.
- Minn. Steel & Machy. Co.

CORD AND ROPE
- Belden Manufacturing Co.
- Lowell Ins. Wire Co.
- Phosphor-Bronze Smelting Co., Ltd.
- Samson Cordage Works

CORRESPONDENCE SCHOOL
- American School of Correspondence

COUNTERS, REVOLUTION
- Belden Mfg. Co.

CRANE MOTORS
- Crocker-Wheeler Co.
- Western Electric Co.

CREOSOTED LUMBER
- Wyckoff Pipe & Creosoting Co.

CROSS-ARMS, BRACKETS, PINS, CLIMBERS, ETC.
- Bissell Co., The F.
- Brady, T. H.
- Central Electric Co.
- Doubleday-Hill Electric Co.
- Klein & Sons, Mathias
- Lindsley Bros. Co., The
- Manhattan Elec. Supply Co.
- Pierce Specialty Co.
- Wesco Supply Co.
- Western Electric Co.
- Wyckoff Pipe & Creosoting Co.

CURRENT TAPS
- Electric Goods Mfg. Co.

CUSHIONS, FIELD COIL
- Massachusetts Chemical Co.

CUT-OUTS AND SWITCHES
- Bissell Co., The F.
- Bossert Elec. Const. Co.
- Central Electric Co.
- Commonwealth Edison Co.
- Cutler-Hammer Mfg. Co.
- Electrical Mfg. Co.
- Elm City Engineering Co.
- Ft. Wayne Elec. Wks., Inc.
- General Electric Co.
- Hart Manufacturing Co.
- Manhattan Elec. Supply Co.
- Pass & Seymour, Inc.
- Trumbull Electric Mfg. Co.
- Wesco Supply Co.
- Western Electric Co.
- Westinghouse Elec. & Mfg. Co
- Zenco Electrical Supply Co.

DIMMERS
- Cutler-Hammer Mfg. Co.
- Ward Leonard Electric Co.

DIRECT MOTOR DRIVE FOR PLANERS
- The Electric Controller & Supply Co.

DRILLS
- Jeffrey Mfg. Co.
- Peirce Specialty Co.

DRYING MACHINERY
- Buffalo Foundry & Mach. Co.
- Devine Co., J. P.

DYNAMOS AND MOTORS
- Allis-Chalmers Co.
- American Engine Co.
- Bissell Co., The F.
- Burke Electric Co.
- C. & C. Electric Co.
- Central Electric Co.
- Century Electric Co.
- Commonwealth-Edison Co.
- Crocker-Wheeler Co.
- Diehl Mfg. Co.
- Doubleday-Hill Electric Co.
- Eck Dynamo & Motor Co.
- Emerson Electric Manufacturing Co.
- Fort Wayne Electric Works.
- General Electric Co.
- Gregory Electric Co.
- Guarantee Electric Co.
- Holtzer-Cabot Electric Co.
- Jeffrey Mfg. Co.
- Kimble Electric Co.
- Novelty Electric Co.
- Richmond Electric Co.
- Ridgway Dynamo & Engine Co.
- Stow Mfg. Co.
- Triumph Electric Co.
- Wagner Electric Mfg. Co.
- Warren Electric Mfg. Co.
- Western Electric Co.
- Westinghouse Electric & Mfg. Co.

ELECTRIC ARC WELDERS
- The Electric Controller & Mfg. Co.

ELECTRIC COOKING APPARATUS
- American Electric Heater Co.
- Doubleday-Hill Electric Co.
- Simplex Electric Heating Co.

ELECTRIC RAILWAYS
- Allis-Chalmers Co.
- Arnold C.o, The
- Byllesby & Co., H. M.
- Darlington, F. W.
- Dodge & Day
- Fergus & Co., W. L.
- General Electric Co.
- Hallberg, J. H.
- Hammer, Wm. J.
- Hanchett, Geo. T.
- Humphrey, Henry H.
- Iron City Eng. Co.
- Kelly Eng. Co., John F.
- Kitfield, Edw. H.
- Knowles, Edw. R.
- Mershon, Ralph D.
- New England Eng. Co.
- Reed, Warren B.
- Westinghouse El. & Mfg. Co.
- White & Co., J. G

CLASSIFIED INDEX—Continued.

ELECTRICAL DECORATIONS
Doubleday-Hill Electric Co.

ELECTRIC GAS LIGHTING
Electric Goods Mfg. Co.

ELECTRIC IRONS
American Electric Heater Co.
Guaranty Electric Heater Co.
Prometheus Electric Co.
Simplex Elec. Heating Co.

ELECTRIC LIGHTERS
Stanley & Patterson

ELECTRIC LOCOMOTIVES
General Electric Co.
Jeffrey Mfg. Co., The
Westinghouse Electric & Mfg. Co.

ELECTRIC SOLDERING IRONS
American Electrical Heater Co.
Guaranty Electric Heater Co.
Simplex Electric Heating Co.

ELECTRICAL SUPPLIES
Bates, Putnam A.
Bissell Co., The F.
Central Electric Co.
Chase-Shawmut Co.
Commonwealth Edison Co.
Crocker-Wheeler Co.
Doubleday-Hill Electric Co.
Electric Appliance Co.
Electric Goods Mfg. Co.
General Electric Co.
International Electric Meter Co.
Johns-Manville Co., H. W.
Lawrence Electric Co., F. D.
Manhattan Electrical Supply Co.
Metropolitan Electrical Supply Co.
Novelty Electric Co.
Paiste Co., H. T.
Partrick, Carter & Wilkins Co.
Stanley & Patterson
Western Electric Co.
Weston Electrical Instrument Co.

ELECTROLIERS
Goodwin & Kintz Co., The

ELECTROMAGNETS
Western Electric Co.
Westinghouse Electric & Mfg. Co.

ELECTRO-PLATING MACHINERY.
Crocker-Wheeler Co.
General Electric Co.

ELEVATING AND CONVEYING MACHINERY
Jeffrey Mfg. Co.

ENGINES, GAS, GASOLINE AND OIL
Allis-Chalmers Co.
American Diesel Engine Co.
Buckeye Engine Co.
Minn. Steel & Machy. Co.
Westinghouse Machine Co.

ENGINES, STEAM
Allis-Chalmers Co.
American Engine Co.
Ball Engine Co.
Buckeye Engine Co.
Minneapolis Steel & Machy. Co.
Ridgway Dynamo & Engine Co.
Rochester Machine Tool Works
Westinghouse Machine Co.

ENGINEERS AND CONTRACTORS
Ahlm, C. E. F.
American Bridge Co.
Arnold Co., The
Badt & Co., F. B.
Bates, Putnam A.
Byllesby & Co., H. M.
Clement, Edward E.
Darlington, F. W.
Dodge & Day
Fergus & Co., W. L.
Hallberg, J. H.
Hanchett, George T.
Hickey Contracting Co.
Humphrey, Henry H.
Hunt & Co.
Iron City Engineering Co.
Jackson, D. C. & W. B.
Kelly Engineering Co., John P.
Kitfield, Edward H.
Kohler Bros.
Knowles, Edward R.
Lansingh, Van Rensselaer
Lyndon, Lamar
McMeen, Samuel G.
Marshall, Albert J.
Mershon, Ralph D.
Miller, Kempster B.
New England Engineering Co.
Pillsbury, Chas. L.
Radford, John A.
Reed, Warren B.
Ruebel & Wells
Sargent & Lundy
Schott, W. H.
Stanton, Le Roy W.
Storer, Simon B.
White & Co., J. G.

EXPOSITION, ELECTRICAL
Electrical Trades Exposition Co.

FANS AND FAN MOTORS
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Commonwealth Edison Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Doubleday-Hill Electric Co.
Edison Manufacturing Co.
Emerson Electric Manufacturing Co.
Fort Wayne Electric Works
General Electric Co.
Jeffrey Mfg. Co.
Stanley & Patterson
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

FAN MOTOR RESISTANCES
Ward Leonard Electric Co.

FIBRE
American Vulcanized Fibre Co.
Fibre Conduit Co.

FIREPLACE, ELECTRIC
Rathbone & Panigot Co.

FIXTURES, GAS AND ELECTRIC
Benjamin Electric Mfg. Co.
Federal Electric Co.

FLASHERS
Bissell Co., The F.
Electric Motor & Equipment Co.
Haller Machine Co.
Reynolds Electric Flasher Mfg. Co.
Schneider, C. O.

FLEXIBLE COUPLINGS FOR SHAFTS
The Electric Controller & Supply Co.

FLAT IRONS, ELECTRIC
Am. Elec. Heater Co.
General Electric Co.
Prometheus Electric Co.
Simplex Elec. Heating Co.
Westinghouse Elec. & Mfg. Co.

FLEXIBLE SHAFTS
Stow Mfg. Co.

FRICTION TAPE
Johns-Manville Co., H. W.
Standard Paint Co.

FUSES
Chase-Shawmut Co.
Central Elec. Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Co.
General Electric Co.
Johns-Manville Co., H. W.
Lawrence Electric Co., F. D.
Manhattan Electrical Supply Co.
Pass & Seymour, Inc.
Sachs Co., The
Wesco Supply Co.
Western Electric Co.

FUSE WIRE
Chase-Shawmut Co.
Chicago Fuse Wire Mfg. Co.
Wesco Supply Co.
Western Electric Co.

GAINS, STEEL
Belden Mfg. Co.

GAS PRODUCER POWER PLANTS
Minn. Steel & Machy. Co.
Westinghouse Machine Co.

GEARS
New Process Raw Hide Co.

GENERATORS
Allis-Chalmers Co.
American Engine Co.
C. & C. Electric Co.
Crocker-Wheeler Co.
Ridgway Dynamo & Engine Co.
Triumph Electric Co.
Western Electric Co.

GLASS TUBING
Lippincott Glass Co., The

GLOBES, SHADES, ETC.
Fostoria Glass Specialty Co.
Holophane Co.
Lippincott Glass Co., The
Phœnix Glass Co.
Wesco Supply Co.

GRAPHITE
Dixon Crucible Co., Joseph
Holmes Fibre Graphite Co.

GROUND CONNECTION CLAMPS]
Chase-Shawmut Co.

GROUND POINTS, PLATES AND CONTACTS
Lord Electric Co.

HANGERS, CONDUIT AND MOULDING.
Chase-Shawmut Co.

HEATING APPARATUS]
American Electrical Heater Co.
Grinnell Electric Heater Co.
Guaranty Elec. Heater Co.
Johns-Manville Co., H. W.
Prometheus Electric Co.
Simplex Electric Heater Co.
Ward Leonard Electric Co.

HEATING (EXHAUST STEAM)
American District Steam Co.

HOISTING MACHINERY
Allis-Chalmers Co.
Brown Hoisting Machinery Co.
Jeffrey Mfg. Co.

HOLDERS, ELECTRICIANS' DRILL BIT
Star Expansion Bolt Co.

HYDRAULIC MACHINERY
Allis-Chalmers Co.

IMPREGNATING APPARATUS
Buffalo Fdy. & Machine Co.
Devine & Co., J. P.
Mitchell, W. E. G.

IMPREGNATING COMPOUND
Mitchell, W. E. G.

INNER GLOBES
Fostoria Glass Specialty Co.
Macbeth-Evans Glass Co.
Phœnix Glass Co.

INSTRUMENTS
Atwater-Kent Mfg. Co.
Bristol Co.
Central Laboratory Supply Co.
Cutter Electrical Mfg. Co.
Doubleday-Hill Electric Co.
Duncan Electric Mfg. Co.
Eldredge Electric Mfg. Co.
Fort Wayne Electric Works.
General Electric Co.
Hoyt Electrical Instrument Works
International Electric Meter Co.
Johns-Manville Co., H. W.
Keystone Electrical Instrument Co.
Leeds & Northrup Co.
Machado & Roller
Oelschlaeger Bros.
Pignolet, Louis M.
Queen & Co., Inc.
Wagner Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Weston Electrical Instrument Co.

INSULATING CEMENTS
Mitchell, W. E. G.

INSULATING COMPOUNDS
Electric Cable Co.
Minerallac Co.
Mitchell, W. E. G.

INSULATING MACHINERY
American Insulating Machinery Co.
New England Butt Co.

INSULATING PAINTS
Standard Paint Co.

INSULATORS AND INSULATING MATERIAL
American Electrical Works
American Vulcanized Fibre Co.
Brixey, W. R.
Brookfield Glass Co.
Central Electric Co.
Chicago Mica Co.
Commonwealth Edison Co.
Detroit Insulated Wire Co.
Doubleday-Hill Electric Co.
Dunton Co., M. W.
Elm City Engineering Co.
General Electric Co.
Hemingray Glass Co.
Indiana Rubber & Insulated Wire Co.
Johns-Manville Co., H. W.
Lima Insulator Co.
Locke Insulator Mfg. Co.
Mass. Chemical Co.
Mica Insulator Co.
Minerallac Co.
Mitchell, W. E. G.
Munsell & Co., Eugene
New Lexington High Voltage Porcelain Co.
New York Insulated Wire Co.
Okonite Co.
Pass & Seymour, Inc.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Paint Co.
Standard Underground Cable Co.
Thomas & Sons, R.
Wesco Supply Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

IRIDIO PLATINUM, WIRE AND SHEET
Baker & Co., Inc.

IRONS, ELECTRIC
American Electrical Heater Co.
General Electric Co.
Guaranty Electric Heater Co.
Prometheus Electric Co.
Simplex Electric Heating Co.
Westinghouse Electric & Mfg. Co.

JUNCTION BOXES
Bossert Electric Construction Co.
D. & W. Fuse Co.

LAMP COLORING
Electric Motor & Equipment Co.

LAMP GUARDS
Foster, Herbert T.
Greenwood Mfg. & Supply Co

LAMP-MAKING MACHINERY
Dwyer Machine Co.
Fahn & McJunkin

LAMPS, ARC
Adams-Bagnall Electric Co.
Bissell Co., The F.
Central Electric Co.
Doubleday-Hill Electric Co.
Excello Arc Lamp Co.
Fort Wayne Electric Works
General Electric Co.
Jandus Electric Co.
Nernst Lamp Co.
Queen & Co.
Stave Electrical Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

LAMPS, DECORATIVE
Central Electric Co.
General Electric Co.

LAMPS, INCANDESCENT
Banner Electric Co.
Bay State Lamp Co.
Boston Incandescent Lamp Co.
Brilliant Electric Co.
Bryan Marsh Co.
Buckeye Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Colonial Electric Co.
Commonwealth Edison Co.
Doubleday-Hill Electric Co.
Economical Elec. Lamp Co.
Economy Electric Co.
Electrical Accessories Co.
Fort Wayne Electric Works
Fostoria Incandescent Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Incandescent Lamp Co.
Germania Electric Lamp Co.
Johns-Manville Co., H. W.
New York & Ohio Co.
Shelby Electric Co.
Standard Electrical Mfg. Co.
Sterling Electrical Mfg. Co.
Sunbeam Incandescent Lamp Co.
Warren Electric & Specialty Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Lamp Co.

LAMPS, MERCURY VAPOR
Cooper Hewitt Electric Co.

LIFTING MAGNETS
The Electric Controller & Mfg. Co.

LIGHTING PLANTS
Allis-Chalmers Co.
Crocker-Wheeler Co.
Doubleday-Hill Electric Co.
Fort Wayne Electric Works
General Electric Co.
Stanley & Patterson
Western Electric Co.
Westinghouse Electric & Mfg. Co.

LIGHTNING ARRESTERS
D. & W. Fuse Co.
General Electric Co.
Gifford Elec. Mfg. Co.
Lord Electric Co.
Westinghouse Electric & Mfg. Co.

LINE MATERIAL
Bissell Co., The F.
Johns-Manville Co., H. W.
Klein & Sons, Mathias
Peirce Specialty Co.

LOCOMOTIVES, ELECTRIC
Jeffrey Mfg. Co.

LUBRICANTS
Dearborn Drug & Chem. Works

MACHINE TOOLS AND MACHINERY
Allis-Chalmers Co.
Jeffrey Mfg. Co.
New England Butt Co.

MACHINES, WIRE MEASURING
Minn. Electric & Construction Co.

MAGNET WIRES
(See Wires and Cables)

MAGNETIC CLUTCHES
The Electric Controller & Mfg. Co.

MAGNETIC FRICTION BRAKES
The Electric Controller & Mfg. Co.

MAGNETIC SOLENOIDS
Cutler-Hammer Mfg. Co.
The Electric Controller & Mfg. Co.

MAGNETIC SWITCH CONTROLLERS FOR LARGE MOTORS
Cutler-Hammer Mfg. Co.
The Electric Controller & Mfg. Co.

MALLEABLE CASTINGS
Jeffrey Mfg. Co.

MAST-ARMS
Bissell Co., The F.
Brady, T. H.

METALS
Baker & Co., Inc.
Phosphor-Bronze Smelt. Co.

CLASSIFIED INDEX—Continued.

METERS
Columbia Meter Co.
Doubleday-Hill Electric Co.
Duncan Electric Mfg. Co.
Fort Wayne Electric Works
General Electric Co.
International Electric Meter Co.
Johns-Manville Co., H. W.
Pignolet, L. M.
Sangamo Electric Co.
Westinghouse Electric & Mfg. Co.
Weston Electrical Instrument Co.

MICA
Chicago Mica Co.
Mica Ins. Co.
Munsell & Co., Eugene

MINING MACHINERY
Allis-Chalmers Co.
Jeffrey Mfg. Co.

MOTORS
(See Dynamos & Motors)

NAME-PLATES
Schwerdtle Stamp Co., The

OUTLET BOXES
Bossert Electric Construction Co.
Chase-Shawmut Co.
Chicago Fuse Wire & Mfg. Co.

OUTLET BOX RECEPTACLES
Benjamin Electric Mfg. Co.

PAINTS, INSULATING
Dixon Crucible Co., Joseph
Massachusetts Chemical Co.
Standard Paint Co.

PANEL-BOARDS
Lang Electric Co., The J.
Trumbull Electric Mfg. Co.

PATENT SOLICITORS
Clement, Edward E.
Duval, Edw. S.
Siggers & Siggers

PHOSPHOR-BRONZE
Phosphor-Bronze Sm. Co., Ltd.

PHOTOMETERS
Dwyer Machine Co.
Electric Motor & Equipment Co.

PHOTOMETER STANDARDS
Electrical Testing Laboratories

PIGTAILS, CARBON BRUSH
Belden Mfg. Co.

PINIONS
New Process Raw Hide Co.

PLATINUM PRODUCTS
American Platinum Works
Baker & Co., Inc.

PLATINUM WIRE AND SHEET, PLATINUM CRUCIBLES AND DISHES, PLATINUM RIVETS
American Platinum Works
Baker & Co., Inc.

PLUGS, ATTACHMENT
Pass & Seymour, Inc.

PLUGS, FUSE
Pass & Seymour, Inc.

POLES, BRACKETS, PINS, TIES, CROSS-ARMS, CLIMBERS, ETC.
Bissell Co., The F.
Brady, T. H.
Brooks, Hall L.
Doubleday-Hill Electric Co.
Johns-Manville Co., H. W.
Kellogg Switch. & Sup. Co.
Klein & Sons, Mathias
Lindsley Bros. Co., The
National Pole Co.
Pacific Coast Pole Co.
Standard Cedar & Lumber Co.
Torrey Cedar Co.
Wittenberg Cedar Co.
Worcester Co., C. H.
Wyckoff Pipe & Creosoting Co

PUMPING MACHINERY
Allis-Chalmers Co.
Minn. Steel & Machy. Co.

PUSH-BUTTONS
Cutler-Hammer Mfg. Co.
Electric Goods Mfg. Co.
Manhattan Electrical Supply Co.
Partrick, Carter & Wilkins Co.
Ward Leonard Electric Co.

RAIL BONDS
Chase-Shawmut Co.
Dossert & Co.
General Electric Co.
Johns-Manville Co., H. W.
Lord Electric Co.
Roebling's Sons Co., John A.

RAIL JOINTS
Rail Joint Co.

RAILWAY SPECIALTIES, ELECTRIC
Blake Signal & Mfg. Co.
Central Electric Co.
Doubleday-Hill Electric Co.
General Electric Co.
Johns-Manville Co., H. W.
Rail Joint Company, The
Westinghouse Electric & Mfg. Co.

REFLECTORS
Frink, I. P.
Holophane Co.
National X-Ray Reflector Co.
Phœnix Glass Co.

REPAIRS
Commonwealth Edison Co.
Gregory Electric Co.
Guarantee Electric Co.
Waterbury & Co.

RESISTANCE BANKS AND UNITS
Cutler-Hammer Mfg. Co.
The Electric Controller & Mfg. Co.
Ward Leonard Electric Co.

RESISTANCES
Cutler-Hammer Mfg. Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.

REVERSING CONTROLLERS FOR CRANES AND SIMILAR SERVICE
Cutler-Hammer Mfg. Co.
The Electric Controller & Mfg. Co.

RHEOSTATS
Crocker-Wheeler Co.
Cutler-Hammer Mfg. Co.
Cutter Electrical & Mfg. Co.
General Electric Co.
Schureman Co., J. L.
Simplex Electric Heating Co.
Ward Leonard Electric Co.
Westinghouse Electric & Mfg. Co.

RUBBER, MOLDED
Massachusetts Chemical Co.

SCALES, AUTOMATIC
Avery Scale Co., The

SCHOOLS AND COLLEGES
Highland Park College

SEALS
Schwerdtle Stamp Co., The

SECOND-HAND MACHINERY
Bissell Co., The F.
Gregory Electric Co.
Guarantee Electric Co.

SHADES
Foster, Herbert T.
Hubbell, Harvey, Inc.

SHADEHOLDERS
Hubbell, Harvey, Inc.

SIGNS, ELECTRIC
Electric Motor & Equipment Co.
Federal Electric Co.
Haller Sign Works, Inc.

SLEEVINGS
Belden Mfg. Co.
Dunton Co., M. W.

SMOKESTACKS, STEEL
Minn. Steel & Machy. Co.

SOCKETS
Federal Electric Co.
Hubbell, Harvey, Inc.
Paiste Co., H. T.
Trumbull Electric Mfg. Co.

SOLDERING STICKS AND PASTE
Allen Co., L. B.
Belden Mfg. Co.
Blake Signal & Mfg. Co.
Burnley Battery & Mfg. Co.
Chase-Shawmut Co.
Dunton Co., M. W.

SOLENOIDS
Ward Leonard Electric Co.

SPARK COILS
Electric Goods Mfg. Co.
Holtzer-Cabot Electric Co.
Manhattan Electrical Supply Co.

SPARKING POINTS
Baker & Co., Inc.

SPEAKING TUBES
Central Electric Co.
Manhattan Elec. Supply Co.
Ostrander & Co., W. R.
Wesco Supply Co.
Western Electric Co.

SPECIAL OVERLOAD NO-VOLTAGE AND RESET CIRCUIT-BREAKERS
Cutler-Hammer Mfg. Co.
The Electric Controller & Mfg. Co.
Ward Leonard Electric Co.

SPECIALTIES
Benjamin Electric Mfg. Co.
Chase-Shawmut Co.
Cutler-Hammer Mfg. Co.
Doubleday-Hill Electric Co.
Novelty Electric Co.
Paiste Co., H. T

SPEED INDICATORS
Weston Electrical Inst. Co.

SPRINGS
Barnes Co., Wallace
Cary Spring Works
Manross, F. N.

STAGE LIGHTING APPARATUS
Chase-Shawmut Co.

STANDARD CELLS
Weston Electrical Instrument Co.

STAPLES, INSULATED
Blake Signal & Mfg. Co.

STATIONERY, DIE EMBOSSED
Wiggins Co., The John B.

STEAM SPECIALTIES
American District Steam Co.
New Process Raw Hide Co.

STEEL
American Bridge Co.
Jessop & Sons, Ltd., Wm.

STEEL STAMPS
Schwerdtle Stamp Co., The

STENCILS
Schwerdtle Stamp Co., The

STOKERS
Babcock & Wilcox Co.
Westinghouse Machine Co.

STORAGE BATTERIES
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
Westinghouse Machine Co.
Willard Storage Battery Co.

SUPPLIES, GENERAL ELECTRICAL
Bissell Co., The F.
Central Electric Co.
Chase-Shawmut Co.
Commonwealth Edison Co.
Manhattan Elec. Supply Co.
Stanley & Patterson.
Wesco Supply Co.
Western Electric Co.
Zenco Electrical Supply Co.

SWITCHBOARDS
Allis-Chalmers Co.
Bissell Co., The F.
Bossert Electric Construction Co.
Crocker-Wheeler Co.
Doubleday-Hill Electric Co.
Eaton Electrical Mfg. Co.
Electric Goods Mfg. Co.
Fort Wayne Electric Works
General Electric Co.
Trumbull Electric Mfg. Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

SWITCHES, ETC
Central Electric Co.
Cutler-Hammer Mfg. Co.
Cutter Electrical Mfg. Co.
Doubleday-Hill Electric Co.
Electric Controller & Mfg. Co.
General Electric Co.
Hart & Hegeman Mfg. Co.
Hart Mfg. Co.
Lang Electric Co., The J.
Lawrence Electric Co., F. D.
Lord Electric Co.
Pacific Electric & Mfg. Co.
Partrick, Carter & Wilkins Co.
Pass & Seymour, Inc.
Pettingell-Andrews Co.
Trumbull Electric Mfg. Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

TABLET BOARDS
Doubleday-Hill Electric Co.

TAPE AND SPLICING COMPOUND
Doubleday-Hill Electric Co.
Massachusetts Chemical Co.
Minerallac Co.
Okonite Co.

TAPES
Belden Mfg. Co.

TELEPHONES
Atwater-Kent Mfg. Co.
Automatic Electric Co.
Central Electric Co.
Doubleday-Hill Electric Co.
Electric Goods Mfg. Co.
Holtzer-Cabot Electric Co.
Kellogg Switchboard & Supply Co.
Manhattan Electrical Supply Co.
Novelty Electric Co.
Stanley & Patterson
Western Electric Co.
Wire & Telephone Co. of America

TELEPHONE SERVICE
American Bell Telephone Co.
Chicago Telephone Co.
New York Telephone Co.

TESTING
Electrical Testing Laboratories

THEATER DIMMERS
Cutler-Hammer Mfg. Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.

TIES, CROSS-ARMS, BRACKETS, PINS, CLIMBERS, ETC.
Bissell Co., The F.
Brady, T. H.
Central Electric Co.
Klein & Sons, Mathias

TIME SWITCHES
Bissell Co., The F.
Hartford Time Switch Co.
Manhattan Electrical Supply Co.

TOOL STEEL
Jessop & Sons, Ltd., Wm.

TOOLS
Klein & Sons, Mathias

TRANSFORMERS
Allis-Chalmers Co.
Crocker-Wheeler Co.
Doubleday-Hill Electric Co.
Duncan Electric Mfg. Co.
Fort Wayne Electric Works
General Electric Co.
International Electric Meter Co.
Kuhlman Electric Co.
Moloney Electric Co.
New York & Ohio Co.
Thordarson Electric Mfg. Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

TROLLEY WHEELS
Doubleday-Hill Electric Co.
Johns-Manville Co., H. W.

TRUCKS, STORAGE BATTERY, AUTO
Westinghouse Machine Co.

TUBES
Fibre Conduit Co.

TURBINE GOVERNORS
Allis-Chalmers Co.
Lombard Water-Wheel Gov. Co.

TURBINES, STEAM
Allis-Chalmers Co.
General Electric Co.
Smith Co., S. Morgan
Westinghouse Machine Co.

TURBINES, WATER
Allis-Chalmers Co.
Leffel & Co., Jas.
Smith Co., S. Morgan

UNCOATED ARMATURE TAPES AND SLEEVINGS
Belden Mfg. Co.
Dunton Co., M. W.

VACUUM CLEANING MACHINERY
General Compressed Air & Vacuum Machinery Co.

VACUUM DRYING
Buffalo Fdy. & Machine Co.
Devine Co., J. P.

VARNISH, INSULATING
Massachusetts Chemical Co.
Standard Paint Co.

WATER-WHEELS
Allis-Chalmers Co.
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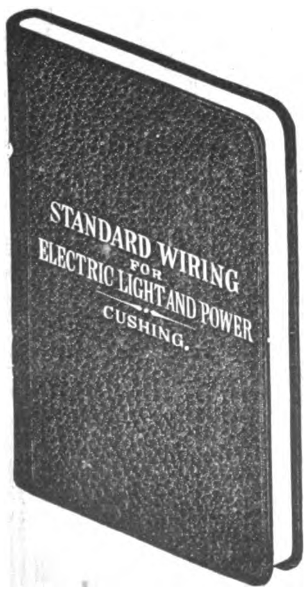

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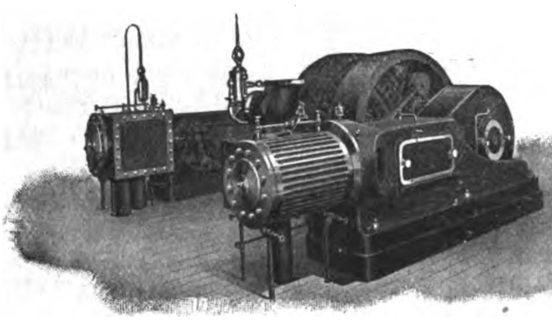

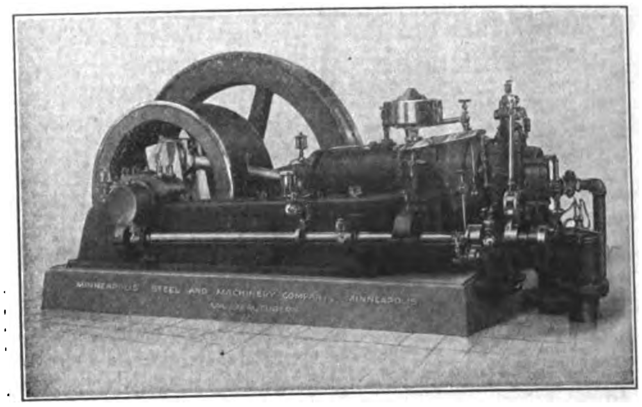

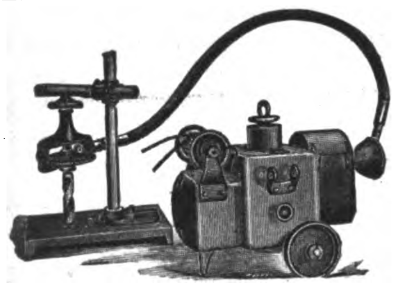

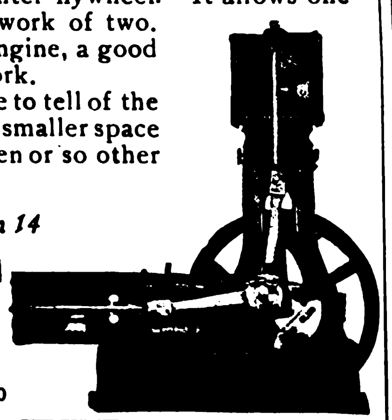

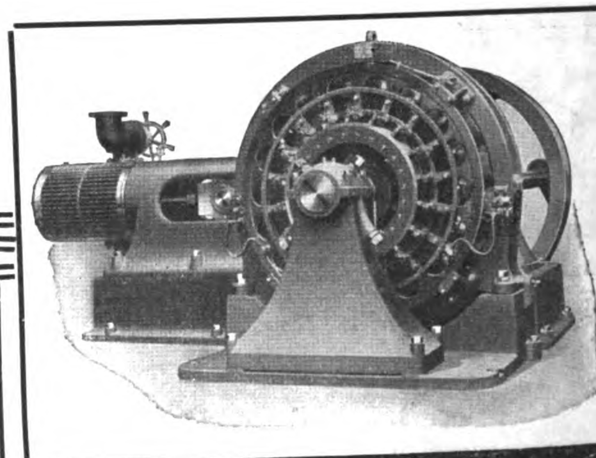

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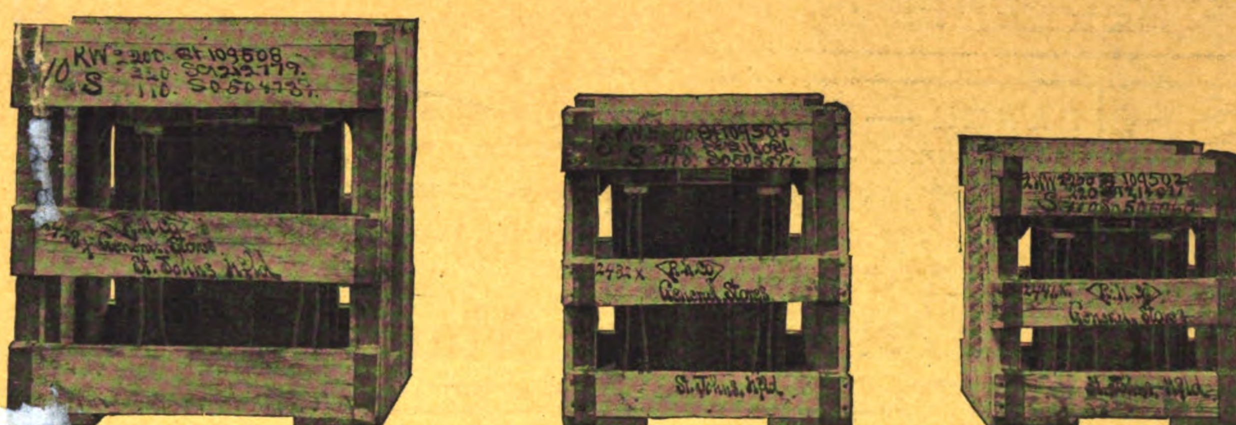

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